R&D Publication20 Remedial Targets Worksheet, Release 2.2a

Tier 3 -Groundwater

ENVIRONMENT AGENCY

Input Parameters (using pull down menu)	Variable	Value	Unit	Source
Contaminant		Aliphatic C10-C12		
Target Concentration	C_T	7.14E-04	mg/l	

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

Ogata Banks — Equations in R&D Pub. 20

Enter'1' to simulate vertical dispersion in one direction, '2' for two directions (pull down menu): 1

Enter '1' if biodegradation rate is for the substance in water,
'0' if rate is for decay in field conditions (i.e. field data from aquifer) (pull down menu: 0

	Variable	Value	Unit	Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	9.90E-99	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	1.83E+03	days	
Calculated decay rate	λ	3.80E-04	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	1.90E+02	m	
Plume thickness at source	Sy	1.00E+01	m	
Saturated aquifer thickness	da	1.08E+01	m	
Bulk density of aquifer materials	ρ	1.70E+00	g/cm^3	
Effective porosity of aquifer	n	1.82E-01	fraction	
Hydraulic gradient	i	1.25E-02	fraction	
Hydraulic conductivity of aquifer	K	2.00E+01	m/d	
Distance to compliance point	x	5.92E+02	m	
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	9.12E+02	l/kg	*see options*
Longitudinal dispersivity	ax	9.730	m	*see options*
Transverse dispersivity	az	0.973	m	*see options*
Vertical dispersivity	ay	0.097	m	*see options*

Calculated Parameters	Variable		
Groundwater flow velocity	v	1.37E+00	m/d
Retardation factor	Rf	8.52E+03	fraction
Decay rate used	λ	3.80E-04	d^{-1}
Rate of contaminant flow due to retardation	u	1.61E-04	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	6.81E-213	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	3.77E-213	mg/l
Attenuation factor (one way vertical dispersion, C_0/C_{ED})	AF	1.45E+114	
Attenuation factor (two way vertical dispersion, C_0/C_{ED})	AF	2.63E+114	

Remedial Targets

Remedial Target Ogata Banks	LTC3	1.04E+111	mg/l	For comparison with measured groundwater concentration.
Distance to compliance point		692	m	
Concentration of contaminant at compliance point	$C_{ED}/C0$	6.81E-213	mg/l	Ogata Banks
after		9.9E+99	days	

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

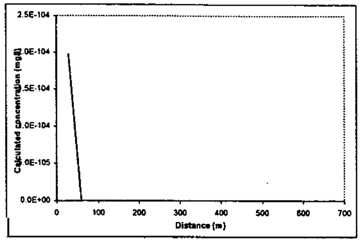
Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd	[redacted]	l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	1.00E+00	fraction
Organic carbon partition coefficient	Koc	9.12E+02	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$	[redacted]	l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Soil water partition coefficient	Kd	9.12E+02	l/kg

Dispersivity

Calculate dependant on distance to compliance point (0), specify dispersivity (1), or calc after Xu & Eckstein (2) ? 2

		Enter value	Calc value Xu & Eckstein	
Longitudinal dispersivity	ax	[redacted]	9.73E+00	m
Transverse dispersivity	az		9.73E-01	m
Vertical dispersivity	ay		9.73E-02	m

For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report ax = $0.83(\log_{10}x)^{2.414}$; 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.

This sheet calculates the Tier3 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

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 Tier 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

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration
	mg/l
29.6	2.0E-104
59.2	4.0E-110
88.8	7.8E-116
118.4	1.5E-121
148.0	3.0E-127
177.6	5.8E-133
207.2	1.1E-138
236.8	2.2E-144
266.4	4.3E-150
296.0	8.3E-156
326.0	1.6E-161
355.2	3.2E-167
384.8	6.2E-173
414.4	1.2E-178
444.0	2.4E-184
b73.9	4.6E-190
503.2	9.0E-196
532.8	1.8E-201
562.4	3.5E-207
592.0	6.8E-213

Site being assessed	Bless Area 1 A murphy K20
Completed by:	AJ
Date:	24 11 2005
Version:	12

R&D Publication 20 Remedial Targets Worksheet, Release 2.2a

Tier 3 - Groundwater

ENVIRONMENT AGENCY

Input Parameters (using pull down menu)	Variable	Value	Unit	Source
Contaminant		Aliphatic C12-C16		
Target Concentration	C_T	7.14E-04	mg/l	

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

Ogata Banks — Equations in R&D Pub. 20

Enter '1' to simulate vertical dispersion in one direction, '2' for two directions (pull down menu)		1		
Enter '1' if biodegradation rate is for the substance in water, '0' if rate is for decay in field conditions (i.e. field data from aquifer) (pull down menu)		0		
				Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	3.47E-02	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	1.83E+03	days	
Calculated decay rate	λ	3.80E-04	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	1.90E+02	m	
Plume thickness at source	Sy	1.00E+01	m	
Saturated aquifer thickness	da	1.08E+01	m	
Bulk density of aquifer materials	ρ	1.70E+00	g/cm^3	
Effective porosity of aquifer	n	1.82E-01	fraction	
Hydraulic gradient	i	1.25E-02	fraction	
Hydraulic conductivity of aquifer	K	2.00E+01	m/d	
Distance to compliance point	x	5.92E+02	m	
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	1.82E+04	l/kg	*see options*
Longitudinal dispersivity	ax		m	*see options*
Transverse dispersivity	az		m	*see options*
Vertical dispersivity	ay		m	*see options*

Calculated Parameters	Variable		
Groundwater flow velocity	v	1.37E+00	m/d
Retardation factor	Rf	1.70E+05	fraction
Decay rate used	λ	3.80E-04	d^{-1}
Rate of contaminant flow due to retardation	u	8.08E-06	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	#NUM!	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	#NUM!	mg/l
Attenuation factor (one way vertical dispersion, C_0/C_{ED})	AF	#NUM!	
Attenuation factor (two way vertical dispersion, C_0/C_{ED})	AF	#NUM!	

Remedial Targets

Remedial Target Ogata Banks	LTC3	#NUM!	mg/l	For comparison with measured groundwater concentration.
Distance to compliance point		592	m	
Concentration of contaminant at compliance point	$C_{ED}/C0$	#NUM!	mg/l	Ogata Banks
after		9.9E+99	days	

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

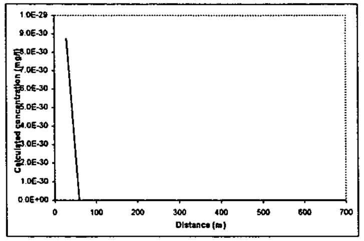
Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd		l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	1.00E+00	fraction
Organic carbon partition coefficient	Koc	1.82E+04	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$		l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Soil water partition coefficient	Kd	1.82E+04	l/kg

Dispersivity

Calculate dependant on distance to compliance point (0), specify dispersivity (1), or calc after Xu & Eckstein (2) ? — 2

		Enter value	Calc value Xu & Eckstein	
Longitudinal dispersivity	ax		9.73E+00	m
Transverse dispersivity	az		9.73E-01	m
Vertical dispersivity	ay		9.73E-02	m

For calculated value, assumes ax = 0.1 * x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report $ax = 0.83(\log_{10}x)^{2.414}$; 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.

This sheet calculates the Tier3 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

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 Tier 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.

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration mg/l
29.6	8.8E-30
59.2	2.2E-57
88.8	5.5E-85
148.0	3.4E-142
177.6	8.2E-168
207.2	2.0E-195
236.8	5.0E-223
266.4	1.2E-250
296.0	3.0E-278
325.6	#NUM!
366.2	#NUM!
384.8	#NUM!
414.4	#NUM!
444.0	#NUM!
473.6	#NUM!
503.2	#NUM!
532.8	#NUM!
562.4	#NUM!
592.0	#NUM!

Site being assessed	Bless Area 1 A murphy K20
Completed by:	AJ
Date	24 11 2005
Version:	12

R&D Publication20 Remedial Targets Worksheet, Release 2.2a

Tier 3 - Groundwater

ENVIRONMENT AGENCY

Input Parameters (using pull down menu)

	Variable	Value	Unit	Source
Contaminant		Aromatic C8-C10		
Target Concentration	C_T	7.14E-04	mg/l	

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

Ogata Banks — Equations in R&D Pub. 20

Enter '1' to simulate vertical dispersion in one direction, '2' for two directions (pull down menu): 1

Enter '1' if biodegradation rate is for the substance in water,
'0' if rate is for decay in field conditions (i.e. field data from aquifer) (pull down menu: 0

				Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	9.90E-99	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	1.83E+03	days	
Calculated decay rate	λ	3.80E-04	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	1.90E+02	m	
Plume thickness at source	Sy	1.00E+01	m	
Saturated aquifer thickness	da	1.08E+01	m	
Bulk density of aquifer materials	ρ	1.70E+00	g/cm^3	
Effective porosity of aquifer	n	1.82E-01	fraction	
Hydraulic gradient	i	1.25E-02	fraction	
Hydraulic conductivity of aquifer	K	2.00E+01	m/d	
Distance to compliance point	x	5.92E+02	m	
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	5.75E+00	l/kg	*see options*
Longitudinal dispersivity	ax	9.730	m	*see options*
Transverse dispersivity	az	0.973	m	*see options*
Vertical dispersivity	ay	0.097	m	*see options*

Calculated Parameters

	Variable		
Groundwater flow velocity	v	1.37E+00	m/d
Retardation factor	Rf	5.47E+01	fraction
Decay rate used	λ	3.80E-04	d^{-1}
Rate of contaminant flow due to retardation	u	2.51E-02	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	2.30E-102	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	1.27E-102	mg/l
Attenuation factor (one way vertical dispersion, C_0/C_{ED})	AF	4.30E+03	
Attenuation factor (two way vertical dispersion, C_0/C_{ED})	AF	7.77E+03	

Remedial Targets

Remedial Target	LTCS	3.07E+08	mg/l	For comparison with measured groundwater concentration.
Ogata Banks				
Distance to compliance point		592	m	
Concentration of contaminant at compliance point	$C_{ED}/C0$	2.30E-102	mg/l	Ogata Banks
after		9.9E+99	days	

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

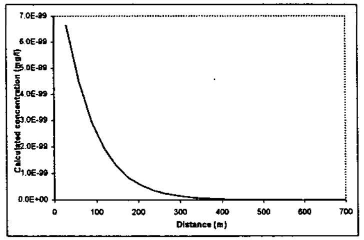
Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd		l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	1.00E+00	fraction
Organic carbon partition coefficient	Koc	5.75E+00	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$		l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Soil water partition coefficient	Kd	5.75E+00	l/kg

Dispersivity

Calculate dependant on distance to compliance point (0), specify dispersivity (1), or calc after Xu & Eckstein (2) ? 2

		Enter value	Calc value Xu & Eckstein	
Longitudinal dispersivity	ax		9.73E+00	m
Transverse dispersivity	az		9.73E-01	m
Vertical dispersivity	ay		9.73E-02	m

For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report $ax = 0.83(\log_{10}x)^{2.414}$; 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.

This sheet calculates the Tier3 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

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 Tier 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

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration
	mg/l
29.6	6.7E-99
59.2	4.5E-99
88.8	3.0E-99
118.4	2.0E-99
148.0	1.3E-99
177.6	8.4E-100
107.2	5.5E-100
236.8	3.6E-100
259.4	2.3E-100
296.0	1.5E-100
325.6	1.0E-100
355.2	6.6E-101
384.8	4.3E-101
414.4	2.8E-101
444.0	1.9E-101
473.6	1.2E-101
503.2	8.0E-102
532.8	5.3E-102
562.4	3.5E-102
592.0	2.3E-102

Site being assessed	Bless Area 1 A murphy K20
Completed by	AJ
Date:	24 11 2005
Version.	12

R&D Publication 20 Remedial Targets Worksheet, Release 2.2a

Tier 3 - Groundwater

ENVIRONMENT AGENCY

Input Parameters (using pull down menu)

Input Parameters (using pull down menu)	Variable	Value	Unit	Source
Contaminant		Aliphatic C16-C21		
Target Concentration	C_T	7.14E-04	mg/l	

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

Ogata Banks — Equations in R&D Pub. 20

Enter '1' to simulate vertical dispersion in one direction, '2' for two directions (pull down menu): 1

Enter '1' if biodegradation rate is for the substance in water,
'0' if rate is for decay in field conditions (i.e. field data from aquifer) (pull down menu): 0

	Variable	Value	Unit	Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	3.47E-02	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	3.65E+03	days	
Calculated decay rate	λ	1.90E-04	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	1.90E+02	m	
Plume thickness at source	Sy	1.00E+01	m	
Saturated aquifer thickness	da	1.08E+01	m	
Bulk density of aquifer materials	ρ	1.70E+00	g/cm^3	
Effective porosity of aquifer	n	1.82E-01	fraction	
Hydraulic gradient	i	1.25E-02	fraction	
Hydraulic conductivity of aquifer	K	2.00E+01	m/d	
Distance to compliance point	x	5.92E+02	m	
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	2.29E+06	l/kg	*see options*
Longitudinal dispersivity	ax	9.730	m	*see options*
Transverse dispersivity	az	0.973	m	*see options*
Vertical dispersivity	ay	0.097	m	*see options*

Calculated Parameters Variable

Calculated Parameters	Variable	Value	Unit
Groundwater flow velocity	v	1.37E+00	m/d
Retardation factor	Rf	2.14E+07	fraction
Decay rate used	λ	1.90E-04	d^{-1}
Rate of contaminant flow due to retardation	u	6.42E-08	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	#NUM!	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	#NUM!	mg/l
Attenuation factor (one way vertical dispersion, C_0/C_{ED})	AF	#NUM!	
Attenuation factor (two way vertical dispersion, C_0/C_{ED})	AF	#NUM!	

Remedial Targets

Remedial Target LTC3 #NUM! mg/l — For comparison with measured groundwater concentration.
Ogata Banks

Distance to compliance point		592	m	
Concentration of contaminant at compliance point	$C_{ED}/C0$	#NUM!	mg/l	Ogata Banks
after		9.9E+99	days	

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

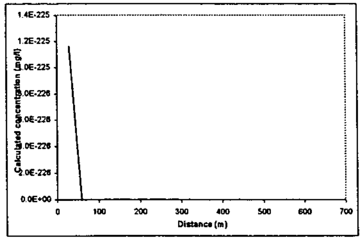
Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd		l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	1.00E+00	fraction
Organic carbon partition coefficient	Koc	2.29E+06	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$		l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Soil water partition coefficient	Kd	2.29E+06	l/kg

Dispersivity

Calculate dependant on distance to compliance point (0), specify dispersivity (1), or calc after Xu & Eckstein (2) ? 2

		Enter value	Calc value Xu & Eckstein	
Longitudinal dispersivity	ax		9.73E+00	m
Transverse dispersivity	az		9.73E-01	m
Vertical dispersivity	ay		9.73E-02	m

For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report ax = $0.83(\log_{10}x)^{2.414}$; 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.

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration
	mg/l
29.6	1.2E-225
59.2	#NUM!
88.8	#NUM!
118.4	#NUM!
148.0	#NUM!
177.6	#NUM!
207.2	#NUM!
236.8	#NUM!
266.4	#NUM!
296.0	#NUM!
325.6	#NUM!
355.2	#NUM!
384.8	#NUM!
414.4	#NUM!
444.0	#NUM!
473.6	#NUM!
503.2	#NUM!
532.8	#NUM!
562.4	#NUM!
592.0	#NUM!

This sheet calculates the Tier3 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

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 Tier 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.

Site being assessed.	Bless Area 1 A murphy K20
Completed by	AJ
Date:	24 11 2005
Version	12

R&D Publication20 Remedial Targets Worksheet, Release 2.2a

Tier 3 • Groundwater

ENVIRONMENT AGENCY

Input Parameters (wing pull down menu) **Variable** **Value** **Unit** **Source**

	Variable	Value	Unit
Contaminant		Aliphatic C21-C35	
Target Concentration	C_T	7.14E-04	mg/l

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

Ogata Banks — Equations in R&D Pub. 20

Enter '1' to simulate vertical dispersion in one direction, '2' for two directions (pull down menu) 1

Enter '1' if biodegradation rate is for the substance in water,
'0' if rate is for decay in field conditions (i.e. field data from aquifer) (pull down menu 0

	Variable	Value	Unit	Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	3.47E-02	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	3.65E+03	days	
Calculated decay rate	λ	1.90E-04	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	1.90E+02	m	
Plume thickness at source	Sy	1.00E+01	m	
Saturated aquifer thickness	da	1.08E+01	m	
Bulk density of aquifer materials	ρ	1.70E+00	g/cm^3	
Effective porosity of aquifer	n	1.82E-01	fraction	
Hydraulic gradient	i	1.25E-02	fraction	
Hydraulic conductivity of aquifer	K	2.00E+01	m/d	
Distance to compliance point	x	5.92E+02	m	
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	2.29E+06	l/kg	*see options*
Longitudinal dispersivity	ax		m	*see options*
Transverse dispersivity	az		m	*see options*
Vertical dispersivity	ay		m	*see options*

Calculated Parameters **Variable**

	Variable	Value	Unit
Groundwater flow velocity	v	1.37E+00	m/d
Retardation factor	Rf	2.14E+07	fraction
Decay rate used	λ	1.90E-04	d^{-1}
Rate of contaminant flow due to retardation	u	6.42E-08	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	#NUM!	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	#NUM!	mg/l
Attenuation factor (one way vertical dispersion, C_0/C_{ED})	AF	#NUM!	
Attenuation factor (two way vertical dispersion, C_0/C_{ED})	AF	#NUM!	

Remedial Targets

Remedial Target LTC3 #NUM! mg/l For comparison with measured groundwater concentration.

Ogata Banks

Distance to compliance point 592 m

Concentration of contaminant at compliance point $C_{ED}/C0$ **#NUM!** **mg/l** Ogata Banks
after **9.9E+99** **days**

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	1.00E+00	fraction
Organic carbon partition coefficient	Koc	2.29E+06	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$		l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		

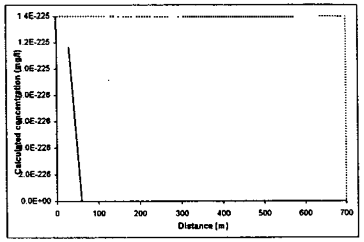
Soil water partition coefficient	Kd	2.29E+06	l/kg

Dispersivity

Calculate dependant on distance to compliance point (0), specify dispersivity (1), or calc after Xu & Eckstein (2) ? 2

		Enter value	Calc value Xu & Eckstein	
Longitudinal dispersivity	ax		9.73E+00	m
Transverse dispersivity	az		9.73E-01	m
Vertical dispersivity	ay		9.73E-02	m

For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report ax = $0.83(\log_{10}x)^{2.414}$; 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.

This sheet calculates the Tier3 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

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 Tier 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.

Calculated concentrations for distance-concentration graph

Ogata Bank.
From calculation sheet

Distance	Concentration mg/l
29.6	1.2E-225
59.2	#NUM!
88.8	#NUM!
118.4	#NUM!
146.0	#NUM!
177.6	#NUM!
207.2	#NUM!
236.6	#NUM!
296.0	#NUM!
325.6	#NUM!
355.2	#NUM!
384.8	#NUM!
414.4	#NUM!
444.0	#NUM!
603.2	#NUM!
632.8	#NUM!
662.4	#NUM!
692.0	#NUM!

Site being assessed	Bless Area 1 A murphy K20
Completed by	AJ
Date:	24 11 2005
Version	12

R&D Publication 20 Remedial Targets Worksheet, Release 2.2a

Tier 3 - Groundwater

ENVIRONMENT AGENCY

Input Parameters (using pull down menu)	Variable	Value	Unit	Source
Contaminant		mmoniacal Nitrogen as		
Target Concentration	C_T	1.20E-01	mg/l	

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

Ogata Banks | Equations in R&D Pub. 20

Enter '1' to simulate vertical dispersion in one direction, '2' for two directions (pull down menu) | 1

Enter '1' if biodegradation rate is for the substance in water,
'0' if rate is for decay in field conditions (i.e. field data from aquifer) (pull down menu | 0

				Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	6.40E+00	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	2.19E+03	days	
Calculated decay rate	λ	3.17E-04	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	1.90E+02	m	
Plume thickness at source	Sy	1.00E+01	m	
Saturated aquifer thickness	da	1.08E+01	m	
Bulk density of aquifer materials	ρ	1.70E+00	g/cm^3	
Effective porosity of aquifer	n	1.82E-01	fraction	
Hydraulic gradient	i	1.25E-02	fraction	
Hydraulic conductivity of aquifer	K	2.00E+01	m/d	
Distance to compliance point	x	5.92E+02	m	
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	5.00E-01	l/kg	*see options*
Longitudinal dispersivity	ax	9.730	m	*see options*
Transverse dispersivity	az	0.973	m	*see options*
Vertical dispersivity	ay	0.097	m	*see options*

Calculated Parameters	Variable		
Groundwater flow velocity	v	1.37E+00	m/d
Retardation factor	Rf	5.67E+00	fraction
Decay rate used	λ	3.17E-04	d^{-1}
Rate of contaminant flow due to retardation	u	2.42E-01	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	1.92E+00	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	1.06E+00	mg/l
Attenuation factor (one way vertical dispersion, C_0/C_{ED})	AF	3.33E+00	
Attenuation factor (two way vertical dispersion, C_0/C_{ED})	AF	6.02E+00	

Remedial Targets

Remedial Target	LTC3	3.99E-01	mg/l	For comparison with measured groundwater concentration.
Ogata Banks				
Distance to compliance point		**592**	**m**	
Concentration of contaminant at compliance point	$C_{ED}/C0$	**1.92E+00**	**mg/l**	Ogata Banks
after		**9.9E+99**	**days**	

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

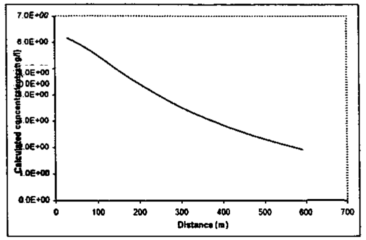
Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd	[redacted]	l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	1.00E+00	fraction
Organic carbon partition coefficient	Koc	5.00E-01	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$	[redacted]	l/kg
Sorption coefficient for ionised species	$K_{oc,i}$	[redacted]	l/kg
pH value	pH	[redacted]	
acid dissociation constant	pKa	[redacted]	
Soil water partition coefficient	Kd	5.00E-01	l/kg

Dispersivity

Calculate dependant on distance to compliance point (0), | 2
specify dispersivity (1), or calc after Xu & Eckstein (2) ?

		Enter value	Calc value Xu & Eckstein	
Longitudinal dispersivity	ax	[redacted]	9.73E+00	m
Transverse dispersivity	az	[redacted]	9.73E-01	m
Vertical dispersivity	ay	[redacted]	9.73E-02	m

For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report ax = 0.83(log_{10}x)$^{2.414}$; 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.

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration
	mg/l
29.6	6.2E+00
59.2	5.9E+00
88.8	5.6E+00
118.4	5.3E+00
148.0	5.0E+00
177.6	4.6E+00
207.2	4.3E+00
236.8	4.1E+00
266.4	3.8E+00
296.0	3.5E+00
325.6	3.3E+00
355.2	3.1E+00
384.8	2.9E+00
414.4	2.8E+00
444.0	2.6E+00
473.6	2.4E+00
503.2	2.3E+00
532.8	2.2E+00
562.4	2.0E+00
592.0	1.9E+00

This sheet calculates the Tier3 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

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 Tier 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.

Site being assessed	Bless Area 1 A murphy K20
Completed by.	AJ
Date.	24 11 2005
Version	12

R&D Publication 20 Remedial Targets Worksheet, Release 2.2a

Tier 3 -Groundwater

ENVIRONMENT AGENCY

Input Parameters (using pull down menu)	Variable	Value	Unit	Source
Contaminant		Anthracene		
Target Concentration	C_T	1.00E+01	mg/l	

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

Ogata Banks — Equations in R&D Pub. 20

Enter '1' to simulate vertical dispersion in one direction, '2' for two directions (pull down menu): 1

Enter '1' if biodegradation rate is for the substance in water, '0' if rate is for decay in field conditions (i.e. field data from aquifer) (pull down menu): 0

				Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	1.00E-01	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	9.20E+02	days	
Calculated decay rate	λ	7.53E-04	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	1.90E+02	m	
Plume thickness at source	Sy	1.00E+01	m	
Saturated aquifer thickness	da	1.08E+01	m	
Bulk density of aquifer materials	ρ	1.70E+00	g/cm^3	
Effective porosity of aquifer	n	1.82E-01	fraction	
Hydraulic gradient	i	1.25E-02	fraction	
Hydraulic conductivity of aquifer	K	2.00E+01	m/d	
Distance to compliance point	x	5.92E+02	m	
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	5.13E+01	l/kg	*see options*
Longitudinal dispersivity	ax	9.730	m	*see options*
Transverse dispersivity	az	0.973	m	*see options*
Vertical dispersivity	ay	0.097	m	*see options*

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	[redacted]	l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	1.00E+00	fraction
Organic carbon partition coefficient	Koc	5.13E+01	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$	[redacted]	l/kg
Sorption coefficient for ionised species	$K_{oc,i}$	[redacted]	l/kg
pH value	pH	[redacted]	
acid dissociation constant	pKa	[redacted]	
Soil water partition coefficient	Kd	5.13E+01	l/kg

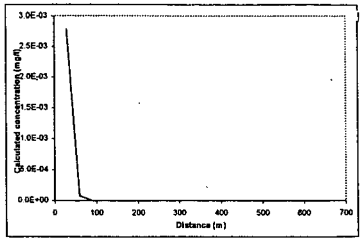
Dispersivity

Calculate dependant on distance to compliance point (0), specify dispersivity (1), or calc after Xu & Eckstein (2) ? 2

		Enter value	Calc value Xu & Eckstein	
Longitudinal dispersivity	ax	[redacted]	9.73E+00	m
Transverse dispersivity	az	[redacted]	9.73E-01	m
Vertical dispersivity	ay	[redacted]	9.73E-02	m

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

Xu & Eckstein (1995) report $ax = 0.83(\log_{10}x)^{2.414}$; 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.

Calculated concentrations for distance-concentration graph

Ogata Banks

DistarcalcConcensheetn

	mg/l
29.6	2.8E-03
69.2	7.7E-05
88.8	2.1E-06
118.4	5.8E-08
148.0	1.6E-09
177.6	4.3E-11
207.2	1.2E-12
236.8	3.1E-14
219.4	8.5E-16
296.0	2.3E-17
325.6	6.3E-19
355.2	1.7E-20
384.8	4.6E-22
414.4	1.3E-23
444.0	3.4E-25
471.6	9.3E-27
503.2	2.5E-28
532.8	7.0E-30
562.4	1.9E-31
592.0	5.2E-33

This sheet calculates the Tier3 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

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 Tier 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.

Calculated Parameters	Variable		
Groundwater flow velocity	v	1.37E+00	m/d
Retardation factor	Rf	4.80E+02	fraction
Decay rate used	λ	7.53E-04	d^{-1}
Rate of contaminant flow due to retardation	u	2.86E-03	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	5.19E-33	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	2.87E-33	mg/l
Attenuation factor (one way vertical dispersion, C_O/C_{ED})	AF	1.93E+31	
Attenuation factor (two way vertical dispersion, C_O/C_{ED})	AF	3.48E+31	

Remedial Targets

Remedial Target	LTCS	1.93E+32	mg/l	For comparison with measured groundwater concentration.
Ogata Banks				
Distance to compliance point		592	m	
Concentration of contaminant at compliance point	$C_{ED}/C0$	5.19E-33	mg/l	Ogata Banks
after		9.9E+99	days	

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.

Site being assessed:	Bless Area 1 Murphys K20
Completed by	AJ
Date:	24 11 2005
Version	12

R&D Publication 20 Remedial Targets Worksheet, Release 2.2a

Tier 3 - Groundwater

ENVIRONMENT AGENCY

Input Parameters (using pull down menu)	Variable	Value	Unit	Source
Contaminant		Aromatic C10-C12		
Target Concentration	C_T	7.14E-04	mg/l	

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

Ogata Banks — Equations in R&D Pub. 20

Enter 1 to simulate vertical dispersion in one direction, '2' for two directions (pull down menu): 1

Enter '1' if biodegradation rate is for the substance in water,
'0' if rate is for decay in field conditions (i.e. field data from aquifer) (pull down menu: 0

				Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	9.90E-99	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	1.83E+03	days	
Calculated decay rate	λ	3.80E-04	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	1.90E+02	m	
Plume thickness at source	Sy	1.00E+01	m	
Saturated aquifer thickness	da	1.08E+01	m	
Bulk density of aquifer materials	ρ	1.70E+00	g/cm^3	
Effective porosity of aquifer	n	1.82E-01	fraction	
Hydraulic gradient	i	1.25E-02	fraction	
Hydraulic conductivity of aquifer	K	2.00E+01	m/d	
Distance to compliance point	x	5.92E+02	m	
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	9.12E+00	l/kg	*see options*
Longitudinal dispersivity	ax	9.730	m	*see options*
Transverse dispersivity	az	0.973	m	*see options*
Vertical dispersivity	ay	0.097	m	*see options*

Calculated Parameters	Variable		
Groundwater flow velocity	v	1.37E+00	m/d
Retardation factor	Rf	8.62E+01	fraction
Decay rate used	λ	3.80E-04	d^{-1}
Rate of contaminant flow due to retardation	u	1.59E-02	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	4.74E-104	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	2.62E-104	mg/l
Attenuation factor (one way vertical dispersion, C_O/C_{ED})	AF	2.09E+05	
Attenuation factor (two way vertical dispersion, C_O/C_{ED})	AF	3.78E+05	

Remedial Targets

Remedial Target	LTC3	1.49E+02	mg/l	For comparison with measured groundwater concentration.
Ogata Banks				
Distance to compliance point		592	m	
Concentration of contaminant at compliance point	$C_{ED}/C0$	4.74E-104	mg/l	Ogata Banks
after		9.9E+99	days	

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

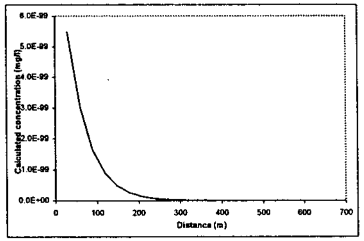
Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd		l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	1.00E+00	fraction
Organic carbon partition coefficient	Koc	9.12E+00	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$		l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Soil water partition coefficient	Kd	9.12E+00	l/kg

Dispersivity

Calculate dependant on distance to compliance point (0), specify dispersivity (1), or calc after Xu & Eckstein (2) ? 2

		Enter value	Calc value Xu & Eckstein	
Longitudinal dispersivity	ax		9.73E+00	m
Transverse dispersivity	az		9.73E-01	m
Vertical dispersivity	ay		9.73E-02	m

For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report ax = $0.83(\log_{10}x)^{2.414}$; 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.

This sheet calculates the Tier3 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

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 Tier 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.

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration mg/l
29.6	5.5E-99
59.2	3.0E-99
88.8	1.7E-99
118.4	9.0E-100
148.0	4.8E-100
177.6	2.6E-100
207.2	1.4E-100
236.8	7.5E-101
266.4	4.1E-101
296.0	2.2E-101
325.6	1.2E-101
355.2	6.4E-102
384.8	3.4E-102
414.4	1.9E-102
444.0	1.0E-102
473.6	5.5E-103
503.2	3.0E-103
532.8	1.6E-103
562.4	8.7E-104
592.0	4.7E-104

Site being assessed	Bless Area 1 A murphy K20
Completed by	AJ
Date.	24 11 2005
Version:	12

R&D Publication 20 Remedial Targets Worksheet, Release 2.2a

ENVIRONMENT
AGENCY

Tier 3 - Groundwater

Input Parameters (using pull down menu)	Variable	Value	Unit	Source
Contaminant		Aromatic C12-C16		
Target Concentration	C_T	7.14E-04	mg/l	

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

Ogata Banks — Equations in R&D Pub. 20

Enter '1' to simulate vertical dispersion in one direction, '2' for two directions (pull down menu): 1

Enter '1' if biodegradation rate is for the substance in water,
'0' if rate is for decay in field conditions (i.e. field data from aquifer) (pull down menu: 0

				Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	3.47E-02	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	1.83E+03	days	
Calculated decay rate	λ	3.80E-04	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	1.90E+02	m	
Plume thickness at source	Sy	1.00E+01	m	
Saturated aquifer thickness	da	1.08E+01	m	
Bulk density of aquifer materials	ρ	1.70E+00	g/cm^3	
Effective porosity of aquifer	n	1.82E-01	fraction	
Hydraulic gradient	i	1.25E-02	fraction	
Hydraulic conductivity of aquifer	K	2.00E+01	m/d	
Distance to compliance point	x	5.92E+02	m	
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	1.82E+01	l/kg	*see options*
Longitudinal dispersivity	ax	9.730	m	*see options*
Transverse dispersivity	az	0.973	m	*see options*
Vertical dispersivity	ay	0.097	m	*see options*

Calculated Parameters	Variable		
Groundwater flow velocity	v	1.37E+00	m/d
Retardation factor	Rf	1.71E+02	fraction
Decay rate used	λ	3.80E-04	d^{-1}
Rate of contaminant flow due to retardation	u	8.04E-03	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	1.99E-11	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	1.10E-11	mg/l
Attenuation factor (one way vertical dispersion, C_0/C_{ED})	AF	1.75E+09	
Attenuation factor (two way vertical dispersion, C_0/C_{ED})	AF	3.16E+09	

Remedial Targets

Remedial Target	LTC3	1.25E+06	mg/l

For comparison with measured groundwater concentration.

Ogata Banks

Distance to compliance point 592 m

Concentration of contaminant at compliance point $C_{ED}/C0$ 1.99E-11 mg/l Ogata Banks
after 9.9E+99 days

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

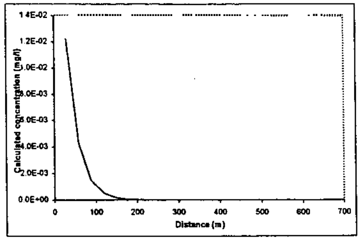
Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd		l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	1.00E+00	fraction
Organic carbon partition coefficient	Koc	1.82E+01	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$		l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Soil water partition coefficient	Kd	1.82E+01	l/kg

Dispersivity

Calculate dependant on distance to compliance point (0), specify dispersivity (1), or calc after Xu & Eckstein (2) ? 2

		Enter value	Calc value Xu & Eckstein	
Longitudinal dispersivity	ax		9.73E+00	m
Transverse dispersivity	az		9.73E-01	m
Vertical dispersivity	ay		9.73E-02	m

For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report ax = 0.83$(\log_{10}x)^{2.414}$; 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.

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration mg/l
29.6	1.2E-02
59.2	4.3E-03
88.8	1.6E-03
118.4	5.2E-04
148.0	1.8E-04
177.6	6.1E-05
207.2	2.1E-05
236.8	7.1E-06
259.4	2.4E-06
296.0	8.4E-07
325.6	2.9E-07
366.2	9.9E-08
384.8	3.2E-08
444.0	4.0E-09
473.5	1.4E-09
503.2	4.8E-10
532.8	1.7E-10
562.4	5.8E-11
692.0	2.0E-11

This sheet calculates the Tier3 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
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 Tier 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.

Site being assessed:	Bless Area 1 A murphy K20
Completed by:	AJ
Date:	24 11 2005
Version:	12

AGENCY

R&D Publication 20 Remedial Targets Worksheet, Release 2.2a

Tier 3 - Groundwater

Input Parameters (using pull down menu)	Variable	Value	Unit	Source
Contaminant		Aromatic C16-C21		
Target Concentration	C_T	7.14E-04	mg/l	

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

Ogata Banks — Equations in R&D Pub. 20

Enter '1' to simulate vertical dispersion in one direction, '2' for two directions (pull down menu): 1

Enter '1' if biodegradation rate is for the substance in water,
'0' if rate is for decay in field conditions (i.e. field data from aquifer) (pull down menu: 0

				Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	3.47E-02	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	3.65E+03	days	
Calculated decay rate	λ	1.90E-04	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	1.90E+02	m	
Plume thickness at source	Sy	1.00E+01	m	
Saturated aquifer thickness	da	1.08E+01	m	
Bulk density of aquifer materials	ρ	1.70E+00	g/cm^3	
Effective porosity of aquifer	n	1.82E-01	fraction	
Hydraulic gradient	i	1.25E-02	fraction	
Hydraulic conductivity of aquifer	K	2.00E+01	m/d	
Distance to compliance point	x	5.92E+02	m	
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	5.75E+01	l/kg	*see options*
Longitudinal dispersivity	ax	9.730	m	*see options*
Transverse dispersivity	az	0.973	m	*see options*
Vertical dispersivity	ay	0.097	m	*see options*

Calculated Parameters	Variable		
Groundwater flow velocity	v	1.37E+00	m/d
Retardation factor	Rf	5.38E+02	fraction
Decay rate used	λ	1.90E-04	d^{-1}
Rate of contaminant flow due to retardation	u	2.55E-03	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	3.02E-15	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	1.67E-15	mg/l
Attenuation factor (one way vertical dispersion, C_0/C_{ED})	AF	1.15E+13	
Attenuation factor (two way vertical dispersion, C_0/C_{ED})	AF	2.07E+13	

Remedial Targets

Remedial Target	LTC3	8.19E+09	mg/l	For comparison with measured groundwater concentration.
Ogata Banks				
Distance to compliance point		**692**	**m**	
Concentration of contaminant at compliance point	$C_{ED}/C0$	**3.02E-15**	**mg/l**	Ogata Banks
after		**9.9E+99**	**days**	

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

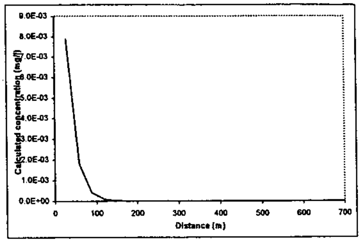
Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd		l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	1.00E+00	fraction
Organic carbon partition coefficient	Koc	5.75E+01	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$		l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Soil water partition coefficient	Kd	5.75E+01	l/kg

Dispersivity

Calculate dependant on distance to compliance point (0), specify dispersivity (1), or calc after Xu & Eckstein (2) ? 2

		Enter value	Calc value Xu & Eckstein	
Longitudinal dispersivity	ax		9.73E+00	m
Transverse dispersivity	az		9.73E-01	m
Vertical dispersivity	ay		9.73E-02	m

For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report ax = $0.83(\log_{10}x)^{2.414}$; 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.

This sheet calculates the Tier3 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

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 Tier 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.

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration
	mg/l
29.6	7.9E-03
88.8	4.8E-04
118.4	8.9E-05
148.0	2.0E-05
177.6	4.4E-M
207.2	9.6E-07
236.8	2.1E-07
266.4	4.7E-08
326.E	2.3E-M
355.2	5.1E-10
414.4	2.5E-11
444.0	5.5E-12
473.8	1.2E-12
503.2	2.7E-13
532.8	6.1E-14
562.4	1.4E-14
592.0	3.0E-15

Site being assessed	Bless Area 1 A murphy K20
Completed by:	AJ
Date	24 11 2005
Version	12

R&D Publication20 Remedial Targets Worksheet, Release 2.2a

Tier 3 -Groundwater

ENVIRONMENT AGENCY

Input Parameters (using pull down menu)	Variable	Value	unit	Source
Contaminant		Aromatic C21-C35		
Target Concentration	C_T	7.14E-04	mg/l	

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

Ogata Banks — Equations in R&D Pub. 20

Enter '1' to simulate vertical dispersion in one direction, '2' for two directions (pull down menu): 1

Enter '1' if biodegradation rate is for the substance in water,
'0' if rate is for decay in field conditions (i.e. field data from aquifer) (pull down menu): 0

	Variable	Value	unit	Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	3.47E-02	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	3.65E+03	days	
Calculated decay rate	λ	1.90E-04	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	1.90E+02	m	
Plume thickness at source	Sy	1.00E+01	m	
Saturated aquifer thickness	da	1.08E+01	m	
Bulk density of aquifer materials	ρ	1.70E+00	g/cm^3	
Effective porosity of aquifer	n	1.82E-01	fraction	
Hydraulic gradient	i	1.25E-02	fraction	
Hydraulic conductivity of aquifer	K	2.00E+01	m/d	
Distance to compliance point	x	5.92E+02	m	
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	4.57E+02	l/kg	*see options*
Longitudinal dispersivity	ax	9.730	m	*see options*
Transverse dispersivity	az	0.973	m	*see options*
Vertical dispersivity	ay	0.097	m	*see options*

Calculated Parameters	Variable		
Groundwater flow velocity	v	1.37E+00	m/d
Retardation factor	Rf	4.27E+03	fraction
Decay rate used	λ	1.90E-04	d^{-1}
Rate of contaminant flow due to retardation	u	3.22E-04	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	7.44E-54	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	4.12E-54	mg/l
Attenuation factor (one way vertical dispersion, C_O/C_{ED})	AF	4.66E+51	
Attenuation factor (two way vertical dispersion, C_O/C_{ED})	AF	8.43E+51	

Remedial Targets

Remedial Target	LTC3	3.33E+48	mg/l	For comparison with measured groundwater concentration.
Ogata Banks				
Distance to compliance point		592	m	
Concentration of contaminant at compliance point	$C_{ED}/C0$	7.44E-54	mg/l	Ogata Banks
after		9.9E+99	days	

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

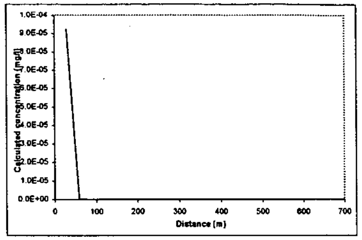
Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd		l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	1.00E+00	fraction
Organic carbon partition coefficient	Koc	4.57E+02	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$		l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Soil water partition coefficient	Kd	4.57E+02	l/kg

Dispersivity

Calculate dependant on distance to compliance point (0), specify dispersivity (1), or calc after Xu & Eckstein (2) ? 2

		Enter value	Calc value Xu & Eckstein	
Longitudinal dispersivity	ax		9.73E+00	m
Transverse dispersivity	az		9.73E-01	m
Vertical dispersivity	ay		9.73E-02	m

For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report $ax = 0.83(\log_{10}x)^{2.414}$; 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.

This sheet calculates the Tier3 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

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 Tier 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.

Calculated concentrations tor distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration
	mg/l
29.6	9.3E-06
59.2	2.5E-07
86.8	6.5E-10
148.8	4.4E-12
177.6	1.1E-17
M7.2	2.9E-20
236.8	7.6E-23
268.4	2.0E-25
296.0	5.1E-28
326.6	1.3E-30
355.2	3.5E-33
384.8	9.0E-36
414.4	2.4E-38
444.0	6.1E-41
473.6	1.6E-43
503.2	4.2E-46
532.8	1.1E-48
562.4	2.8E-51
592.0	7.4E-54

Site being assessed:	Bless Area 1 A murphy K20
Completed by:	AJ
Date:	24 11 2005
Version:	12

R&D Publication 20 Remedial Targets Worksheet, Release 2.2a

Tier 3 - Groundwater

ENVIRONMENT AGENCY

Input Parameters (using pull down menu)	Variable	Value	Unit	Source
Contaminant		Benzo(a)anthracene		
Target Concentration	C_T	6.25E-06	mg/l	

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

Ogata Banks — Equations in R&D Pub. 20

Enter '1' to simulate vertical dispersion in one direction, '2' for two directions (pull down menu): 1

Enter '1' if biodegradation rate is for the substance in water,
'0' if rate is for decay in field conditions (i.e. field data from aquifer) (pull down menu): 0

	Variable	Value	Unit	Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	2.00E-01	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	1.36E+03	days	
Calculated decay rate	λ	5.10E-04	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	1.90E+02	m	
Plume thickness at source	Sy	1.00E+01	m	
Saturated aquifer thickness	da	1.08E+01	m	
Bulk density of aquifer materials	ρ	1.70E+00	g/cm^3	
Effective porosity of aquifer	n	1.82E-01	fraction	
Hydraulic gradient	i	1.25E-02	fraction	
Hydraulic conductivity of aquifer	K	2.00E+01	m/d	
Distance to compliance point	x	5.92E+02	m	
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	5.01E+03	l/kg	*see options*
Longitudinal dispersivity	ax	9.730	m	*see options*
Transverse dispersivity	az	0.973	m	*see options*
Vertical dispersivity	ay	0.097	m	*see options*

Calculated Parameters	Variable		
Groundwater flow velocity	v	1.37E+00	m/d
Retardation factor	Rf	4.68E+04	fraction
Decay rate used	λ	5.10E-04	d^{-1}
Rate of contaminant flow due to retardation	u	2.93E-05	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	#NUM!	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	#NUM!	mg/l
Attenuation factor (one way vertical dispersion, C_0/C_{ED})	AF	#NUM!	
Attenuation factor (two way vertical dispersion, C_0/C_{ED})	AF	#NUM!	

Remedial Targets

Remedial Target	LTC3	#NUM!	mg/l	For comparison with measured groundwater concentration.
Ogata Banks				
Distance to compliance point		592	m	
Concentration of contaminant at compliance point	$C_{ED}/C0$	#NUM!	mg/l	Ogata Banks
after		9.9E+99	days	

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

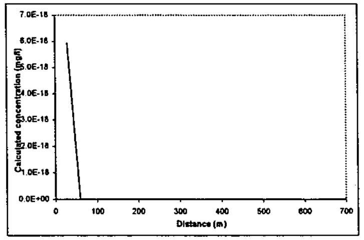
Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd		l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	1.00E+00	fraction
Organic carbon partition coefficient	Koc	5.01E+03	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$		l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Soil water partition coefficient	Kd	5.01E+03	l/kg

Dispersivity

Calculate dependant on distance to compliance point (0), specify dispersivity (1), or calc after Xu & Eckstein (2) ? 2

		Enter value	Calc value Xu & Eckstein	
Longitudinal dispersivity	ax		9.73E+00	m
Transverse dispersivity	az		9.73E-01	m
Vertical dispersivity	ay		9.73E-02	m

For calculated value, assumes ax = 0.1 * x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report ax = $0.83(\log_{10}x)^{2.414}$; 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.

This sheet calculates the Tier3 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

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 Tier 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.

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration mg/l
29.6	5.9E-18
59.2	1.8E-34
88.8	5.2E-51
118.4	1.5E-67
148.0	4.4E-84
177.6	1.3E-100
207.2	3.6E-117
236.8	1.0E-133
266.4	3.0E-150
296.0	8.8E-167
325.6	2.6E-183
355.2	7.4E-200
384.8	2.1E-216
414.4	6.2E-233
444.0	1.8E-249
473.6	5.2E-266
503.2	1.5E-282
532.8	#NUM!
562.4	#NUM!
592.0	#NUM!

Site being assessed	Biess Area 1 Murphys K20
Completed by:	AJ
Date:	24 11 2005
Version:	12

R&D Publication 20 Remedial Targets Worksheet, Release 2.2a

Tier 3 - Groundwater

ENVIRONMENT
AGENCY

Input Parameters (using pull d a m menu)	Variable	Value	Unit	Source
Contaminant		s (2 ethylhexyl)phthala		
Target Concentration	C_T	1.00E-02	mg/l	

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

Ogata Banks Equations in R&D Pub. 20

Enter '1' to simulate vertical dispersion in one direction, '2' for two directions (pull down menu) 1

Enter '1' if biodegradation rate is for the substance in water,
'0' if rate is for decay in field conditions (i.e. field data from aquifer) (pull down menu 0

	Variable	Value	Unit	Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	4.20E-02	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	3.89E+02	days	
Calculated decay rate	λ	1.78E-03	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	1.90E+02	m	
Plume thickness at source	Sy	1.00E+01	m	
Saturated aquifer thickness	da	1.08E+01	m	
Bulk density of aquifer materials	ρ	1.70E+00	g/cm^3	
Effective porosity of aquifer	n	1.82E-01	fraction	
Hydraulic gradient	i	1.25E-02	fraction	
Hydraulic conductivity of aquifer	K	2.00E+01	m/d	
Distance to compliance point	x	5.92E+02	m	
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	5.89E+02	l/kg	*see options*
Longitudinal dispersivity	ax	9.730	m	*see options*
Transverse dispersivity	az	0.973	m	*see options*
Vertical dispersivity	ay	0.097	m	*see options*

Calculated Parameters	Variable		
Groundwater flow velocity	v	1.37E+00	m/d
Retardation factor	Rf	5.50E+03	fraction
Decay rate used	λ	1.78E-03	d^{-1}
Rate of contaminant flow due to retardation	u	2.50E-04	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	1.21E-209	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	6.71E-210	mg/l
Attenuation factor (one way vertical dispersion, C_O/C_{ED})	AF	3.46E+207	
Attenuation factor (two way vertical dispersion, C_O/C_{ED})	AF	6.26E+207	

Remedial Targets

Remedial Target LTC3 3.46E+205 mg/l For comparison with measured groundwater concentration.
Ogata Banks

Distance to compliance point		**592**	**m**	
Concentration of contaminant at compliance point	$C_{ED}/C0$	**1.21E-209**	**mg/l**	**Ogata Banks**
after		**9.9E+99**	**days**	

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

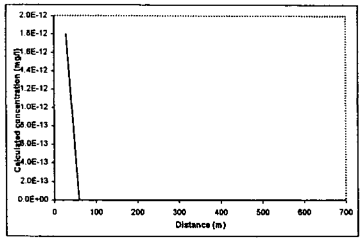
Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd	[redacted]	l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	1.00E+00	fraction
Organic carbon partition coefficient	Koc	5.89E+02	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$	[redacted]	l/kg
Sorption coefficient for ionised species	$K_{oc,i}$	[redacted]	l/kg
pH value	pH	[redacted]	
acid dissociation constant	pKa	[redacted]	
Soil water partition coefficient	Kd	5.89E+02	l/kg

Dispersivity

Calculate dependant on distance to compliance point (0), 2
specify dispersivity (1), or calc after Xu & Eckstein (2) ?

		Enter value	Calc value Xu & Eckstein	
Longitudinal dispersivity	**ax**	[redacted]	9.73E+00	m
Transverse dispersivity	**az**	[redacted]	9.73E-01	m
Vertical dispersivity	**ay**	[redacted]	9.73E-02	m

For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report $ax = 0.83(\log_{10}x)^{2.414}$; 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.

This sheet calculates the Tier3 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

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 Tier 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

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration mg/l
29.6	1.8E-12
59.2	7.7E-23
88.8	3.3E-33
118.4	1.4E-43
148.0	5.7E-54
177.0	2.4E-64
207.2	1.0E-74
236.8	4.1E-85
266.4	1.7E-95
296.0	7.2E-106
325.6	3.0E-116
355.2	1.3E-126
384.8	5.3E-137
414.4	2.2E-147
444.0	9.3E-158
473.0	3.9E-168
503.2	1.6E-178
532.8	6.9E-189
562.4	2.9E-199
692.0	1.2E-209

Site being assessed:	Sless Area 1 Murphys K20
Completed by:	AJ
Date:	24 11 2005
Version:	12

R&D Publication20 Remedial Targets Worksheet, Release 2.2a

ENVIRONMENT AGENCY

Tier 3 -Groundwater

Input Parameters (using pull down menu)	Variable	Value	Unit	Source
Contaminant		Chrysene		
Target Concentration	C_T	6.25E-06	mg/l	

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

Ogata Banks — Equations in R&D Pub. 20

Enter '1' to simulate vertical dispersion in one direction, '2' for two directions (pull down menu): 1

Enter '1' if biodegradation rate is for the substance in water, '0' if rate is for decay in field conditions (i.e. field data from aquifer) (pull down menu): 0

	Variable	Value	Unit	Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	2.00E+01	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	2.00E+03	days	
Calculated decay rate	λ	3.47E-04	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	1.90E+02	m	
Plume thickness at source	Sy	1.00E+01	m	
Saturated aquifer thickness	da	1.08E+01	m	
Bulk density of aquifer materials	ρ	1.70E+00	g/cm^3	
Effective porosity of aquifer	n	1.82E-01	fraction	
Hydraulic gradient	i	1.25E-02	fraction	
Hydraulic conductivity of aquifer	K	2.00E+01	m/d	
Distance to compliance point	x	5.92E+02	m	
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	7.24E+02	l/kg	*see options*
Longitudinal dispersivity	ax	9.730	m	*see options*
Transverse dispersivity	az	0.973	m	*see options*
Vertical dispersivity	ay	0.097	m	*see options*

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	1.00E+00	fraction
Organic carbon partition coefficient	Koc	7.24E+02	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$		l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Soil water partition coefficient	Kd	7.24E+02	l/kg

Dispersivity

Calculate dependant on distance to compliance point (0), specify dispersivity (1), or calc after Xu & Eckstein (2) ? 2

		Enter value	Calc value Xu & Eckstein	
Longitudinal dispersivity	**ax**		9.73E+00	m
Transverse dispersivity	**az**		9.73E-01	m
Vertical dispersivity	**ay**		9.73E-02	m

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

Xu & Eckstein (1995) report $ax = 0.83(\log_{10}x)^{2.414}$; az = ax/10, ay = ax/100 are assumed

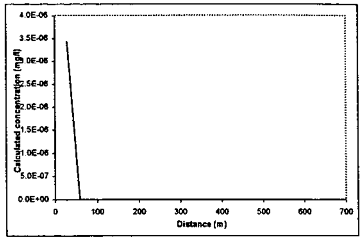
Calculated Parameters

	Variable		
Groundwater flow velocity	v	1.37E+00	m/d
Retardation factor	Rf	6.77E+03	fraction
Decay rate used	λ	3.47E-04	d^{-1}
Rate of contaminant flow due to retardation	u	2.03E-04	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	6.59E-97	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	3.65E-97	mg/l
Attenuation factor (one way vertical dispersion, C_O/C_{ED})	AF	3.03E+95	
Attenuation factor (two way vertical dispersion, C_O/C_{ED})	AF	5.48E+95	

Remedial Targets

Remedial Target Ogata Banks	**LTC3**	**1.90E+00**	**mg/l**	For comparison with measured groundwater concentration.
Distance to compliance point		**592**	**m**	
Concentration of contaminant at compliance point	$C_{ED}/C0$	**6.59E-97**	**mg/l**	Ogata Banks
after		**9.9E+99**	**days**	

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.



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.

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	**Concentration**
	mg/l
29.6	**3.4E-06**
59.2	**5.9E-11**
88.8	**1.0E-15**
118.4	**1.7E-20**
148.0	**2.8E-25**
177.6	**4.7E-30**
207.2	**7.9E-35**
236.8	**1.3E-39**
266.4	**2.2E-44**
296.0	**3.7E-49**
126.6	**6.1E-54**
355.2	
	1.0E-58
414.4	**2.9E-68**
444.0	**4.9E-73**
471.6	**8.2E-78**
503.2	**2.4E-82**
562.4	**3.9E-92**
592.0	**6.6E-97**

This sheet calculates the Tier3 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

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 Tier 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

Site being assessed:	Bloss Area 1 Murphys K20
Completed by.	AJ
Date:	24 11 2005
Version	12

R&D Publication20 Remedial Targets Worksheet, Release2.2a

Tier 3 - Groundwater

ENVIRONMENT AGENCY

Input Parameters (using pull down menu)

	Variable	Value	Unit	Source
Contaminant		Flouride		
Target Concentration	C_T	1.00E+00	mg/l	

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

Ogata Banks — Equations in R&D Pub. 20

Enter '1' to simulate vertical dispersion in one direction, '2' for two directions (pull down menu) 1

Enter '1' if biodegradation rate is for the substance in water,
'0' if rate is for decay in field conditions (i.e. field data from aquifer) (pull down menu) 0

	Variable	Value	Unit	Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	2.70E+00	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	9.90E+99	days	
Calculated decay rate	λ	7.00E-101	days^{-1}	
Width of plume in aquifer at source (perpendicular to flow)	Sz	1.90E+02	m	
Plume thickness at source	Sy	1.00E+01	m	
Saturated aquifer thickness	da	1.08E+01	m	
Bulk density of aquifer materials	ρ	1.70E+00	g/cm^3	
Effective porosity of aquifer	n	1.82E-01	fraction	
Hydraulic gradient	i	1.25E-02	fraction	
Hydraulic conductivity of aquifer	K	2.00E+01	m/d	
Distance to compliance point	x	5.92E+02	m	
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	0.00E+00	l/kg	*see options*
Longitudinal dispersivity	ax		m	*see options*
Transverse dispersivity	az		m	*see options*
Vertical dispersivity	av		m	*see options*

Calculated Parameters

	Variable		
Groundwater flow velocity	v	1.37E+00	m/d
Retardation factor	Rf	1.00E+00	fraction
Decay rate used	λ	7.00E-101	d^{-1}
Rate of contaminant flow due to retardation	u	1.37E+00	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	1.74E+00	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	9.63E-01	mg/l
Attenuation factor (one way vertical dispersion, C_0/C_{ED})	AF	1.55E+00	
Attenuation factor (two way vertical dispersion, C_0/C_{ED})	AF	2.80E+00	

Remedial Targets

Remedial Target Ogata Banks	LTC3	1.55E+00	mg/l	For comparison with measured groundwater concentration.
Distance to compliance point		**592**	**m**	
Concentration of contaminant at compliance point	$C_{ED}/C0$	**1.74E+00**	**mg/l**	Ogata Banks
after		**9.9E+99**	**days**	

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

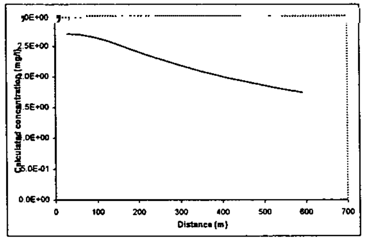
Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd		l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	1.00E+00	fraction
Organic carbon partition coefficient	Koc	0.00E+00	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$		l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Soil water partition coefficient	Kd	0.00E+00	l/kg

Dispersivity

Calculate dependant on distance to compliance point (0), specify dispersivity (1), or calc after Xu & Eckstein (2) ? 2

		Enter value	Calc value Xu & Eckstein	
Longitudinal dispersivity	ax		9.73E+00	m
Transverse dispersivity	az		9.73E-01	m
Vertical dispersivity	ay		9.73E-02	m

For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report ax = 0.83(log$_{10}$x)$^{2.414}$; 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.

This sheet calculates the Tier3 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

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 Tier 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.

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration
	mg/l
29.6	2.7E+00
59.2	2.7E+00
88.8	2.7E+00
118.4	2.6E+00
148.0	2.6E+00
177.6	2.6E+00
201.2	2.4E+00
230.1	2.3E+00
266.4	2.3E+00
296.0	2.2E+00
326.C	2.1E+00
355.2	2.1E+00
384.8	2.0E+00
414.4	2.0E+00
444.0	1.9E+00
603.2	1.9E+00
632.1	1.8E+00
562.4	1.8E+00
592.0	1.7E+00

Site being assessed	Bless Area 1 A murphy K20
Completed by	AJ
Date:	24 11 2005
Version	12

R&D Publication20 Remedial Targets Worksheet, Release 2.2a

ENVIRONMENT AGENCY

Tier 3 - Groundwater

Input Parameters(using pull down menu)	Variable	Value	unit	Source
Contaminant		Fluoranthene		
Target Concentration	C_T	1.00E-03	mg/l	

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

Ogata Banks Equations in R&D Pub. 20

Enter '1' to simulate vertical dispersion in one direction, '2' for two directions (pull down menu) 1

Enter '1' if biodegradation rate is for the substance in water,
'0' if rate is for decay in field conditions (i.e. field data from aquifer) (pull down menu) 0

	Variable	Value	unit	Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	5.00E-01	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	8.80E+02	days	
Calculated decay rate	λ	7.88E-04	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	1.90E+02	m	
Plume thickness at source	Sy	1.00E+01	m	
Saturated aquifer thickness	da	1.08E+01	m	
Bulk density of aquifer materials	ρ	1.70E+00	g/cm^3	
Effective porosity of aquifer	n	1.82E-01	fraction	
Hydraulic gradient	i	1.25E-02	fraction	
Hydraulic conductivity of aquifer	K	2.00E+01	m/d	
Distance to compliance point	x	5.92E+02	m	
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	1.38E+02	l/kg	*see options*
Longitudinal dispersivity	ax	9.730	m	*see options*
Transverse dispersivity	az	0.973	m	*see options*
Vertical dispersivity	ay	0.097	m	*see options*

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	[redacted]	l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	1.00E+00	fraction
Organic carbon partition coefficient	Koc	1.38E+02	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$	[redacted]	l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		

Soil water partition coefficient	Kd	1.38E+02	l/kg

Dispersivity

Calculate dependant on distance to compliance point (0), 2
specify dispersivity (1), or calc after Xu & Eckstein (2) ?

		Enter value	Calc value Xu & Eckstein	
Longitudinal dispersivity	ax	[redacted]	9.73E+00	m
Transverse dispersivity	az		9.73E-01	m
Vertical dispersivity	ay		9.73E-02	m

For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report ax = 0.83(log_{10}x)$^{2.414}$; az = ax/10, ay = ax/100 are assumed

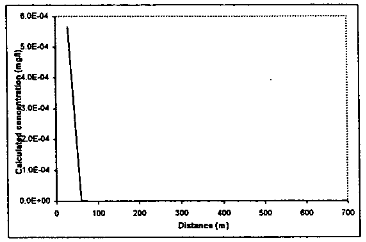
Calculated Parameters	Variable		
Groundwater flow velocity	v	1.37E+00	m/d
Retardation factor	Rf	1.29E+03	fraction
Decay rate used	λ	7.88E-04	d^{-1}
Rate of contaminant flow due to retardation	u	1.06E-03	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	4.04E-60	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	2.23E-60	mg/l
Attenuation factor (one way vertical dispersion, C_O/C_{ED})	AF	1.24E+59	
Attenuation factor (two way vertical dispersion, C_O/C_{ED})	AF	2.24E+59	

Remedial Targets

Remedial Target LTCS 1.24E+56 mg/l For comparison with measured groundwater concentration.
Ogata Banks

Distance to compliance point		**592**	**m**	
Concentration of contaminant at compliance point	$C_{ED}/C0$	**4.04E-60**	**mg/l**	Ogata Banks
after		**9.9E+99**	**days**	

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.



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.

This sheet calculates the Tier3 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

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 Tier 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.

Calculated concentrations for distance-concentration graph

Ogata Banks

Distance	Concentration
29.6	5.mg/l4
69.2	6.4E-07
88.8	7.2E-10
118.4	8.0E-13
148.0	8.8E-16
177.6	9.7E-19
207.2	1.1E-21
236.8	1.2E-24
266.4	1.3E-27
296.0	1.4E-30
325.6	1.6E-33
355.2	1.8E-36
384.8	1.9E-39
414.4	2.2E-42
444.0	2.4E-45
471.6	2.6E-48
503.2	2.9E-51
612.6	3.3E-54
562.4	3.6E-57
592.0	4.0E-60

Site being assessed:	Bless Area 1 Murphys K20
Completed by:	AJ
Date:	24 11 2005
Version.	12

R&D Publication 20 Remedial Targets Worksheet, Release 2.2a

Tier 3 - Groundwater

ENVIRONMENT AGENCY

Input Parameters (using pull down menu)	Variable	Value	Unit	Source
Contaminant		Fluorene		
Target Concentration	C_T	6.25E-06	mg/l	

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

Ogata Banks — Equations in R&D Pub. 20

Enter 1 to simulate vertical dispersion in one direction, '2' for two directions (pull down menu): 1

Enter '1' if biodegradation rate is for the substance in water,
'0' if rate is for decay in field conditions (i.e. field data from aquifer) (pull down menu: 0

	Variable	Value	Unit	Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	3.00E-01	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	1.20E+02	days	
Calculated decay rate	λ	5.78E-03	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	1.90E+02	m	
Plume thickness at source	Sy	1.00E+01	m	
Saturated aquifer thickness	da	1.08E+01	m	
Bulk density of aquifer materials	ρ	1.70E+00	g/cm^3	
Effective porosity of aquifer	n	1.82E-01	fraction	
Hydraulic gradient	i	1.25E-02	fraction	
Hydraulic conductivity of aquifer	K	2.00E+01	m/d	
Distance to compliance point	x	5.92E+02	m	
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	2.63E+01	l/kg	*see options*
Longitudinal dispersivity	ax	9.730	m	*see options*
Transverse dispersivity	az	0.973	m	*see options*
Vertical dispersivity	ay	0.097	m	*see options*

Calculated Parameters	Variable		
Groundwater flow velocity	v	1.37E+00	m/d
Retardation factor	Rf	2.47E+02	fraction
Decay rate used	λ	5.78E-03	d^{-1}
Rate of contaminant flow due to retardation	u	5.57E-03	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	3.34E-73	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	1.85E-73	mg/l
Attenuation factor (one way vertical dispersion, C_0/C_{ED})	AF	8.97E+71	
Attenuation factor (two way vertical dispersion, C_0/C_{ED})	AF	1.62E+72	

Remedial Targets

Remedial Target	LTC3	5.61E+66	mg/l	For comparison with measured groundwater concentration.
Ogata Banks				
Distance to compliance point		**592**	**m**	
Concentration of contaminant at compliance point	$C_{ED}/C0$	**3.34E-73**	**mg/l**	Ogata Banks
after		**9.9E+99**	**days**	

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 dorm menu)

Calculate for non-polar organic chemicals

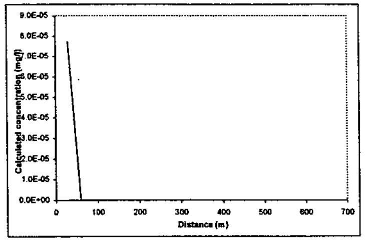
Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd	[redacted]	l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	1.00E+00	fraction
Organic carbon partition coefficient	Koc	2.63E+01	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$	[redacted]	l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Soil water partition coefficient	Kd	2.63E+01	l/kg

Dispersivity

Calculate dependant on distance to compliance point (0), specify dispersivity (1), or calc after Xu & Eckstein (2) ? 2

		Enter value	Calc value Xu & Eckstein	
Longitudinal dispersivity	ax	[redacted]	9.73E+00	m
Transverse dispersivity	az		9.73E-01	m
Vertical dispersivity	ay		9.73E-02	m

For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report $ax = 0.83(\log_{10}x)^{2.414}$; 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.

This sheet calculates the Tier3 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

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 Tier 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.

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration mg/l
n.o	7.7E-05
59.2	2.0E-08
88.8	5.1E-12
118.4	1.3E-15
148.0	3.2E-19
177.6	8.1E-23
207.2	2.0E-26
236.8	5.1E-30
266.4	1.3E-33
296.0	3.2E-37
325.6	8.1E-41
355.2	2.0E-44
384.8	5.1E-48
444.0	3.2E-55
473.6	8.2E-59
503.2	2.1E-62
532.8	5.2E-66
562.4	1.3E-69
592.0	3.3E-73

Site being assessed:	Bless Area 1 Murphys K20
Completed by:	AJ
Date:	24 11 2005
Version:	12

R&D Publication20 Remedial Targets Worksheet, Release 2.2a

ENVIRONMENT AGENCY

Tier 3 -Groundwater

Input Parameters (using pull down menu)	Variable	Value	Unit	Source
Contaminant		Lead		
Target Concentration	C_T	1.00E-02	mg/l	

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

Ogata Banks — Equations in R&D Pub. 20

Enter '1' to simulate vertical dispersion in one direction, '2' for two directions (pull down menu): 1

Enter '1' if biodegradation rate is for the substance in water,
'0' if rate is for decay in field conditions (i.e. field data from aquifer) (pull down menu: 0

	Variable	Value	Unit	Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	7.50E-02	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	9.90E+99	days	
Calculated decay rate	λ	7.00E-101	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	1.90E+02	m	
Plume thickness at source	Sy	1.00E+01	m	
Saturated aquifer thickness	da	1.08E+01	m	
Bulk density of aquifer materials	ρ	1.70E+00	g/cm^3	
Effective porosity of aquifer	n	1.82E-01	fraction	
Hydraulic gradient	i	1.25E-02	fraction	
Hydraulic conductivity of aquifer	K	2.00E+01	m/d	
Distance to compliance point	x	5.92E+02	m	
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	3.16E+04	l/kg	*see options*
Longitudinal dispersivity	ax	9.730	m	*see options*
Transverse dispersivity	az	0.973	m	*see options*
Vertical dispersivity	ay	0.097	m	*see options*

Calculated Parameters	Variable		
Groundwater flow velocity	v	1.37E+00	m/d
Retardation factor	Rf	2.95E+05	fraction
Decay rate used	λ	7.00E-101	d^{-1}
Rate of contaminant flow due to retardation	u	4.65E-06	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	4.84E-02	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	2.68E-02	mg/l
Attenuation factor (one way vertical dispersion, C_O/C_{ED})	AF	1.55E+00	
Attenuation factor (two way vertical dispersion, C_O/C_{ED})	AF	2.80E+00	

Remedial Targets

Remedial Target	LTC3	1.55E-02	mg/l

For comparison with measured groundwater concentration.

Ogata Banks

Distance to compliance point		592	m	
Concentration of contaminant at compliance point	$C_{ED}/C0$	4.84E-02	mg/l	Ogata Banks
after		9.9E+99	days	

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

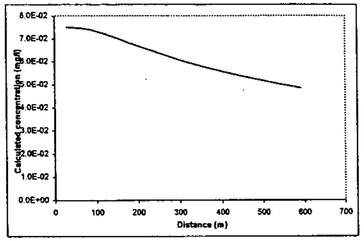
Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd		l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	1.00E+00	fraction
Organic carbon partition coefficient	Koc	3.16E+04	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$		l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Soil water partition coefficient	Kd	3.16E+04	l/kg

Dispersivity

Calculate dependant on distance to compliance point (0), specify dispersivity (1), or calc after Xu & Eckstein (2) ? 2

		Enter value	Calc value Xu & Eckstein	
Longitudinal dispersivity	ax		9.73E+00	m
Transverse dispersivity	az		9.73E-01	m
Vertical dispersivity	ay		9.73E-02	m

For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, av = 0.001 * x
Xu & Eckstein (1995) report ax = 0.83$(\log_{10}x)^{2.414}$; 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.

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration
	mg/l
29.6	7.5E-02
59.2	7.5E-02
88.8	7.4E-02
148.0	7.0E-02
177.6	6.8E-02
207.2	6.6E-02
236.8	6.4E-02
266.4	6.3E-02
296.0	6.1E-02
325.6	5.9E-02
355.2	5.8E-02
384.8	5.6E-02
414.4	5.5E-02
444.0	5.4E-02
473.1	5.3E-02
603.2	5.1E-02
532.8	5.0E-02
562.4	4.9E-02
592.0	4.8E-02

This sheet calculates the Tier3 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

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 Tier 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.

Site being assessed	Bless Area 1 A murphy K20
Completed by:	AJ
Date.	24 11 2005
Version	12

R&D Publication 20 Remedial Targets Worksheet, Release 2.2a

Tier 3 - Groundwater

ENVIRONMENT AGENCY

Input Parameters (using pull down menu)	Variable	Value	Unit	Source
Contaminant		Phenanthrene		
Target Concentration	C_T	6.25E-06	mg/l	

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

Ogata Banks — Equations in R&D Pub. 20

Enter '1' to simulate vertical dispersion in one direction, '2' for two directions (pull down menu): 1

Enter '1' if biodegradation rate is for the substance in water, '0' if rate is for decay in field conditions (i.e. field data from aquifer) (pull down menu): 0

	Variable	Value	Unit	Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	1.30E+00	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	4.00E+02	days	
Calculated decay rate	λ	1.73E-03	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	1.90E+02	m	
Plume thickness at source	Sy	1.00E+01	m	
Saturated aquifer thickness	da	1.08E+01	m	
Bulk density of aquifer materials	ρ	1.70E+00	g/cm^3	
Effective porosity of aquifer	n	1.82E-01	fraction	
Hydraulic gradient	i	1.25E-02	fraction	
Hydraulic conductivity of aquifer	K	2.00E+01	m/d	
Distance to compliance point	x	5.92E+02	m	
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	5.13E+01	l/kg	*see options*
Longitudinal dispersivity	ax	9.730	m	*see options*
Transverse dispersivity	az	0.973	m	*see options*
Vertical dispersivity	ay	0.097	m	*see options*

Calculated Parameters	Variable		
Groundwater flow velocity	v	1.37E+00	m/d
Retardation factor	Rf	4.80E+02	fraction
Decay rate used	λ	1.73E-03	d^{-1}
Rate of contaminant flow due to retardation	u	2.86E-03	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	4.49E-53	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	2.48E-53	mg/l
Attenuation factor (one way vertical dispersion, C_0/C_{ED})	AF	2.89E+52	
Attenuation factor (two way vertical dispersion, C_0/C_{ED})	AF	5.23E+52	

Remedial Targets

Remedial Target Ogata Banks	LTC3	1.91E+47	mg/l	For comparison with measured groundwater concentration.
Distance to compliance point		592	m	
Concentration of contaminant at compliance point	$C_{ED}/C0$	4.49E-53	mg/l	Ogata Banks
after		9.9E+99	days	

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

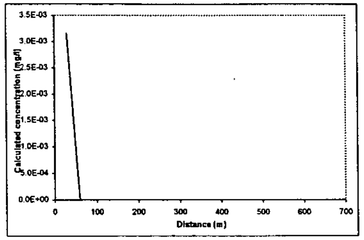
Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd	[redacted]	l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	1.00E+00	fraction
Organic carbon partition coefficient	Koc	5.13E+01	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$	[redacted]	l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Soil water partition coefficient	Kd	5.13E+01	l/kg

Dispersivity

Calculate dependant on distance to compliance point (0), specify dispersivity (1), or calc after Xu & Eckstein (2) ? 2

		Enter value	Calc value Xu & Eckstein	
Longitudinal dispersivity	ax	[redacted]	9.73E+00	m
Transverse dispersivity	az		9.73E-01	m
Vertical dispersivity	ay		9.73E-02	m

For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report ax = $0.83(\log_{10}x)^{2.414}$; 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.

This sheet calculates the Tier3 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

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 Tier 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.

Calculated concentrations for distance-concentration graph

Ogata Banks

DistanceConcentration	mg/l
29.6	3.2E-03
59.2	7.7E-06
88.8	1.8E-08
118.4	4.4E-11
148.0	1.0E-13
177.6	2.5E-16
2072	5.8E-19
236.8	1.4E-21
266.4	3.3E-24
296.0	7.7E-27
326.6	1.8E-29
355.2	4.3E-32
384.8	1.0E-34
414.4	2.5E-37
473.6	5.8E-40
503.2	3.3E-45
532.8	7.9E-48
562.4	1.9E-50
592.0	4.5E-53

Site being assessed	Bless Area 1 Murphys K20
Completed by	AJ
Date	24 11 2005
Version.	12

R&D Publication 20 Remedial Targets Worksheet, Release 2.2a

ENVIRONMENT AGENCY

Tier 3 -Groundwater

Input Parameters (using pull down menu)	Variable	Value	Unit	Source
Contaminant		Phenol		
Target Concentration	C_T	5.00E-04	mg/l	

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

Ogata Banks — Equations in R&D Pub. 20

Enter '1' to simulate vertical dispersion in one direction, '2' for two directions (pull down menu): 1

Enter '1' if biodegradation rate is for the substance in water,
'0' if rate is for decay in field conditions (i.e. field data from aquifer) (pull down menu: 0

				Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	5.00E-01	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	1.00E+01	days	
Calculated decay rate	λ	6.93E-02	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	1.90E+02	m	
Plume thickness at source	Sy	1.00E+01	m	
Saturated aquifer thickness	da	1.08E+01	m	
Bulk density of aquifer materials	ρ	1.70E+00	g/cm^3	
Effective porosity of aquifer	n	1.82E-01	fraction	
Hydraulic gradient	i	1.25E-02	fraction	
Hydraulic conductivity of aquifer	K	2.00E+01	m/d	
Distance to compliance point	x	5.92E+02	m	
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	1.05E-01	l/kg	*see options*
Longitudinal dispersivity	ax	9.730	m	*see options*
Transverse dispersivity	az	0.973	m	*see options*
Vertical dispersivity	ay	0.097	m	*see options*

Calculated Parameters	Variable		
Groundwater flow velocity	v	1.37E+00	m/d
Retardation factor	Rf	1.98E+00	fraction
Decay rate used	λ	6.93E-02	d^{-1}
Rate of contaminant flow due to retardation	u	6.94E-01	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	3.32E-17	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	1.83E-17	mg/l
Attenuation factor (one way vertical dispersion, C_0/C_{ED})	AF	1.51E+16	
Attenuation factor (two way vertical dispersion, C_0/C_{ED})	AF	2.73E+16	

Remedial Targets

Remedial Target	LTC3	7.54E+12	mg/l

For comparison with measured groundwater concentration.

Ogata Banks

Distance to compliance point		592	m	
Concentration of contaminant at compliance point	$C_{ED}/C0$	3.32E-17	mg/l	Ogata Banks
after		9.9E+99	days	

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

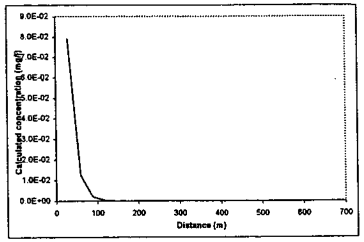
Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd	[redacted]	l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	1.00E+00	fraction
Organic carbon partition coefficient	Koc	1.05E-01	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$	[redacted]	l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Soil water partition coefficient	Kd	1.05E-01	l/kg

Dispersivity

Calculate dependant on distance to compliance point (0), specify dispersivity (1), or calc after Xu & Eckstein (2) ? 2

		Enter value	Calc value	Xu & Eckstein	
Longitudinal dispersivity	ax	[redacted]		9.73E+00	m
Transverse dispersivity	az			9.73E-01	m
Vertical dispersivity	ay			9.73E-02	m

For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report $ax = 0.83(\log_{10}x)^{2.414}$; 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.

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration
	mg/l
29.6	7.9E-02
59.2	1.3E-02
88.8	2.0E-03
118.4	3.1E-04
148.0	4.7E-05
177.6	7.3E-06
236.8	1.7E-06
266.4	2.7E-08
296.0	4.1E-09
325.6	6.4E-10
355.2	9.8E-11
384.8	1.5E-11
414.4	2.4E-12
444.0	3.7E-13
471.6	5.7E-14
503.2	8.8E-15
532.8	1.4E-15
562.4	2.1E-16
682.0	3.3E-17

This sheet calculates the Tier3 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

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 Tier 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.

Site being assessed	Bless Area 1 A murphy K20
Completed by	AJ
Date:	24 11 2005
Version	12

ENVIRONMENT AGENCY

R&D Publication20 Remedial Targets Worksheet, Release 2.2a

Tier 3 -Groundwater

Input Parameters (using pull down menu)	Variable	Value	Unit	Source
Contaminant		Phosphorus		
Target Concentration	C_T	2.20E+00	mg/l	

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

Ogata Banks — Equations in R&D Pub. 20

Enter '1' to simulate vertical dispersion in one direction, '2' for two directions (pull down menu): 1

Enter '1' if biodegradation rate is for the substance in water,
'0' if rate is for decay in field conditions (i.e. field data from aquifer) (pull down menu): 0

				Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	1.03E+00	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	9.90E+99	days	
Calculated decay rate	λ	7.00E-101	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	1.90E+02	m	
Plume thickness at source	Sy	1.00E+01	m	
Saturated aquifer thickness	da	1.08E+01	m	
Bulk density of aquifer materials	ρ	1.70E+00	g/cm^3	
Effective porosity of aquifer	n	1.82E-01	fraction	
Hydraulic gradient	i	1.25E-02	fraction	
Hydraulic conductivity of aquifer	K	2.00E+01	m/d	
Distance to compliance point	x	5.92E+02	m	
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	0.00E+00	l/kg	*see options*
Longitudinal dispersivity	ax	9.730	m	*see options*
Transverse dispersivity	az	0.973	m	*see options*
Vertical dispersivity	ay	0.097	m	*see options*

Calculated Parameters	Variable		
Groundwater flow velocity	v	1.37E+00	m/d
Retardation factor	Rf	1.00E+00	fraction
Decay rate used	λ	7.00E-101	d^{-1}
Rate of contaminant flow due to retardation	u	1.37E+00	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	6.65E-01	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	3.68E-01	mg/l
Attenuation factor (one way vertical dispersion, C_0/C_{ED})	AF	1.55E+00	
Attenuation factor (two way vertical dispersion, C_0/C_{ED})	AF	2.80E+00	

Remedial Targets

Remedial Target	LTC3	3.41E+00	mg/l

For comparison with measured groundwater concentration.

Ogata Banks

Distance to compliance point		**592**	**m**	
Concentration of contaminant at compliance point	$C_{ED}/C0$	**6.65E-01**	**mg/l**	**Ogata Banks**
after		**9.9E+99**	**days**	

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

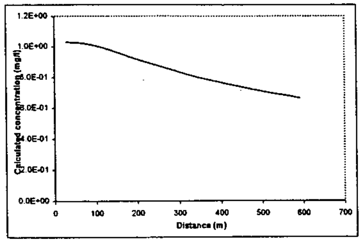
Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd		l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	1.00E+00	fraction
Organic carbon partition coefficient	Koc	0.00E+00	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$		l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Soil water partition coefficient	Kd	0.00E+00	l/kg

Dispersivity

Calculate dependant on distance to compliance point (0), specify dispersivity (1), or calc after Xu & Eckstein (2) ? 2

		Enter value	Calc value Xu & Eckstein	
Longitudinal dispersivity	**ax**		9.73E+00	m
Transverse dispersivity	**az**		9.73E-01	m
Vertical dispersivity	**ay**		9.73E-02	m

For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report ax = 0.83$(\log_{10}x)^{2.414}$; 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.

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	**Concentration**
	mg/l
29.6	**1.0E+00**
59.2	**1.0E+00**
88.8	**1.0E+00**
118.4	**9.9E-01**
148.0	**9.7E-01**
177.6	**9.4E-01**
207.2	**9.1E-01**
236.8	**8.9E-01**
266.4	**8.6E-01**
296.0	**8.4E-01**
325.6	**8.1E-01**
355.2	**7.9E-01**
384.8	**7.7E-01**
414.4	**7.6E-01**
444.0	**7.4E-01**
473.6	**7.2E-01**
503.2	**7.1E-01**
532.8	**6.9E-01**
562.4	**6.8E-01**
592.0	**6.6E-01**

This sheet calculates the Tier3 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

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 Tier 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.

Site being assessed	Bless Area 1 A murphy K20
Completed by	AJ
Date.	24 11 2005
Version	12

R&D Publication 20 Remedial Targets Worksheet, Release 2.2a

Tier 3 - Groundwater

ENVIRONMENT AGENCY

Input Parameters (using pull down menu)

	Variable	Value	Unit	Source
Contaminant		Pyrene		
Target Concentration	C_T	6.25E-06	mg/l	

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

Ogata Banks — Equations in R&D Pub. 20

Enter '1' to simulate vertical dispersion in one direction, '2' for two directions (pull down menu): 1

Enter '1' if biodegradation rate is for the substance in water,
'0' if rate is for decay in field conditions (i.e. field data from aquifer) (pull down menu: 0

	Variable	Value	Unit	Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	6.00E-01	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	3.80E+03	days	
Calculated decay rate	λ	1.82E-04	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	1.90E+02	m	
Plume thickness at source	Sy	1.00E+01	m	
Saturated aquifer thickness	da	1.08E+01	m	
Bulk density of aquifer materials	ρ	1.70E+00	g/cm^3	
Effective porosity of aquifer	n	1.82E-01	fraction	
Hydraulic gradient	i	1.25E-02	fraction	
Hydraulic conductivity of aquifer	K	2.00E+01	m/d	
Distance to compliance point	x	5.92E+02	m	
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	1.38E+02	l/kg	*see options*
Longitudinal dispersivity	ax	9.730	m	*see options*
Transverse dispersivity	az	0.973	m	*see options*
Vertical dispersivity	ay	0.097	m	*see options*

Calculated Parameters

	Variable		
Groundwater flow velocity	v	1.37E+00	m/d
Retardation factor	Rf	1.29E+03	fraction
Decay rate used	λ	1.82E-04	d^{-1}
Rate of contaminant flow due to retardation	u	1.06E-03	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	1.64E-24	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	9.07E-25	mg/l
Attenuation factor (one way vertical dispersion, C_O/C_{ED})	AF	3.66E+23	
Attenuation factor (two way vertical dispersion, C_O/C_{ED})	AF	6.62E+23	

Remedial Targets

Remedial Target LTC3 2.29E+18 mg/l — For comparison with measured groundwater concentration.
Ogata Banks

Distance to compliance point 592 m

Concentration of contaminant at compliance point $C_{ED}/C0$ 1.64E-24 mg/l Ogata Banks
after 9.9E+99 days

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

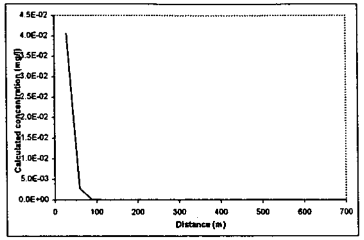
Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd	[redacted]	l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	1.00E+00	fraction
Organic carbon partition coefficient	Koc	1.38E+02	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$	[redacted]	l/kg
Sorption coefficient for ionised species	$K_{oc,i}$	[redacted]	l/kg
pH value	pH	[redacted]	
acid dissociation constant	pKa	[redacted]	
Soil water partition coefficient	Kd	1.38E+02	l/kg

Dispersivity

Calculate dependant on distance to compliance point (0), specify dispersivity (1), or calc after Xu & Eckstein (2) ? 2

		Enter value	Calc value Xu & Eckstein	
Longitudinal dispersivity	**ax**	[redacted]	9.73E+00	m
Transverse dispersivity	**az**	[redacted]	9.73E-01	m
Vertical dispersivity	**ay**	[redacted]	9.73E-02	m

For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report ax = $0.83(\log_{10}x)^{2.414}$; 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.

This sheet calculates the Tier3 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

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 Tier 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.

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration mg/l
29.6	4.1E-02
59.2	2.8E-03
88.8	1.8E-04
118.4	1.2E-05
148.0	8.1E-07
177.6	5.3E-08
207.2	3.5E-09
236.8	2.3E-10
266.4	1.5E-11
296.0	1.0E-12
325.6	6.6E-14
355.2	4.4E-15
384.8	2.9E-16
414.4	1.9E-17
444.0	1.3E-18
473.6	8.4E-20
503.2	5.6E-21
532.8	3.7E-22
562.4	2.5E-23
592.0	1.6E-24

Site being assessed	Bless Area 1 Murphys K20
Completed by	AJ
Date:	24 11 2005
Version.	12

R&D Publication 20 Remedial Targets Worksheet, Release 2.2a

Tier 3 - Groundwater

ENVIRONMENT
AGENCY

Input Parameters (using pull down menu)	Variable	Value	Unit	Source
Contaminant		Selenium		
Target Concentration	C_T	1.00E-02	mg/l	

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

Ogata Banks — Equations in R&D Pub. 20

Enter '1' to simulate vertical dispersion in one direction, '2' for two directions (pull down menu): 1

Enter '1' if biodegradation rate is for the substance in water,
'0' if rate is for decay in field conditions (i.e. field data from aquifer) (pull down menu: 0

	Variable	Value	Unit	Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	2.00E-03	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	9.90E+99	days	
Calculated decay rate	λ	7.00E-101	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	1.90E+02	m	
Plume thickness at source	Sy	1.00E+01	m	
Saturated aquifer thickness	da	1.08E+01	m	
Bulk density of aquifer materials	ρ	1.70E+00	g/cm^3	
Effective porosity of aquifer	n	1.82E-01	fraction	
Hydraulic gradient	i	1.25E-02	fraction	
Hydraulic conductivity of aquifer	K	2.00E+01	m/d	
Distance to compliance point	x	5.92E+02	m	
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	9.55E+00	l/kg	*see options*
Longitudinal dispersivity	ax	9.730	m	*see options*
Transverse dispersivity	az	0.973	m	*see options*
Vertical dispersivity	ay	0.097	m	*see options*

Calculated Parameters	Variable		
Groundwater flow velocity	v	1.37E+00	m/d
Retardation factor	Rf	9.02E+01	fraction
Decay rate used	λ	7.00E-101	d^{-1}
Rate of contaminant flow due to retardation	u	1.52E-02	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	1.29E-03	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	7.14E-04	mg/l
Attenuation factor (one way vertical dispersion, C_0/C_{ED})	AF	1.55E+00	
Attenuation factor (two way vertical dispersion, C_0/C_{ED})	AF	2.80E+00	

Remedial Targets

Remedial Target	LTC3	1.55E-02	mg/l	For comparison with measured groundwater concentration.
Ogata Banks				
Distance to compliance point		**592**	**m**	
Concentration of contaminant at compliance point	$C_{ED}/C0$	**1.29E-03**	**mg/l**	Ogata Banks
after		**9.9E+99**	**days**	

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

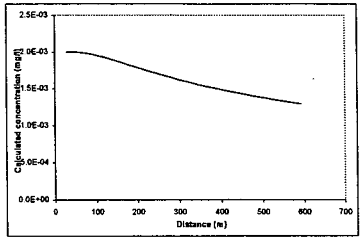
Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd		l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	1.00E+00	fraction
Organic carbon partition coefficient	Koc	9.55E+00	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$		l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Soil water partition coefficient	Kd	9.55E+00	l/kg

Dispersivity

Calculate dependant on distance to compliance point (0), specify dispersivity (1), or calc after Xu & Eckstein (2) ? 2

		Enter value	Calc value Xu & Eckstein	
Longitudinal dispersivity	ax		9.73E+00	m
Transverse dispersivity	az		9.73E-01	m
Vertical dispersivity	ay		9.73E-02	m

For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report $ax = 0.83(\log_{10}x)^{2.414}$; 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.

This sheet calculates the Tier3 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

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 Tier 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.

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration mg/l
29.6	2.0E-03
69.2	2.0E-03
88.8	2.0E-03
119.4	1.9E-03
148.0	1.9E-03
177.6	1.8E-03
207.2	1.8E-03
236.8	1.7E-03
266.4	1.7E-03
296.0	1.6E-03
325.6	1.6E-03
355.2	1.5E-03
384.8	1.5E-03
414.4	1.6E-03
444.0	1.4E-03
473.9	1.4E-03
503.2	1.4E-03
532.8	1.3E-03
562.4	1.3E-03
592.0	1.3E-03

Site being assessed	Bless Area 1 A murphy K20
Completed by:	AJ
Date:	24 11 2005
Version	12

R&D Publication 20 Remedial Targets Worksheet, Release 2.2a

Tier 3 - Groundwater

ENVIRONMENT AGENCY

Input Parameters (using pull down manu)	Variable	Value	Unit	Source
Contaminant		Strontium		
Target Concentration	C_T	1.00E+00	mg/l	

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

Ogata Banks — Equations in R&D Pub. 20

Enter '1' to simulate vertical dispersion in one direction, '2' for two directions (pull down menu): 1

Enter '1' if biodegradation rate is for the substance in water, '0' if rate is for decay in field conditions (i.e. field data from aquifer) (pull down menu): 0

				Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	4.90E-01	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	9.90E+99		
Calculated decay rate	λ	7.00E-101	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	1.90E+02	m	
Plume thickness at source	Sy	1.00E+01	m	
Saturated aquifer thickness	da	1.08E+01	m	
Bulk density of aquifer materials	ρ	1.70E+00	g/cm^3	
Effective porosity of aquifer	n	1.82E-01	fraction	
Hydraulic gradient	i	1.25E-02	fraction	
Hydraulic conductivity of aquifer	K	2.00E+01	m/d	
Distance to compliance point	x	5.92E+02		
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00		
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	0 00E+00	l/kg	*see options*
Longitudinal dispersivity	ax		m	*see options*
Transverse dispersivity	az		m	*see options*
Vertical dispersivity	ay		m	*see options*

Calculated Parameters	Variable		
Groundwater flow velocity	v	1.37E+00	m/d
Retardation factor	Rf	1.00E+00	fraction
Decay rate used	λ	7.00E-101	d^{-1}
Rate of contaminant flow due to retardation	u	1.37E+00	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	3.16E-01	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	1.75E-01	mg/l
Attenuation factor (one way vertical dispersion, C_O/C_{ED})	AF	1.55E+00	
Attenuation factor (two way vertical dispersion, C_O/C_{ED})	AF	2.80E+00	

Remedial Targets

Remedial Target	LTCS	1.55E+00	mg/l	For comparison with measured groundwater concentration.
Ogata Banks				
Distance to compliance point		**592**	**m**	
Concentration of contaminant at compliance point	$C_{ED}/C0$	**3.16E-01**	**mg/l**	Ogata Banks
after		**9.9E+99**	**days**	

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

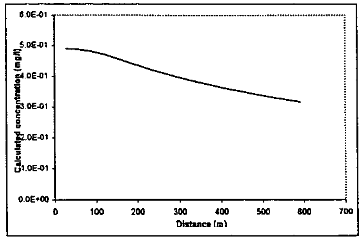
Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd		l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	1.00E+00	fraction
Organic carbon partition coefficient	Koc	0.00E+00	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$		l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Soil water partition coefficient	Kd	0.00E+00	l/kg

Dispersivity

Calculate dependant on distance to compliance point (0), specify dispersivity (1), or calc after Xu & Eckstein (2) ? 2

		Enter value	Calc value Xu & Eckstein	
Longitudinal dispersivity	ax		9.73E+00	m
Transverse dispersivity	az		9.73E-01	m
Vertical dispersivity	ay		9.73E-02	m

For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report $ax = 0.83(\log_{10}x)^{2.414}$; 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.

Calculated concentrations for distance-concentration graph

Ogata Banks

BistarcalcConcentration	mg/l
29.8	4.9E-01
69.2	4.9E-01
88.8	4.8E-01
118.4	4.7E-01
148.0	4.6E-01
177.8	4.5E-01
207.2	4.3E-01
236.1	4.2E-01
296.4	4.1E-01
296.0	4.0E-01
325.6	3.9E-01
366.2	3.8E-01
384.8	3.7E-01
414.4	3.6E-01
444.0	3.5E-01
473.6	5.4E-01
W3.2	3.4E-01
532.8	3.3E-01
662.4	3.2E-01
592.0	3.2E-01

This sheet calculates the Tier3 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

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 Tier 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.

Site being assessed:	Bless Area 1 A murphy K20
Completed by:	AJ
Date:	24 11 2005
Version:	12

R&D Publication 20 Remedial Targets Worksheet, Release 2.2a

Tier 3 - Groundwater

ENVIRONMENT AGENCY

Input Parameters (using pull down menu)	Variable	Value	Unit	Source
Contaminant		Sulphate		
Target Concentration	C_T	2.00E+02	mg/l	

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

Ogata Banks Equations in R&D Pub. 20

Enter'l to simulate vertical dispersion in one direction, '2' for two directions (pull down menu) 1

Enter '1' if biodegradation rate is for the substance in water,
'0' if rate is for decay in field conditions (i.e. field data from aquifer) (pull down menu 0

	Variable	Value	Unit	Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	4.20E+01	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	9.90E+99	days	
Calculated decay rate	λ	7.00E-101	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	1.90E+02	m	
Plume thickness at source	Sy	1.00E+01	m	
Saturated aquifer thickness	da	1.06E+01	m	
Bulk density of aquifer materials	ρ	1.70E+00	g/cm^3	
Effective porosity of aquifer	n	1.82E-01	fraction	
Hydraulic gradient	i	1.25E-02	fraction	
Hydraulic conductivity of aquifer	K	2.00E+01	m/d	
Distance to compliance point	x	5.92E+02	m	
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	0.00E+00	l/kg	*see options*
Longitudinal dispersivity	ax	9.730	m	*see options*
Transverse dispersivity	az	0.973	m	*see options*
Vertical dispersivity	ay	0.097	m	*see options*

Calculated Parameters	Variable		
Groundwater flow velocity	v	1.37E+00	m/d
Retardation factor	Rf	1.00E+00	fraction
Decay rate used	λ	7.00E-101	d^{-1}
Rate of contaminant flow due to retardation	u	1.37E+00	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	2.71E+01	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	1.50E+01	mg/l
Attenuation factor (one way vertical dispersion, C_0/C_{ED})	AF	1.55E+00	
Attenuation factor (two way vertical dispersion, C_0/C_{ED})	AF	2.80E+00	

Remedial Targets

Remedial Target	LTC3	3.10E+02	mg/l

For comparison with measured groundwater concentration.

Ogata Banks

Distance to compliance point 592 m

Concentration of contaminant at compliance point $C_{ED}/C0$ 2.71E+01 mg/l Ogata Banks
after 9.9E+99 days

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

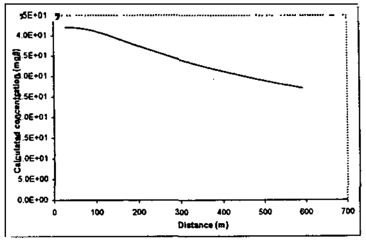
Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd	[redacted]	l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	1.00E+00	fraction
Organic carbon partition coefficient	Koc	0.00E+00	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$	[redacted]	l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	*pKa*		
Soil water partition coefficient	Kd	0.00E+00	l/kg

Dispersivity

Calculate dependant on distance to compliance point (0), specify dispersivity (1), or calc after Xu & Eckstein (2) ? 2

		Enter value	Calc value Xu & Eckstein	
Longitudinal dispersivity	ax	[redacted]	9.73E+00	m
Transverse dispersivity	az		9.73E-01	m
Vertical dispersivity	ay		9.73E-02	m

For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report ax = $0.83(\log_{10}x)^{2.414}$; 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.

This sheet calculates the Tier3 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

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 Tier 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

Calculated concentrations for distance-concentration graph

Ogata Banks

DistancalcConcentration	mg/l
29.6	4.2E+01
69.2	4.2E+01
88.8	4.1E+01
148.0	4.0E+01
177.8	3.8E+01
207.2	3.7E+01
266.8	3.6E+01
296.0	3.4E+01
325.6	3.3E+01
355.2	3.2E+01
384.8	3.2E+01
414.4	3.1E+01
444.0	3.0E+01
473.0	2.9E+01
503.2	2.9E+01
532.8	2.8E+01
592.0	2.7E+01

Site being assessed	Sless Area 1 A murphy K20
Completed by.	AJ
Date	24 11 2005
Version	12

R&D Publication 20 Remedial Targets Worksheet. Release 2.2a

Tier 3 - Groundwater

ENVIRONMENT AGENCY

Input Parameters (using pull down menu)

Input Parameters (using pull down menu)	Variable	Value	Unit	Source
Contaminant		Sulphide		
Target Concentration	C_T	2.50E-04	mg/l	

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

Ogata Banks — Equations in R&D Pub. 20

Enter '1' to simulate vertical dispersion in one direction, '2' for two directions (pull down menu) 1

Enter '1' if biodegradation rate is for the substance in water,
'0' if rate is for decay in field conditions (i.e. field data from aquifer) (pull down menu 0

				Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	1.50E-01	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	9.90E+99	days	
Calculated decay rate	λ	7.00E-101	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	1.90E+02	m	
Plume thickness at source	Sy	1.00E+01	m	
Saturated aquifer thickness	da	1.08E+01	m	
Bulk density of aquifer materials	ρ	1.70E+00	g/cm^3	
Effective porosity of aquifer	n	1.82E-01	fraction	
Hydraulic gradient	i	1.25E-02	fraction	
Hydraulic conductivity of aquifer	K	2.00E+01	m/d	
Distance to compliance point	x	5.92E+02	m	
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	0.00E+00	l/kg	*see options*
Longitudinal dispersivity	ax	9.730	m	*see options*
Transverse dispersivity	az	0.973	m	*see options*
Vertical dispersivity	ay	0.097	m	*see options*

Calculated Parameters

Calculated Parameters	Variable		
Groundwater flow velocity	v	1.37E+00	m/d
Retardation factor	Rf	1.00E+00	fraction
Decay rate used	λ	7.00E-101	d^{-1}
Rate of contaminant flow due to retardation	u	1.37E+00	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	9.68E-02	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	5.35E-02	mg/l
Attenuation factor (one way vertical dispersion, C_0/C_{ED})	AF	1.55E+00	
Attenuation factor (two way vertical dispersion, C_0/C_{ED})	AF	2.80E+00	

Remedial Targets

Remedial Target	**LTC3**	**3.97E-04**	**mg/l**	For comparison with measured groundwater concentration.
Ogata Banks				
Distance to compliance point		**592**	**m**	
Concentration of contaminant at compliance point	**$C_{ED}/C0$**	**9.68E-02**	**mg/l**	Ogata Banks
after		**9.9E+99**	**days**	

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

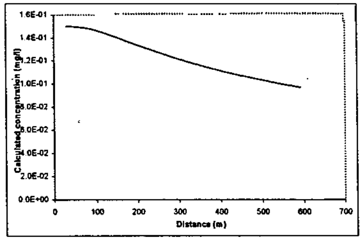
Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd		l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	1.00E+00	fraction
Organic carbon partition coefficient	Koc	0.00E+00	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$		l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Soil water partition coefficient	Kd	0.00E+00	l/kg

Dispersivity

Calculate dependant on distance to compliance point (0), specify dispersivity (1), or calc after Xu & Eckstein (2) ? 2

		Enter value	Calc value Xu & Eckstein	
Longitudinal dispersivity	ax		9.73E+00	m
Transverse dispersivity	az		9.73E-01	m
Vertical dispersivity	ay		9.73E-02	m

For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report ax = $0.83(\log_{10}x)^{2.414}$; 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.

This sheet calculates the Tier3 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

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 Tier 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.

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration
	mg/l
29.6	1.5E-01
59.2	1.5E-01
88.8	1.5E-01
118.4	1.4E-01
148.0	1.4E-01
177.6	1.4E-01
207.2	1.3E-01
236.8	1.3E-01
266.4	1.3E-01
296.0	1.2E-01
325.6	1.2E-01
355.2	1.2E-01
384.8	1.1E-01
414.4	1.1E-01
444.0	1.1E-01
473.6	1.1E-01
503.2	1.0E-01
532.8	1.0E-01
562.4	9.9E-02
592.0	9.7E-02

Site being assessed.	Bless Area 1 A murphy K20
Completed by	AJ
Date.	24 11 2005
Version	12

R&D Publication20 Remedial Targets Worksheet, Release 2.2a

Tier 3 - Groundwater

ENVIRONMENT AGENCY

Input Parameters (using cull down menu)	Variable	Value	Unit	Source
Contaminant		tert Butylbenzene		
Target Concentration	C_T	1.00E-03	mg/l	

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

Ogata Banks — Equations in R&D Pub. 20

Enter '1' to simulate vertical dispersion in one direction, '2' for two directions (pull down menu) 1

Enter '1' if biodegradation rate is for the substance in water,
'0' if rate is for decay in field conditions (i.e. field data from aquifer) (pull down menu 0

				Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	9.90E-99	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	9.99E+99	days	
Calculated decay rate	λ	6.94E-101	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	1.90E+02	m	
Plume thickness at source	Sy	1.00E+01	m	
Saturated aquifer thickness	da	1.08E+01	m	
Bulk density of aquifer materials	ρ	1.70E+00	g/cm^3	
Effective porosity of aquifer	n	1.82E-01	fraction	
Hydraulic gradient	i	1.25E-02	fraction	
Hydraulic conductivity of aquifer	K	2.00E+01	m/d	
Distance to compliance point	x	5.92E+02	m	
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	2.14E-01	l/kg	*see options*
Longitudinal dispersivity	ax	9.730	m	*see options*
Transverse dispersivity	az	0.973	m	*see options*
Vertical dispersivity	ay	0.097	m	*see options*

Calculated Parameters	Variable		
Groundwater flow velocity	v	1.37E+00	m/d
Retardation factor	Rf	3.00E+00	fraction
Decay rate used	λ	6.94E-101	d^{-1}
Rate of contaminant flow due to retardation	u	4.58E-01	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	6.39E-99	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	3.53E-99	mg/l
Attenuation factor (one way vertical dispersion, C_0/C_{ED})	AF	1.55E+00	
Attenuation factor (two way vertical dispersion, C_0/C_{ED})	AF	2.80E+00	

Remedial Targets

Remedial Target	LTC3	1.55E-03	mg/l	For comparison with measured groundwater concentration.
Ogata Banks				
Distance to compliance point		592	m	
Concentration of contaminant at compliance point	$C_{ED}/C0$	6.39E-99	mg/l	Ogata Banks
after		9.9E+99	days	

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

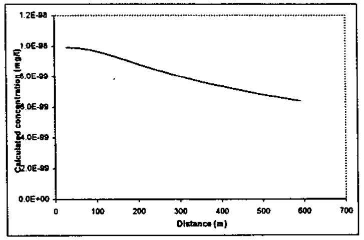
Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd		l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	1.00E+00	fraction
Organic carbon partition coefficient	Koc	2.14E-01	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$		l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Soil water partition coefficient	Kd	2.14E-01	l/kg

Dispersivity

Calculate dependant on distance to compliance point (0), specify dispersivity (1), or calc after Xu & Eckstein (2) ? 2

		Enter value	Calc value Xu & Eckstein	
Longitudinal dispersivity	ax		9.73E+00	m
Transverse dispersivity	az		9.73E-01	m
Vertical dispersivity	ay		9.73E-02	m

For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report ax = 0.83$(\log_{10}x)^{2.414}$; 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.

This sheet calculates the Tier3 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
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 Tier 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.

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration
	mg/l
29.6	9.9E-99
59.2	9.9E-99
88.8	9.7E-99
118.4	9.5E-99
148.0	9.3E-99
177.6	9.0E-99
207.2	8.8E-99
236.8	8.5E-99
266.4	8.3E-99
296.0	8.0E-99
326.8	7.8E-99
355.2	7.6E-99
384.8	7.4E-99
414.4	7.3E-99
444.0	7.1E-99
473.6	6.9E-99
503.2	6.8E-99
532.8	6.7E-99
562.4	6.5E-99
592.0	6.4E-99

Site being assessed	B'css Area 1 A murphy K20
Completed by	AJ
Date:	24 11.2005
Version	12

R&D Publication 20 Remedial Targets Worksheet, Release 2.2a

Tier 3 -Groundwater

ENVIRONMENT AGENCY

Input Parameters (using pull dorm menu)	Variable	Value	Unit	Source
Contaminant		2 methylnapthalene		
Target Concentration	C_T	1.00E-02	mg/l	

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

Ogata Banks — Equations in R&D Pub. 20

Enter '1 to simulate vertical dispersion in one direction, '2' for two directions (pull down menu) — 1

Enter '1' if biodegradation rate is for the substance in water,
'0' if rate is for decay in field conditions (i.e. field data from aquifer) (pull down menu — 0

				Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	1.00E-03	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	2.58E+02	days	
Calculated decay rate	λ	2.69E-03	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	1.90E+02	m	
Plume thickness at source	Sy	1.00E+01	m	
Saturated aquifer thickness	da	1.08E+01	m	
Bulk density of aquifer materials	ρ	1.70E+00	g/cm^3	
Effective porosity of aquifer	n	1.82E-01	fraction	
Hydraulic gradient	i	1.25E-02	fraction	
Hydraulic conductivity of aquifer	K	2.00E+01	m/d	
Distance to compliance point	x	5.92E+02	m	
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	7.24E+00	l/kg	*see options*
Longitudinal dispersivity	ax	9.730	m	*see options*
Transverse dispersivity	az	0.973	m	*see options*
Vertical dispersivity	ay	0.097	m	*see options*

Calculated Parameters	Variable		
Groundwater flow velocity	v	1.37E+00	m/d
Retardation factor	Rf	6.87E+01	fraction
Decay rate used	λ	2.69E-03	d^{-1}
Rate of contaminant flow due to retardation	u	2.00E-02	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	1.13E-23	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	6.27E-24	mg/l
Attenuation factor (one way vertical dispersion, C_0/C_{ED})	AF	8.81E+19	
Attenuation factor (two way vertical dispersion, C_0/C_{ED})	AF	1.59E+20	

Remedial Targets

Remedial Target	LTC3	8.81E+17	mg/l	For comparison with measured groundwater concentration.
Ogata Banks				
Distance to compliance point		592	m	
Concentration of contaminant at compliance point	$C_{ED}/C0$	1.13E-23	mg/l	Ogata Banks
after		9.9E+99	days	

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

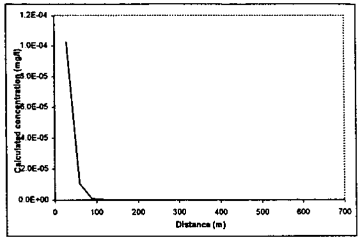
Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd		l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	1.00E+00	fraction
Organic carbon partition coefficient	Koc	7.24E+00	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$		l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Soil water partition coefficient	Kd	7.24E+00	l/kg

Dispersivity

Calculate dependant on distance to compliance point (0), specify dispersivity (1), or calc after Xu & Eckstein (2) ? — 2

		Enter value	Calc value Xu & Eckstein	
Longitudinal dispersivity	ax		9.73E+00	m
Transverse dispersivity	az		9.73E-01	m
Vertical dispersivity	ay		9.73E-02	m

For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report ax = $0.83(\log_{10}x)^{2.414}$; 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.

This sheet calculates the Tier3 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

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 Tier 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.

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration mg/l
29.6	1.0E-04
59.2	1.1E-05
88.8	1.1E-06
118.4	1.1E-07
148.0	1.1E-08
177.6	1.1E-09
207.2	1.1E-10
236.8	1.1E-11
266.4	1.1E-12
296.0	1.1E-13
325.6	1.1E-14
355.2	1.1E-15
384.8	1.1E-16
414.4	1.1E-17
444.0	1.1E-18
473.6	1.1E-19
503.2	1.1E-20
532.8	1.1E-21
562.4	1.1E-22
592.0	1.1E-23

Site being assessed:	Bless Area 1 Murphys K20
Completed by:	AJ
Date:	24 11 2005
Version:	12

R&D Publication 20 Remedial Targets Worksheet, Release 2.2a

Tier 3 - Groundwater

ENVIRONMENT AGENCY

Input Parameters (using pull down menu)	Variable	Value	Unit	Source
Contaminant		Aliphatic C8-C10		
Target Concentration	C_T	7.14E-04	mg/l	

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

Ogata Banks — Equations in R&D Pub. 20

Enter o simulate vertical dispersion in one direction, '2' for two directions (pull down menu): 1

Enter '1' if biodegradation rate is for the substance in water,
'0' if rate is for decay in field conditions (i.e. field data from aquifer) (pull down menu: 0

	Variable	Value	Unit	Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	9.90E-99	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	1.83E+03	days	
Calculated decay rate	λ	3.80E-04	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	1.90E+02	m	
Plume thickness at source	Sy	1.00E+01	m	
Saturated aquifer thickness	da	1.08E+01	m	
Bulk density of aquifer materials	ρ	1.70E+00	g/cm^3	
Effective porosity of aquifer	n	1.82E-01	fraction	
Hydraulic gradient	i	1.25E-02	fraction	
Hydraulic conductivity of aquifer	K	2.00E+01	m/d	
Distance to compliance point	x	5.92E+02	m	
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	1.15E+02	l/kg	*see options*
Longitudinal dispersivity	ax	9.730	m	*see options*
Transverse dispersivity	az	0.973	m	*see options*
Vertical dispersivity	av	0.097	m	*see options*

Calculated Parameters	Variable		
Groundwater flow velocity	v	1.37E+00	m/d
Retardation factor	Rf	1.07E+03	fraction
Decay rate used	λ	3.80E-04	d^{-1}
Rate of contaminant flow due to retardation	u	1.28E-03	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	1.63E-132	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	9.03E-133	mg/l
Attenuation factor (one way vertical dispersion, C_0/C_{ED})	AF	6.06E+33	
Attenuation factor (two way vertical dispersion, C_0/C_{ED})	AF	1.10E+34	

Remedial Targets

Remedial Target Ogata Banks	LTC3	4.33E+39	mg/l	For comparison with measured groundwater concentration.
Distance to compliance point		592	m	
Concentration of contaminant at compliance point	$C_{ED}/C0$	1.63E-132	mg/l	Ogata Banks
after		9.9E+99	days	

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

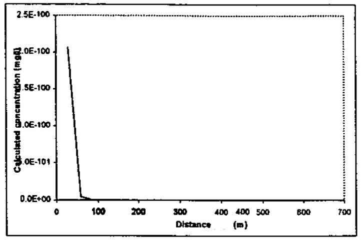
Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd		l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	1.00E+00	fraction
Organic carbon partition coefficient	Koc	1.15E+02	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$		l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Soil water partition coefficient	Kd	1.15E+02	l/kg

Dispersivity

Calculate dependant on distance to compliance point (0), specify dispersivity (1), or calc after Xu & Eckstein (2) ? 2

		Enter value	Calc value Xu & Eckstein	
Longitudinal dispersivity	ax		9.73E+00	m
Transverse dispersivity	az		9.73E-01	m
Vertical dispersivity	ay		9.73E-02	m

For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report ax = $0.83(\log_{10}x)^{2.414}$; 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.

This sheet calculates the Tier3 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
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 Tier 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.

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration
	mg/l
29.6	2.1E-100
59.2	4.3E-102
88.8	8.9E-104
118.4	1.8E-105
148.0	3.7E-107
177.6	7.5E-109
207.2	1.5E-110
236.8	3.1E-112
266.4	6.3E-114
296.0	1.3E-115
325.6	2.6E-117
355.2	5.3E-119
384.8	1.1E-120
414.4	2.2E-122
444.0	4.5E-124
473.6	9.3E-126
503.2	1.9E-127
532.8	3.9E-129
562.4	8.0E-131
592.0	1.6E-132

Site being assessed	Bless Area 1 A murphy K20
Completed by:	AJ
Date:	24 11 2005
Version	12

ENVIRONMENT AGENCY

R&D Publication 20 Remedial Targets Worksheet, Release 2.2a

Tier 3 - Groundwater

Input Parameters (using pull down menu)	Variable	Value	Unit	Source
Contaminant		Aliphatic C16-C21		
Target Concentration	C_T	7.14E-04	mg/l	

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

Ogata Banks — Equations in R&D Pub. 20

Enter '1' to simulate vertical dispersion in one direction, '2' for two directions (pull down menu): 1

Enter '1' if biodegradation rate is for the substance in water,
'0' if rate is for decay in field conditions (i.e. field data from aquifer) (pull down menu): 0

	Variable	Value	Unit	Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	3.47E-02	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	3.65E+03	days	
Calculated decay rate	λ	1.90E-04	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	1.90E+02	m	
Plume thickness at source	Sy	1.00E+01	m	
Saturated aquifer thickness	da	1.08E+01	m	
Bulk density of aquifer materials	ρ	1.70E+00	g/cm^3	
Effective porosity of aquifer	n	1.82E-01	fraction	
Hydraulic gradient	i	1.25E-02	fraction	
Hydraulic conductivity of aquifer	K	2.00E+01	m/d	
Distance to compliance point	x	5.92E+02	m	
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	2.29E+06	l/kg	*see options*
Longitudinal dispersivity	ax	9.730	m	*see options*
Transverse dispersivity	az	0.973	m	*see options*
Vertical dispersivity	ay	0.097	m	*see options*

Calculated Parameters Variable

	Variable	Value	Unit
Groundwater flow velocity	v	1.37E+00	m/d
Retardation factor	Rf	2.14E+07	fraction
Decay rate used	λ	1.90E-04	d^{-1}
Rate of contaminant flow due to retardation	u	6.42E-08	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	#NUM!	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	#NUM!	mg/l
Attenuation factor (one way vertical dispersion, C_O/C_{ED})	AF	#NUM!	
Attenuation factor (two way vertical dispersion, C_O/C_{ED})	AF	#NUM!	

Remedial Targets

Remedial Target	LTCS	#NUM!	mg/l	For comparison with measured groundwater concentration.
Ogata Banks				

Distance to compliance point		592	m	
Concentration of contaminant at compliance point	$C_{ED}/C0$	#NUM!	mg/l	Ogata Banks
after		9.9E+99	days	

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

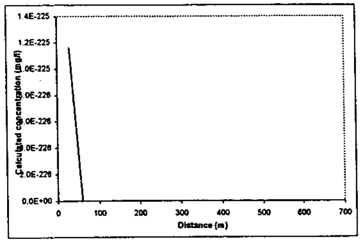
Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd	[redacted]	l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	1.00E+00	fraction
Organic carbon partition coefficient	Koc	2.29E+06	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$	[redacted]	l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Soil water partition coefficient	Kd	2.29E+06	l/kg

Dispersivity

Calculate dependant on distance to compliance point (0), specify dispersivity (1), or calc after Xu & Eckstein (2) ? 2

		Enter value	Calc value Xu & Eckstein	
Longitudinal dispersivity	ax	[redacted]	9.73E+00	m
Transverse dispersivity	az		9.73E-01	m
Vertical dispersivity	ay		9.73E-02	m

For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report $ax = 0.83(\log_{10}x)^{2.414}$; 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.

This sheet calculates the Tier3 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

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 Tier 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.

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration
	mg/l
29.6	1.2E-225
59.2	#NUM!
88.8	#NUM!
118.4	#NUM!
148.0	#NUM!
177.6	#NUM!
207.2	#NUM!
236.8	#NUM!
266.4	#NUM!
296.0	#NUM!
325.6	#NUM!
355.2	#NUM!
384.8	#NUM!
414.4	#NUM!
444.0	#NUM!
473.6	#NUM!
503.2	#NUM!
532.8	#NUM!
562.4	#NUM!
592.0	#NUM!

Site being assessed	Bloss Area 1 A murphy K20
Completed by	AJ
Date	24 11 2005
Version	12

R&D Publication20 Remedial Targets Worksheet, Release 2.2a

Tier 3 - Groundwater

ENVIRONMENT AGENCY

Input Parameters (using pull down menu)	Variable	Value	Unit	Source
Contaminant		Aliphatic C21-C35		
Target Concentration	C_T	7.14E-04	mg/l	

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

Ogata Banks — Equations in R&D Pub. 20

Enter '1' to simulate vertical dispersion in one direction, '2' for two directions (pull down menu): 1

Enter '1' if biodegradation rate is for the substance in water,
'0' if rate is for decay in field conditions (i.e. field data from aquifer) (pull down menu): 0

	Variable	Value	Unit	Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	3.47E-02	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	3.65E+03	days	
Calculated decay rate	λ	1.90E-04	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	1.90E+02	m	
Plume thickness at source	Sy	1.00E+01	m	
Saturated aquifer thickness	da	1.08E+01	m	
Bulk density of aquifer materials	ρ	1.70E+00	g/cm^3	
Effective porosity of aquifer	n	1.82E-01	fraction	
Hydraulic gradient	i	1.25E-02	fraction	
Hydraulic conductivity of aquifer	K	2.00E+01	m/d	
Distance to compliance point	x	5.92E+02	m	
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	2.29E+06	l/kg	*see options*
Longitudinal dispersivity	ax	9.730	m	*see options*
Transverse dispersivity	az	0.973	m	*see options*
Vertical dispersivity	ay	0.097	m	*see options*

Calculated Parameters	Variable		
Groundwater flow velocity	v	1.37E+00	m/d
Retardation factor	Rf	2.14E+07	fraction
Decay rate used	λ	1.90E-04	d^{-1}
Rate of contaminant flow due to retardation	u	6.42E-08	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	#NUM!	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	#NUM!	mg/l
Attenuation factor (one way vertical dispersion, C_0/C_{ED})	AF	#NUM!	
Attenuation factor (two way vertical dispersion, C_0/C_{ED})	AF	#NUM!	

Remedial Targets

Remedial Target LTC3 #NUM! mg/l — For comparison with measured groundwater concentration.
Ogata Banks

Distance to compliance point		**592**	**m**	
Concentration of contaminant at compliance point	$C_{ED}/C0$	**#NUM!**	**mg/l**	Ogata Banks
after		**9.9E+99**	**days**	

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

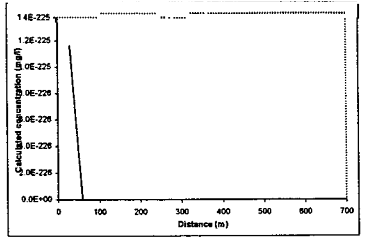
Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd	[redacted]	l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	1.00E+00	fraction
Organic carbon partition coefficient	Koc	2.29E+06	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$	[redacted]	l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Soil water partition coefficient	Kd	2.29E+06	l/kg

Dispersivity

Calculate dependant on distance to compliance point (0), specify dispersivity (1), or calc after Xu & Eckstein (2) ? 2

		Enter value	Calc value Xu & Eckstein	
Longitudinal dispersivity	**ax**	[redacted]	9.73E+00	m
Transverse dispersivity	**az**		9.73E-01	m
Vertical dispersivity	**ay**		9.73E-02	m

For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report ax = $0.83(\log_{10}x)^{2.414}$; 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.

This sheet calculates the Tier3 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

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 Tier 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.

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration
	mg/l
29.6	1.2E-225
59.2	#NUM!
88.8	#NUM!
118.4	#NUM!
148.0	#NUM!
177.6	#NUM!
207.2	#NUM!
236.8	#NUM!
266.4	#NUM!
296.0	#NUM!
325.6	#NUM!
355.2	#NUM!
384.8	#NUM!
414.4	#NUM!
444.0	#NUM!
473.6	#NUM!
503.2	#NUM!
532.8	#NUM!
562.4	#NUM!
592.0	#NUM!

Site being assessed	Bless Area 1 A murphy K20
Completed by:	AJ
Date	24 11 2005
Version	12

R8D Publication20 Remedial Targets Worksheet, Release 2.2a

Tier 3 • Groundwater

ENVIRONMENT AGENCY

Input Parameters (using pull dorm menu)

	Variable	Value	Unit	Source
Contaminant		Aromatic C16-C21		
Target Concentration	C_T	7.14E-04	mg/l	

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

Ogata Banks — Equations in R&D Pub. 20

Enter '1' to simulate vertical dispersion in one direction, '2' for two directions (pull down menu): 1

Enter '1' if biodegradation rate is for the substance in water,
'0' if rate is for decay in field conditions (i.e. field data from aquifer) (pull down menu): 0

	Variable	Value	Unit	Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	3.47E-02	mg/l	
Half life for degradation of contaminant in water	1-11	3.65E+03	days	
Calculated decay rate	λ	1.90E-04	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	1.90E+02	m	
Plume thickness at source	Sy	1.00E+01	m	
Saturated aquifer thickness	da	1.08E+01	m	
Bulk density of aquifer materials	ρ	1.70E+00	g/cm^3	
Effective porosity of aquifer		1.82E-01	fraction	
Hydraulic gradient	.	1.25E-02	fraction	
Hydraulic conductivity of aquifer	K	2.00E+01	m/d	
Distance to compliance point	x	5.92E+02	m	
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	5.75E+01	l/kg	*see options*
Longitudinal dispersivity	ax	9.730	m	*see options*
Transverse dispersivity	az	0.973	m	*see options*
Vertical dispersivity	ay	0.097	m	*see options*

Calculated Parameters

	Variable		
Groundwater flow velocity	v	1.37E+00	m/d
Retardation factor	Rf	5.38E+02	fraction
Decay rate used	λ	1.90E-04	d^{-1}
Rate of contaminant flow due to retardation	u	2.55E-03	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	3.02E-15	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	1.67E-15	mg/l
Attenuation factor (one way vertical dispersion, C_O/C_{ED})	AF	1.15E+13	
Attenuation factor (two way vertical dispersion, C_O/C_{ED})	AF	2.07E+13	

Remedial Targets

Remedial Target	LTC3	8.19E+08	mg/l	For comparison with measured groundwater concentration.
Ogata Banks				
Distance to compliance point		592	m	
Concentration of contaminant at compliance point	$C_{ED}/C0$	3.02E-15	mg/l	Ogata Banks
after		9.9E+99	days	

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

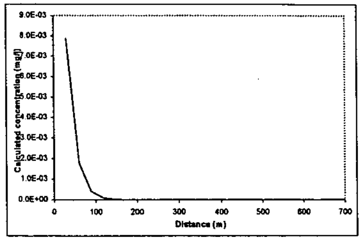
Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd	[redacted]	l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	1.00E+00	fraction
Organic carbon partition coefficient	Koc	5.75E+01	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$	[redacted]	l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Soil water partition coefficient	Kd	5.75E+01	l/kg

Dispersivity

Calculate dependant on distance to compliance point (0),
specify dispersivity (1), or calc after Xu & Eckstein (2) ? 2

		Enter value	Calc value Xu & Eckstein	
Longitudinal dispersivity	ax	[redacted]	9.73E+00	m
Transverse dispersivity	az		9.73E-01	m
Vertical dispersivity	ay		9.73E-02	m

For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report ax = $0.83(\log_{10}x)^{2.414}$; 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.

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration
	mg/l
29.8	7.8E-W
69.2	1.8E-W
88.8	4.0E-04
148.0	8.9E-05
177.6	4.4E-06
207.2	9.6E-07
236.8	2.1E-07
266.4	4.7E-08
296.0	I.OE-08
325.6	2.3E-09
355.2	5.1E-10
384.8	1.1E-10
414.4	2.5E-11
444.0	5.5E-12
473.8	1.2E-12
503.2	2.7E-13
632.8	6.1E-14
6824	1.4E-14
592.0	3.0E-15

This sheet calculates the Tier3 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

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 Tier 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.

Site being assessed	Bless Area 1 A murphy K20
Completed by,	AJ
Date:	24 11 2005
Version:	12

R&D Publication 20 Remedial Targets Worksheet, Release 2.2a

Tier 3 - Groundwater

ENVIRONMENT AGENCY

Input Parameters (using pull down menu)

Input Parameters	Variable	Value	Unit	Source
Contaminant		mmoniacal Nitrogen as		
Target Concentration	C_T	1.20E-01	mg/l	

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

Ogata Banks — Equations in R&D Pub. 20

Enter '1' to simulate vertical dispersion in one direction, '2' for two directions (pull down menu): 1

Enter '1' if biodegradation rate is for the substance in water,
'0' if rate is for decay in field conditions (i.e. field data from aquifer) (pull down menu): 0

	Variable	Value	Unit	Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	6.40E+00	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	2.19E+03	days	
Calculated decay rate	λ	3.17E-04	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	1.90E+02	m	
Plume thickness at source	Sy	1.00E+01	m	
Saturated aquifer thickness	da	1.08E+01	m	
Bulk density of aquifer materials	ρ	1.70E+00	g/cm^3	
Effective porosity of aquifer	n	1.82E-01	fraction	
Hydraulic gradient	i	1.25E-02	fraction	
Hydraulic conductivity of aquifer	K	2.00E+01	m/d	
Distance to compliance point	x	5.92E+02	m	
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	5.00E-01	l/kg	*see options*
Longitudinal dispersivity	ax	9.730	m	*see options*
Transverse dispersivity	az	0.973	m	*see options*
Vertical dispersivity	ay	0.097	m	*see options*

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

Calculate for non-polar organic chemicals

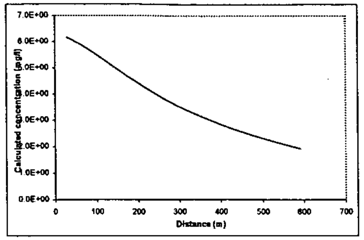
Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd	[redacted]	l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	1.00E+00	fraction
Organic carbon partition coefficient	Koc	5.00E-01	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$	[redacted]	l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Soil water partition coefficient	Kd	5.00E-01	l/kg

Dispersivity

Calculate dependant on distance to compliance point (0), specify dispersivity (1), or calc after Xu & Eckstein (2) ? 2

		Enter value	Calc value Xu & Eckstein	
Longitudinal dispersivity	ax	[redacted]	9.73E+00	m
Transverse dispersivity	az		9.73E-01	m
Vertical dispersivity	ay		9.73E-02	m

For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report ax = $0.83(\log_{10}x)^{2.414}$; 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.

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration mg/l
29.6	6.2E+00
59.2	5.9E+00
88.8	5.6E+00
118.4	5.3E+00
148.0	5.0E+00
177.6	4.6E+00
207.2	4.3E+00
236.8	4.1E+00
266.4	3.8E+00
296.0	3.5E+00
325.6	3.3E+00
355.2	3.1E+00
384.8	2.9E+00
414.4	2.8E+00
444.0	2.6E+00
473.6	2.4E+00
503.2	2.3E+00
532.8	2.2E+00
562.4	2.0E+00
592.0	1.9E+00

This sheet calculates the Tier3 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

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 Tier 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.

Calculated Parameters

Calculated Parameters	Variable		
Groundwater flow velocity	v	1.37E+00	m/d
Retardation factor	Rf	5.67E+00	fraction
Decay rate used	λ	3.17E-04	d^{-1}
Rate of contaminant flow due to retardation	u	2.42E-01	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	1.92E+00	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	1.06E+00	mg/l
Attenuation factor (one way vertical dispersion, C_O/C_{ED})	AF	3.33E+00	
Attenuation factor (two way vertical dispersion, C_O/C_{ED})	AF	6.02E+00	

Remedial Targets

Remedial Target	LTC3	3.99E-01	mg/l	For comparison with measured groundwater concentration.
Ogata Banks				
Distance to compliance point		592	m	
Concentration of contaminant at compliance point	$C_{ED}/C0$	1.92E+00	mg/l	Ogata Banks
after		9.9E+99	days	

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.

Site being assessed.	Bless Area 1 A murphy K20
Completed by.	AJ
Date:	24 11 2005
Version.	12

ENVIRONMENT AGENCY

R&D Publication 20 Remedial Targets Worksheet, Release 2.2a

Tier 3 - Groundwater

Input Parameters (using pull down menu)	Variable	Value	Unit	Source
Contaminant		Anthracene		
Target Concentration	C_T	1.00E+01	mg/l	

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

Ogata Banks — Equations in R&D Pub. 20

Enter '1' to simulate vertical dispersion in one direction, '2' for two directions (pull down menu) 1

Enter '1' if biodegradation rate is for the substance in water,
'0' if rate is for decay in field conditions (i.e. field data from aquifer) (pull down menu) 0

	Variable	Value	Unit	Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	1.00E-01	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	9.20E+02	days	
Calculated decay rate	λ	7.53E-04	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	1.90E+02	m	
Plume thickness at source	Sy	1.00E+01	m	
Saturated aquifer thickness	da	1.08E+01	m	
Bulk density of aquifer materials	ρ	1.70E+00	g/cm^3	
Effective porosity of aquifer	n	1.82E-01	fraction	
Hydraulic gradient	i	1.25E-02	fraction	
Hydraulic conductivity of aquifer	K	2.00E+01	m/d	
Distance to compliance point	x	5.92E+02	m	
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	5.13E+01	l/kg	*see options*
Longitudinal dispersivity	ax			*see options*
Transverse dispersivity	az			*see options*
Vertical dispersivity	ay			*see options*

Calculated Parameters	Variable		
Groundwater flow velocity	v	1.37E+00	m/d
Retardation factor	Rf	4.80E+02	fraction
Decay rate used	λ	7.53E-04	d^{-1}
Rate of contaminant flow due to retardation	u	2.86E-03	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	5.19E-33	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	2.87E-33	mg/l
Attenuation factor (one way vertical dispersion, C_0/C_{ED})	AF	1.93E+31	
Attenuation factor (two way vertical dispersion, C_0/C_{ED})	AF	3.48E+31	

Remedial Targets

Remedial Target	LTC3	1.93E+32	mg/l

For comparison with measured groundwater concentration.

Ogata Banks

Distance to compliance point		592	m	
Concentration of contaminant at compliance point	$C_{ED}/C0$	5.19E-33	mg/l	Ogata Banks
after		9.9E+99	days	

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

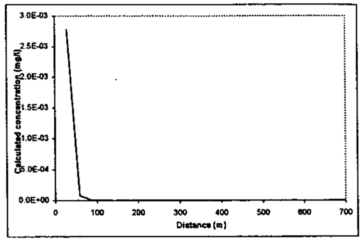
Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd		l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	1.00E+00	fraction
Organic carbon partition coefficient	Koc	5.13E+01	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$		l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Soil water partition coefficient	Kd	5.13E+01	l/kg

Dispersivity

Calculate dependant on distance to compliance point (0), specify dispersivity (1), or calc after Xu & Eckstein (2) ? 2

		Enter value	Calc value Xu & Eckstein	
Longitudinal dispersivity	ax		9.73E+00	m
Transverse dispersivity	az		9.73E-01	m
Vertical dispersivity	ay		9.73E-02	m

For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report ax = $0.83(\log_{10}x)^{2.414}$; 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.

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration
	mg/l
29.6	2.8E-03
59.2	7.7E-05
88.8	2.1E-06
118.4	5.8E-08
148.0	1.6E-09
177.6	4.3E-11
207.2	1.2E-12
236.8	3.1E-14
266.4	8.5E-16
296.0	2.3E-17
325.6	6.3E-19
355.2	1.7E-20
384.8	4.6E-22
414.4	1.3E-23
444.0	3.4E-25
473.6	9.3E-27
503.2	2.5E-28
532.8	7.0E-30
562.4	1.9E-31
592.0	5.2E-33

This sheet calculates the Tier3 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

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 Tier 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.

Site being assessed	Bloss Area 1 Murphys K20
Completed by	AJ
Date:	24 11 2005
Version	12

ENVIRONMENT
AGENCY

R&D Publication 20 Remedial Targets Worksheet, Release 2.2a

Tier 3 -Groundwater

Input Parameters (using pull down menu)	Variable	Value	Unit	Source
Contaminant		Aromatic C8-C10		
Target Concentration	C_T	7.14E-04	mg/l	

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

Ogata Banks — Equations in R&D Pub. 20

Enter '1' to simulate vertical dispersion in one direction, '2' for two directions (pull down menu) 1

Enter '1' if biodegradation rate is for the substance in water,
'0' if rate is for decay in field conditions (i.e. field data from aquifer) (pull down menu) 0

				Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	9.90E-99	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	1.83E+03	days	
Calculated decay rate	λ	3.80E-04	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	1.90E+02	m	
Plume thickness at source	Sy	1.00E+01	m	
Saturated aquifer thickness	da	1.08E+01	m	
Bulk density of aquifer materials	ρ	1.70E+00	g/cm^3	
Effective porosity of aquifer	n	1.82E-01	fraction	
Hydraulic gradient	i	1.25E-02	fraction	
Hydraulic conductivity of aquifer	K	2.00E+01	m/d	
Distance to compliance point	x	5.92E+02	m	
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	5.75E+00	l/kg	*see options*
Longitudinal dispersivity	ax	9.730	m	*see options*
Transverse dispersivity	az	0.973	m	*see options*
Vertical dispersivity	av	0.097	m	*see options*

Calculated Parameters	Variable		
Groundwater flow velocity	v	1.37E+00	m/d
Retardation factor	Rf	5.47E+01	fraction
Decay rate used	λ	3.80E-04	d^{-1}
Rate of contaminant flow due to retardation	u	2.51E-02	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	2.30E-102	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	1.27E-102	mg/l
Attenuation factor (one way vertical dispersion, C_O/C_{ED})	AF	4.30E+03	
Attenuation factor (two way vertical dispersion, C_O/C_{ED})	AF	7.77E+03	

Remedial Targets

Remedial Target LTC3 3.07E+00 mg/l For comparison with measured groundwater concentration.
Ogata Banks

Distance to compliance point		**592**	**m**	
Concentration of contaminant at compliance point	$C_{ED}/C0$	**2.30E-102**	**mg/l**	Ogata Banks
after		**9.9E+99**	**days**	

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

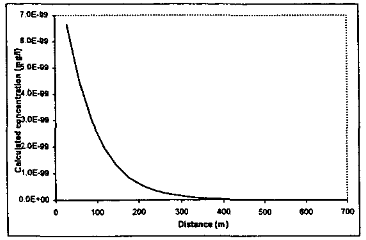
Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd	[redacted]	l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	1.00E+00	fraction
Organic carbon partition coefficient	Koc	5.75E+00	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$	[redacted]	l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Soil water partition coefficient	Kd	5.75E+00	l/kg

Dispersivity

Calculate dependant on distance to compliance point (0), specify dispersivity (1), or calc after Xu & Eckstein (2) ? 2

		Enter value	Calc value Xu & Eckstein	
Longitudinal dispersivity	ax	[redacted]	9.73E+00	m
Transverse dispersivity	az		9.73E-01	m
Vertical dispersivity	av		9.73E-02	m

For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, av = 0.001 * x
Xu & Eckstein (1995) report $ax = 0.83(\log_{10}x)^{2.414}$; az = ax/10, av = 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.

This sheet calculates the Tier3 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

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 Tier 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.

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration
	mg/l
29.6	6.7E-99
59.2	4.5E-99
88.8	3.0E-99
118.4	2.0E-99
148.0	(1.3E-99)
207.2	6.5E-100
236.8	3.6E-100
266.4	2.3E-100
296.0	1.5E-100
325.6	1.0E-100
355.2	6.6E-101
414.8	2.9E-101
473.6	1.2E-101
503.2	8.0E-102
552.8	5.5E-102
592.0	2.3E-102

Site being assessed	Bless Area 1 A murphy K20
Completed by	AJ
Date	24 11 2005
Version	12

R&D Publication 20 Remedial Targets Worksheet, Release 2.2a

Tier 3 - Groundwater

ENVIRONMENT AGENCY

Input Parameters (using pull down menu)	Variable	Value	Unit	Source
Contaminant		Aromatic C10-C12		
Target Concentration	C_T	7.14E-04	mg/l	

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

Ogata Banks — Equations in R&D Pub. 20

Enter '1' to simulate vertical dispersion in one direction, '2' for two directions (pull down menu): 1

Enter '1' if biodegradation rate is for the substance in water,
'0' if rate is for decay in field conditions (i.e. field data from aquifer) (pull down menu): 0

	Variable	Value	Unit	Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	9.90E-99	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	1.83E+03	days	
Calculated decay rate	λ	3.80E-04	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	1.90E+02	m	
Plume thickness at source	Sy	1.00E+01	m	
Saturated aquifer thickness	da	1.08E+01	m	
Bulk density of aquifer materials	ρ	1.70E+00	g/cm^3	
Effective porosity of aquifer	n	1.82E-01	fraction	
Hydraulic gradient	i	1.25E-02	fraction	
Hydraulic conductivity of aquifer	K	2.00E+01	m/d	
Distance to compliance point	x	5.92E+02	m	
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	9.12E+00	l/kg	*see options*
Longitudinal dispersivity	ax	9.730	m	*see options*
Transverse dispersivity	az	0.973	m	*see options*
Vertical dispersivity	ay	0.097	m	*see options*

Calculated Parameters	Variable		
Groundwater flow velocity	v	1.37E+00	m/d
Retardation factor	Rf	8.62E+01	fraction
Decay rate used	λ	3.80E-04	d^{-1}
Rate of contaminant flow due to retardation	u	1.59E-02	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	4.74E-104	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	2.62E-104	mg/l
Attenuation factor (one way vertical dispersion, C_0/C_{ED})	AF	2.09E+05	
Attenuation factor (two way vertical dispersion, C_0/C_{ED})	AF	3.78E+05	

Remedial Targets

Remedial Target LTC3 1.49E+02 mg/l — For comparison with measured groundwater concentration.

Ogata Banks

Distance to compliance point 592 m

Concentration of contaminant at compliance point $C_{ED}/C0$ **4.74E-104** mg/l Ogata Banks
after **9.9E+99** days

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

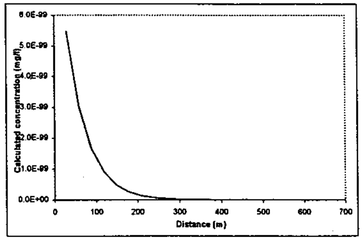
Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd	[redacted]	l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	1.00E+00	fraction
Organic carbon partition coefficient	Koc	9.12E+00	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$	[redacted]	l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Soil water partition coefficient	Kd	9.12E+00	l/kg

Dispersivity

Calculate dependant on distance to compliance point (0), specify dispersivity (1), or calc after Xu & Eckstein (2) ? 2

		Enter value	Calc value Xu & Eckstein	
Longitudinal dispersivity	ax	[redacted]	9.73E+00	m
Transverse dispersivity	az		9.73E-01	m
Vertical dispersivity	ay		9.73E-02	m

For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report ax = $0.83(\log_{10}x)^{2.414}$; 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.

This sheet calculates the Tier3 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

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 Tier 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.

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration mg/l
29.6	5.5E-99
59.2	3.0E-99
88.8	1.7E-99
148.0	4.8E-100
177.6	2.6E-100
207.2	7.4E-100
266.4	4.1E-101
296.0	2.2E-101
326.1	1.2E-101
355.2	6.4E-102
384.8	3.4E-102
414.4	1.9E-102
444.0	1.0E-102
413.6	5.5E-103
503.2	3.6E-103
562.4	8.7E-104
592.0	4.7E-104

Site being assessed	Bless Area 1 A murphy K20
Completed by	AJ
Date:	24 11 2005
Version:	12

R&D Publication 20 Remedial Targets Worksheet, Release 2.2a

Tier 3 - Groundwater

ENVIRONMENT AGENCY

Input Parameters (using pull down menu)

Input Parameters (using pull down menu)	Variable	Value	Unit	Source
Contaminant		Aromatic C12-C16		
Target Concentration	C_T	7.14E-04	mg/l	

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

Ogata Banks — Equations in R&D Pub. 20

Enter '1' to simulate vertical dispersion in one direction, '2' for two directions (pull down menu): 1

Enter '1' if biodegradation rate is for the substance in water,
'0' if rate is for decay in field conditions (i.e. field data from aquifer) (pull down menu): 0

	Variable	Value	Unit	Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	3.47E-02	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	1.83E+03	days	
Calculated decay rate	λ	3.80E-04	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	1.90E+02	m	
Plume thickness at source	Sy	1.00E+01	m	
Saturated aquifer thickness	da	1.08E+01	m	
Bulk density of aquifer materials	ρ	1.70E+00	g/cm^3	
Effective porosity of aquifer	n	1.82E-01	fraction	
Hydraulic gradient	i	1.25E-02	fraction	
Hydraulic conductivity of aquifer	K	2.00E+01	m/d	
Distance to compliance point	x	5.92E+02	m	
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	1.82E+01	l/kg	*see options*
Longitudinal dispersivity	ax	9.730	m	*see options*
Transverse dispersivity	az	0.973	m	*see options*
Vertical dispersivity	ay	0.097	m	*see options*

Calculated Parameters

Calculated Parameters	Variable		
Groundwater flow velocity	v	1.37E+00	m/d
Retardation factor	Rf	1.71E+02	fraction
Decay rate used	λ	3.80E-04	d^{-1}
Rate of contaminant flow due to retardation	u	8.04E-03	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	1.99E-11	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	1.10E-11	mg/l
Attenuation factor (one way vertical dispersion, C_0/C_{ED})	AF	1.75E+09	
Attenuation factor (two way vertical dispersion, C_0/C_{ED})	AF	3.16E+09	

Remedial Targets

Remedial Target	LTC3	1.25E+08	mg/l

For comparison with measured groundwater concentration.

Ogata Banks

Distance to compliance point		592	m	
Concentration of contaminant at compliance point	$C_{ED}/C0$	1.99E-11	mg/l	Ogata Banks
after		9.9E+99	days	

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

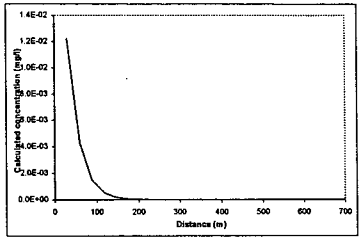
Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd	[redacted]	l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	1.00E+00	fraction
Organic carbon partition coefficient	Koc	1.82E+01	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$	[redacted]	l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Soil water partition coefficient	Kd	1.82E+01	l/kg

Dispersivity

Calculate dependant on distance to compliance point (0), specify dispersivity (1), or calc after Xu & Eckstein (2) ? 2

		Enter value	Calc value Xu & Eckstein	
Longitudinal dispersivity	ax	[redacted]	9.73E+00	m
Transverse dispersivity	az		9.73E-01	m
Vertical dispersivity	ay		9.73E-02	m

For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report ax = 0.83$(\log_{10}x)^{2.414}$; 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.

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration
	mg/l
29.6	1.2E-02
63.2	4.3E-03
88.8	1.5E-03
118.4	5.2E-04
148.0	1.8E-04
177.6	6.1E-05
207.2	2.1E-05
236.8	7.1E-06
266.4	2.4E-06
296.0	8.4E-07
325.6	2.9E-07
355.2	9.9E-08
384.8	3.4E-08
414.4	1.2E-08
444.0	4.0E-09
473.6	1.4E-09
503.2	4.8E-10
532.8	1.7E-10
562.4	5.8E-11
592.0	2.0E-11

This sheet calculates the Tier3 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

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 Tier 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.

Site being assessed	Bless Area 1 A murphy K20
Completed by:	AJ
Date.	24 11 2005
Version:	12

R&D Publication 20 Remedial Targets Worksheet, Release 2.2a

Tier 3 - Groundwater

ENVIRONMENT AGENCY

Input Parameters (using pull down menu)

Input Parameters (using pull down menu)	Variable	Value	Unit	Source
Contaminant		Aromatic C21-C35		
Target Concentration	C_T	7.14E-04	mg/l	

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

Ogata Banks — Equations in R&D Pub. 20

Enter '1' to simulate vertical dispersion in one direction, '2' for two directions (pull down menu): 1

Enter '1' if biodegradation rate is for the substance in water,
'0' if rate is for decay in field conditions (i.e. field data from aquifer) (pull down menu): 0

	Variable	Value	Unit	Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	3.47E-02	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	3.65E+03	days	
Calculated decay rate	λ	1.90E-04	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	1.90E+02	m	
Plume thickness at source	Sy	1.00E+01	m	
Saturated aquifer thickness	da	1.08E+01	m	
Bulk density of aquifer materials	ρ	1.70E+00	g/cm^3	
Effective porosity of aquifer	n	1.82E-01	fraction	
Hydraulic gradient	i	1.25E-02	fraction	
Hydraulic conductivity of aquifer	K	2.00E+01	m/d	
Distance to compliance point	x	5.92E+02	m	
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	4.57E+02	l/kg	*see options*
Longitudinal dispersivity	ax	9.730	m	*see options*
Transverse dispersivity	az	0.973	m	*see options*
Vertical dispersivity	ay	0.097	m	*see options*

Calculated Parameters

Calculated Parameters	Variable		
Groundwater flow velocity	v	1.37E+00	m/d
Retardation factor	Rf	4.27E+03	fraction
Decay rate used	λ	1.90E-04	d^{-1}
Rate of contaminant flow due to retardation	u	3.22E-04	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	7.44E-54	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	4.12E-54	mg/l
Attenuation factor (one way vertical dispersion, C_O/C_{ED})	AF	4.66E+51	
Attenuation factor (two way vertical dispersion, C_O/C_{ED})	AF	8.43E+51	

Remedial Targets

Remedial Target	LTC3	3.33E+48	mg/l

For comparison with measured groundwater concentration.

Ogata Banks

Distance to compliance point		**592**	**m**	
Concentration of contaminant at compliance point	$C_{ED}/C0$	**7.44E-54**	**mg/l**	Ogata Banks
after		**9.9E+99**	**days**	

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

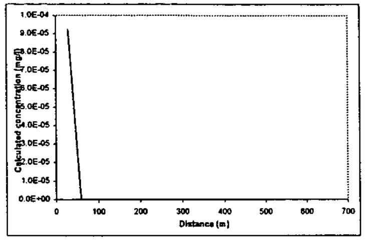
Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd	[redacted]	l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	1.00E+00	fraction
Organic carbon partition coefficient	Koc	4.57E+02	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$	[redacted]	l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Soil water partition coefficient	Kd	4.57E+02	l/kg

Dispersivity

Calculate dependant on distance to compliance point (0), specify dispersivity (1), or calc after Xu & Eckstein (2) ? 2

		Enter value	Calc value Xu & Eckstein	
Longitudinal dispersivity	ax	[redacted]	9.73E+00	m
Transverse dispersivity	az		9.73E-01	m
Vertical dispersivity	ay		9.73E-02	m

For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report $ax = 0.83(\log_{10}x)^{2.414}$; 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.

This sheet calculates the Tier3 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

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 Tier 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.

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration mg/l
29.6	9.3E-05
59.2	2.5E-07
88.8	6.5E-10
118.4	1.7E-12
148.0	4.4E-15
177.6	1.1E-17
207.2	2.9E-20
236.8	7.6E-23
266.4	2.0E-25
296.0	5.1E-28
325.6	1.3E-30
355.2	3.5E-33
384.8	9.0E-36
414.4	2.4E-38
444.0	6.1E-41
473.6	1.6E-43
503.2	4.2E-46
532.8	1.1E-48
562.4	2.8E-51
592.0	7.4E-54

Site being assessed:	Bless Area 1 A murphy K20
Completed by.	AJ
Date:	24 11 2005
Version:	12

R&D Publication20 Remedial Targets Worksheet, Release 2.2a

Tier 3 - Groundwater

ENVIRONMENT AGENCY

Input Parameters (using pull down menu)	Variable	Value	Unit	Source
Contaminant		Benzo(a)anthracene		
Target Concentration	C_T	6.25E-06	mg/l	

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

Ogata Banks — Equations in R&D Pub. 20

Enter '1' to simulate vertical dispersion in one direction, '2' for two directions (pull down menu): 1

Enter '1' if biodegradation rate is for the substance in water,
'0' if rate is for decay in field conditions (i.e. field data from aquifer) (pull down menu): 0

	Variable	Value	Unit	Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	2.00E-01	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	1.36E+03	days	
Calculated decay rate	λ	5.10E-04	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	1.90E+02	m	
Plume thickness at source	Sy	1.00E+01	m	
Saturated aquifer thickness	da	1.08E+01	m	
Bulk density of aquifer materials	ρ	1.70E+00	g/cm^3	
Effective porosity of aquifer	n	1.82E-01	fraction	
Hydraulic gradient	i	1.25E-02	fraction	
Hydraulic conductivity of aquifer	K	2.00E+01	m/d	
Distance to compliance point	x	5.92E+02	m	
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	5.01E+03	l/kg	*see options*
Longitudinal dispersivity	ax	9.730	m	*see options*
Transverse dispersivity	az	0.973	m	*see options*
Vertical dispersivity	ay	0.097	m	*see options*

Calculated Parameters	Variable		
Groundwater flow velocity	v	1.37E+00	m/d
Retardation factor	Rf	4.68E+04	fraction
Decay rate used	λ	5.10E-04	d^{-1}
Rate of contaminant flow due to retardation	u	2.93E-05	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	#NUM!	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	#NUM!	mg/l
Attenuation factor (one way vertical dispersion, C_0/C_{ED})	AF	#NUM!	
Attenuation factor (two way vertical dispersion, C_0/C_{ED})	AF	#NUM!	

Remedial Targets

Remedial Target Ogata Banks	LTC3	#NUM!	mg/l	For comparison with measured groundwater concentration.
Distance to compliance point		592	m	
Concentration of contaminant at compliance point	$C_{ED}/C0$	#NUM!	mg/l	Ogata Banks
after		9.9E+99	days	

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

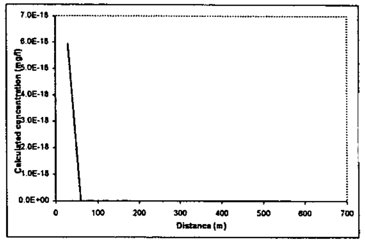
Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd		l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	1.00E+00	fraction
Organic carbon partition coefficient	Koc	5.01E+03	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$		l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Soil water partition coefficient	Kd	5.01E+03	l/kg

Dispersivity

Calculate dependant on distance to compliance point (0), specify dispersivity (1), or calc after Xu & Eckstein (2) ? 2

		Enter value	Calc value Xu & Eckstein	
Longitudinal dispersivity	ax		9.73E+00	m
Transverse dispersivity	az		9.73E-01	m
Vertical dispersivity	ay		9.73E-02	m

For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report $ax = 0.83(\log_{10}x)^{2.414}$; 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.

This sheet calculates the Tier3 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

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 Tier 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.

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration mg/l
29.6	5.9E-18
69.2	1.8E-34
88.8	5.2E-51
118.4	1.5E-67
148.0	4.4E-84
177.6	1.3E-100
207.2	3.6E-117
236.8	1.0E-133
266.4	3.0E-150
296.0	8.8E-167
325.6	2.5E-183
355.2	7.4E-200
384.8	2.1E-216
414.4	6.2E-233
444.0	1.8E-249
473.6	5.2E-266
503.2	1.5E-282
532.8	#NUM!
562.4	#NUM!
592.0	#NUM!

Site being assessed:	Bless Area 1 Murphys K20
Completed by:	AJ
Date:	24 11 2005
Version:	12

R&D Publication 20 Remedial Targets Worksheet, Release 2.2a

Tier 3 - Groundwater

ENVIRONMENT AGENCY

Input Parameters (using pull down menu)	Variable	Value	Unit	Source
Contaminant		s (2 ethylhexyl)phthala		
Target Concentration	C_T	1.00E-02	mg/l	

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

Ogata Banks — Equations in R&D Pub. 20

Enter '1' to simulate vertical dispersion in one direction, '2' for two directions (pull down menu): 1

Enter '1' if biodegradation rate is for the substance in water,
'0' if rate is for decay in field conditions (i.e. field data from aquifer) (pull down menu: 0

				Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	4.20E-02	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	3.89E+02	days	
Calculated decay rate	λ	1.78E-03	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	1.90E+02	m	
Plume thickness at source	Sy	1.00E+01	m	
Saturated aquifer thickness	da	1.08E+01	m	
Bulk density of aquifer materials	ρ	1.70E+00	g/cm^3	
Effective porosity of aquifer	n	1.82E-01	fraction	
Hydraulic gradient	i	1.25E-02	fraction	
Hydraulic conductivity of aquifer	K	2.00E+01	m/d	
Distance to compliance point	x	5.92E+02	m	
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	5.89E+02	l/kg	*see options*
Longitudinal dispersivity	ax	9.730	m	*see options*
Transverse dispersivity	az	0.973	m	*see options*
Vertical dispersivity	ay	0.097	m	*see options*

Calculated Parameters	Variable		
Groundwater flow velocity	v	1.37E+00	m/d
Retardation factor	Rf	5.50E+03	fraction
Decay rate used	λ	1.78E-03	d^{-1}
Rate of contaminant flow due to retardation	u	2.50E-04	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	1.21E-209	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	6.71E-210	mg/l
Attenuation factor (one way vertical dispersion, C_0/C_{ED})	AF	3.46E+207	
Attenuation factor (two way vertical dispersion, C_0/C_{ED})	AF	6.26E+207	

Remedial Targets

Remedial Target	LTC3	3.46E+205	mg/l	For comparison with measured groundwater concentration.
Ogata Banks				
Distance to compliance point		**592**	**m**	
Concentration of contaminant at compliance point	$C_{ED}/C0$	**1.21E-209**	**mg/l**	Ogata Banks
after		**9.9E+99**	**days**	

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

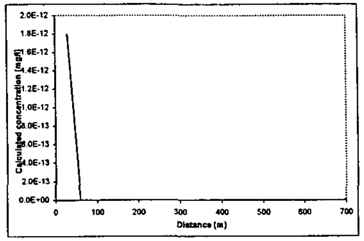
Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd		l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	1.00E+00	fraction
Organic carbon partition coefficient	Koc	5.89E+02	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$		l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	*pKa*		
Soil water partition coefficient	Kd	5.89E+02	l/kg

Dispersivity

Calculate dependant on distance to compliance point (0), specify dispersivity (1), or calc after Xu & Eckstein (2) ? 2

		Enter value	Calc value Xu & Eckstein	
Longitudinal dispersivity	ax		9.73E+00	m
Transverse dispersivity	az		9.73E-01	m
Vertical dispersivity	ay		9.73E-02	m

For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report ax = $0.83(\log_{10}x)^{2.414}$; 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.

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration mg/l
29.6	1.8E-12
59.2	7.7E-23
88.8	3.3E-33
118.4	1.4E-43
148.0	5.7E-54
177.6	2.4E-64
207.2	1.0E-74
236.8	4.1E-85
266.4	1.7E-95
296.0	7.2E-106
325.6	3.0E-116
355.2	1.3E-126
384.8	5.3E-137
414.4	2.2E-147
444.0	9.3E-158
473.6	3.9E-168
503.2	1.6E-178
532.8	6.9E-189
562.4	2.9E-199
592.0	1.2E-209

This sheet calculates the Tier3 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

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 Tier 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.

Site being assessed	Bicss Area 1 Murphys K20
Completed by	AJ
Date	24 11 2005
Version	12

R&D Publication 20 Remedial Targets Worksheet, Release 2.2a

Tier 3 -Groundwater

ENVIRONMENT AGENCY

Input Parameters (using pull down menu)

	Variable	Value	Unit	Source
Contaminant		Chrysene		
Target Concentration	C_T	6.25E-06	mg/l	

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

Ogata Banks — Equations in R&D Pub. 20

Enter '1' to simulate vertical dispersion in one direction, '2' for two directions (pull down menu): 1

Enter '1' if biodegradation rate is for the substance in water,
'0' if rate is for decay in field conditions (i.e. field data from aquifer) (pull down menu: 0

	Variable	Value	Unit	Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	2.00E-01	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	2.00E+03	days	
Calculated decay rate	λ	3.47E-04	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	1.90E+02	m	
Plume thickness at source	Sy	1.00E+01	m	
Saturated aquifer thickness	da	1.08E+01	m	
Bulk density of aquifer materials	ρ	1.70E+00	g/cm^3	
Effective porosity of aquifer	n	1.82E-01	fraction	
Hydraulic gradient	i	1.25E-02	fraction	
Hydraulic conductivity of aquifer	K	2.00E+01	m/d	
Distance to compliance point	x	5.92E+02	m	
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	7.24E+02	l/kg	*see options*
Longitudinal dispersivity	ax	9.730	m	*see options*
Transverse dispersivity	az	0.973	m	*see options*
Vertical dispersivity	ay	0.097	m	*see options*

Calculated Parameters

	Variable		
Groundwater flow velocity	v	1.37E+00	m/d
Retardation factor	Rf	6.77E+03	fraction
Decay rate used	λ	3.47E-04	d^{-1}
Rate of contaminant flow due to retardation	u	2.03E-04	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	6.59E-97	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	3.65E-97	mg/l
Attenuation factor (one way vertical dispersion, C_0/C_{ED})	AF	3.03E+95	
Attenuation factor (two way vertical dispersion, C_0/C_{ED})	AF	5.48E+95	

Remedial Targets

Remedial Target	LTC3	1.90E+00	mg/l	For comparison with measured groundwater concentration.
Ogata Banks				
Distance to compliance point		592	m	
Concentration of contaminant at compliance point	$C_{ED}/C0$	6.59E-97	mg/l	Ogata Banks
after		9.9E+99	days	

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

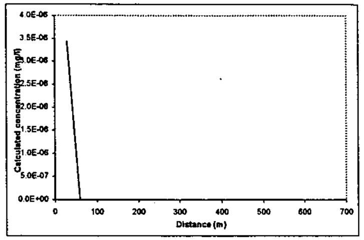
Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd		l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	1.00E+00	fraction
Organic carbon partition coefficient	Koc	7.24E+02	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$		l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Soil water partition coefficient	Kd	7.24E+02	l/kg

Dispersivity

Calculate dependant on distance to compliance point (0), specify dispersivity (1), or calc after Xu & Eckstein (2) ? 2

		Enter value	Calc value Xu & Eckstein	
Longitudinal dispersivity	ax		9.73E+00	m
Transverse dispersivity	az		9.73E-01	m
Vertical dispersivity	ay		9.73E-02	m

For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report ax = $0.83(\log_{10}x)^{2.414}$; 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.

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration
	mg/l
29.6	3.4E-06
59.2	5.9E-11
88.8	1.0E-15
118.4	1.7E-20
148.0	2.8E-25
177.8	4.7E-30
207.2	7.9E-35
236.8	1.3E-39
288.4	2.2E-44
296.0	3.7E-49
IP.8	6.1E-54
355.2	1.0E-58
384.8	1.7E-63
414.4	2.9E-68
444.0	4.9E-73
471.8	8.2E-78
503.2	1.4E-82
532.8	2.3E-87
882.4	3.9E-92
592.0	6.6E-97

This sheet calculates the Tier3 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

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 Tier 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.

Site being assessed.	Bless Area 1 Murphys K20
Completed by:	AJ
Date.	24 11 2005
Version	12

R&D Publication 20 Remedial Targets Worksheet, Release 2.2a

Tier 3 - Groundwater

ENVIRONMENT AGENCY

Input Parameters (using pull down menu)

	Variable	Value	Unit	Source
Contaminant		Flouride		
Target Concentration	C_T	1.00E+00	mg/l	

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

Ogata Banks — Equations in R&D Pub. 20

Enter '1' to simulate vertical dispersion in one direction, '2' for two directions (pull down menu): 1

Enter '1' if biodegradation rate is for the substance in water,
'0' if rate is for decay in field conditions (i.e. field data from aquifer) (pull down menu): 0

	Variable	Value	Unit	Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	2.70E+00	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	9.90E+99	days	
Calculated decay rate	λ	7.00E-101	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	1.90E+02	m	
Plume thickness at source	Sy	1.00E+01	m	
Saturated aquifer thickness	da	1.08E+01	m	
Bulk density of aquifer materials	ρ	1.70E+00	g/cm^3	
Effective porosity of aquifer	n	1.82E-01	fraction	
Hydraulic gradient	i	1.25E-02	fraction	
Hydraulic conductivity of aquifer	K	2.00E+01	m/d	
Distance to compliance point	x	5.92E+02	m	
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	0.00E+00	l/kg	*see options*
Longitudinal dispersivity	ax	9.730	m	*see options*
Transverse dispersivity	az	0.973	m	*see options*
Vertical dispersivity	ay	0.097	m	*see options*

Calculated Parameters

	Variable		
Groundwater flow velocity	v	1.37E+00	m/d
Retardation factor	Rf	1.00E+00	fraction
Decay rate used	λ	7.00E-101	d^{-1}
Rate of contaminant flow due to retardation	u	1.37E+00	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	1.74E+00	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	9.63E-01	mg/l
Attenuation factor (one way vertical dispersion, C_0/C_{ED})	AF	1.55E+00	
Attenuation factor (two way vertical dispersion, C_0/C_{ED})	AF	2.80E+00	

Remedial Targets

Remedial Target	LTC3	1.55E+00	mg/l	For comparison with measured groundwater concentration.
Ogata Banks				
Distance to compliance point		592	m	
Concentration of contaminant at compliance point	$C_{ED}/C0$	1.74E+00	mg/l	Ogata Banks
after		9.9E+99	days	

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

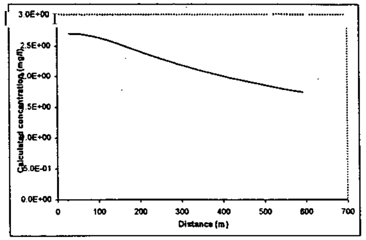
Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd		l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	1.00E+00	fraction
Organic carbon partition coefficient	Koc	0.00E+00	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$		l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Soil water partition coefficient	Kd	0.00E+00	l/kg

Dispersivity

Calculate dependant on distance to compliance point (0), specify dispersivity (1), or calc after Xu & Eckstein (2) ? 2

		Enter value	Calc value Xu & Eckstein	
Longitudinal dispersivity	ax		9.73E+00	m
Transverse dispersivity	az		9.73E-01	m
Vertical dispersivity	ay		9.73E-02	m

For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report ax = 0.83$(\log_{10}x)^{2.414}$; 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.

This sheet calculates the Tier3 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

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 Tier 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.

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration
	mg/l
29.6	2.7E+00
59.2	2.7E+00
88.8	2.7E+00
118.4	2.6E+00
148.0	2.5E+00
177.6	2.5E+00
207.2	2.4E+00
236.8	2.3E+00
266.4	2.3E+00
296.0	2.2E+00
325.6	2.1E+00
355.2	2.1E+00
384.8	2.0E+00
414.4	2.0E+00
444.0	1.9E+00
473.6	1.9E+00
503.2	1.9E+00
532.8	1.8E+00
562.4	1.8E+00
592.0	1.7E+00

Site being assessed	Bloss Area 1 A murphy K20
Completed by.	AJ
Date.	24 11 2005
Version:	12

R&D Publication 20 Remedial Targets Worksheet, Release 2.2a

Tier 3 - Groundwater

ENVIRONMENT AGENCY

Input Parameters (using pull down menu)	Variable	Value	Unit	Source
Contaminant		Fluoranthene		
Target Concentration	C_T	1.00E-03	mg/l	

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

Ogata Banks — Equations in R&D Pub. 20

Enter '1' to simulate vertical dispersion in one direction, '2' for two directions (pull down menu): 1

Enter '1' if biodegradation rate is for the substance in water,
'0' if rate is for decay in field conditions (i.e. field data from aquifer) (pull down menu): 0

				Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	5.00E-01	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	8.80E+02	days	
Calculated decay rate	λ	7.88E-04	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	1.90E+02	m	
Plume thickness at source	Sy	1.00E+01	m	
Saturated aquifer thickness	da	1.08E+01	m	
Bulk density of aquifer materials	ρ	1.70E+00	g/cm^3	
Effective porosity of aquifer	n	1.82E-01	fraction	
Hydraulic gradient	i	1.25E-02	fraction	
Hydraulic conductivity of aquifer	K	2.00E+01	m/d	
Distance to compliance point	x	5.92E+02	m	
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time varient options only*
Parameters values determined from options				
Partition coefficient	Kd	1.38E+02	l/kg	*see options*
Longitudinal dispersivity	ax	9.730	m	*see options*
Transverse dispersivity	az	0.973	m	*see options*
Vertical dispersivity	ay	0.097	m	*see options*

Calculated Parameters	Variable		
Groundwater flow velocity	v	1.37E+00	m/d
Retardation factor	Rf	1.29E+03	fraction
Decay rate used	λ	7.88E-04	d^{-1}
Rate of contaminant flow due to retardation	u	1.06E-03	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	4.04E-60	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	2.23E-60	mg/l
Attenuation factor (one way vertical dispersion, C_0/C_{ED})	AF	1.24E+59	
Attenuation factor (two way vertical dispersion, C_0/C_{ED})	AF	2.24E+59	

Remedial Targets

Remedial Target	LTC3	1.24E+56	mg/l	For comparison with measured groundwater concentration.
Ogata Banks				
Distance to compliance point		592	m	
Concentration of contaminant at compliance point	$C_{ED}/C0$	4.04E-60	mg/l	Ogata Banks
after		9.9E+99	days	

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

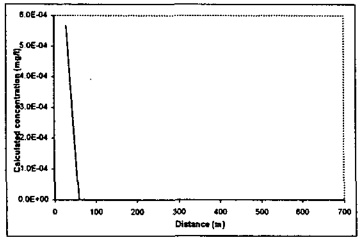
Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd		l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	1.00E+00	fraction
Organic carbon partition coefficient	Koc	1.38E+02	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$		l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Soil water partition coefficient	Kd	1.38E+02	l/kg

Dispersivity

Calculate dependant on distance to compliance point (0), specify dispersivity (1), or calc after Xu & Eckstein (2) ? 2

		Enter value	Calc value Xu & Eckstein	
Longitudinal dispersivity	ax		9.73E+00	m
Transverse dispersivity	az		9.73E-01	m
Vertical dispersivity	ay		9.73E-02	m

For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report $ax = 0.83(\log_{10}x)^{2.414}$; 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.

This sheet calculates the Tier3 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

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 Tier 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.

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration
	mg/l
29.6	5.7E-04
59.2	6.4E-07
88.8	7.2E-10
118.4	8.0E-13
148.0	8.8E-16
177.6	9.7E-19
207.2	1.1E-21
236.8	1.2E-24
266.4	1.3E-27
296.0	1.4E-30
325.6	1.6E-33
355.2	1.8E-36
384.8	1.9E-39
414.4	2.2E-42
444.0	2.4E-45
473.6	2.6E-48
503.2	2.9E-51
532.8	3.3E-54
562.4	3.6E-57
592.0	4.0E-60

Site being assessed.	Bless Area 1 Murphys K20
Completed by.	AJ
Date	24 11 2005
Version	12

R&D Publication 20 Remedial Targets Worksheet, Release 2.2a

ENVIRONMENT AGENCY

Tier 3 - Groundwater

Input Parameters (using pull down menu)	Variable	Value	Unit	Source
Contaminant		Fluorene		
Target Concentration	C_T	6.25E-08	mg/l	

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

Ogata Banks — Equations in R&D Pub. 20

Enter '1' to simulate vertical dispersion in one direction, '2' for two directions (pull down menu): 1

Enter '1' if biodegradation rate is for the substance in water,
'0' if rate is for decay in field conditions (i.e. field data from aquifer) (pull down menu): 0

	Variable	Value	Unit	Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	3.00E-01	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	1.20E+02	days	
Calculated decay rate	λ	5.78E-03	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	1.90E+02	m	
Plume thickness at source	Sy	1.00E+01	m	
Saturated aquifer thickness	da	1.08E+01	m	
Bulk density of aquifer materials	ρ	1.70E+00	g/cm^3	
Effective porosity of aquifer	n	1.82E-01	fraction	
Hydraulic gradient	i	1.25E-02	fraction	
Hydraulic conductivity of aquifer	K	2.00E+01	m/d	
Distance to compliance point	x	5.92E+02	m	
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	2.63E+01	l/kg	*see options*
Longitudinal dispersivity	ax	9.730	m	*see options*
Transverse dispersivity	az	0.973	m	*see options*
Vertical dispersivity	ay	0.097	m	*see options*

Calculated Parameters

	Variable		
Groundwater flow velocity	v	1.37E+00	m/d
Retardation factor	Rf	2.47E+02	fraction
Decay rate used	λ	5.78E-03	d^{-1}
Rate of contaminant flow due to retardation	u	5.57E-03	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	3.34E-73	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	1.85E-73	mg/l
Attenuation factor (one way vertical dispersion, C_O/C_{ED})	AF	8.97E+71	
Attenuation factor (two way vertical dispersion, C_O/C_{ED})	AF	1.82E+72	

Remedial Targets

Remedial Target LTC3 5.61E+66 mg/l — For comparison with measured groundwater concentration.

Ogata Banks

Distance to compliance point		**592**	**m**	
Concentration of contaminant at compliance point	$C_{ED}/C0$	**3.34E-73**	**mg/l**	Ogata Banks
after		**9.9E+99**	**days**	

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

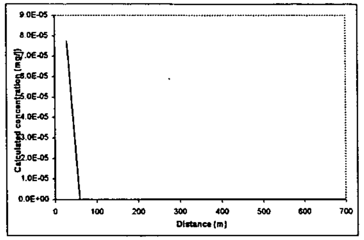
Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd	[redacted]	l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	1.00E+00	fraction
Organic carbon partition coefficient	Koc	2.63E+01	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$	[redacted]	l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Soil water partition coefficient	Kd	2.63E+01	l/kg

Dispersivity

Calculate dependant on distance to compliance point (0), specify dispersivity (1), or calc after Xu & Eckstein (2) ? 2

		Enter value	Calc value Xu & Eckstein	
Longitudinal dispersivity	ax	[redacted]	9.73E+00	m
Transverse dispersivity	az		9.73E-01	m
Vertical dispersivity	ay		9.73E-02	m

For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report ax = $0.83(\log_{10}x)^{2.414}$; 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.

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration
	mg/l
29.6	7.7E-05
59.2	2.0E-08
88.8	5.1E-12
131.4	1.3E-15
148.0	3.2E-19
377.1	8.1E-23
207.2	2.0E-26
266.6	
	5.3E-30
296.0	3.2E-37
126.E	8.1E-41
355.2	L D E U
384.8	5.1E-48
414.4	1.3E-51
444.0	3.2E-55
471.1	8.2E-59
601.2	2.1E-62
532.8	5.2E-66
592.0	3.3E-69

This sheet calculates the Tier3 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

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 Tier 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.

Site being assessed:	Bless Area 1 Murphys K20
Completed by	AJ
Date:	24 11 2005
Version	12

R&D Publication20 Remedial Targets Worksheet, Release 2.2a

Tier 3 - Groundwater

ENVIRONMENT
AGENCY

Input Parameters (using pull down menu)

	Variable	Value	Unit	Source
Contaminant		Lead		
Target Concentration	C_T	1.00E-02	mg/l	

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

Ogata Banks — Equations in R&D Pub. 20

Ente: '1' to simulate vertical dispersion in one direction, '2' for two directions (pull down menu): 1

Enter '1' if biodegradation rate is for the substance in water,
'0' if rate is for decay in field conditions (i.e. field data from aquifer) (pull down menu: 0

	Variable	Value	Unit	Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	7.50E-02	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	9.90E+99	days	
Calculated decay rate	λ	7.00E-101	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	1.90E+02	m	
Plume thickness at source	Sy	1.00E+01	m	
Saturated aquifer thickness	da	1.08E+01	m	
Bulk density of aquifer materials	ρ	1.70E+00	g/cm^3	
Effective porosity of aquifer	n	1.82E-01	fraction	
Hydraulic gradient	i	1.25E-02	fraction	
Hydraulic conductivity of aquifer	K	2.00E+01	m/d	
Distance to compliance point	x	5.92E+02	m	
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	3.16E+04	l/kg	*see options*
Longitudinal dispersivity	ax	9.730	m	*see options*
Transverse dispersivity	az	0.973	m	*see options*
Vertical dispersivity	ay	0.097	m	*see options*

Calculated Parameters

	Variable		
Groundwater flow velocity	v	1.37E+00	m/d
Retardation factor	Rf	2.95E+05	fraction
Decay rate used	λ	7.00E-101	d^{-1}
Rate of contaminant flow due to retardation	u	4.65E-06	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	4.84E-02	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	2.68E-02	mg/l
Attenuation factor (one way vertical dispersion, C_0/C_{ED})	AF	1.55E+00	
Attenuation factor (two way vertical dispersion, C_0/C_{ED})	AF	2.80E+00	

Remedial Targets

Remedial Target LTC3 1.55E-02 mg/l — For comparison with measured groundwater concentration.
Ogata Banks

Distance to compliance point		592	m	
Concentration of contaminant at compliance point	$C_{ED}/C0$	4.84E-02	mg/l	Ogata Banks
after		9.9E+99	days	

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

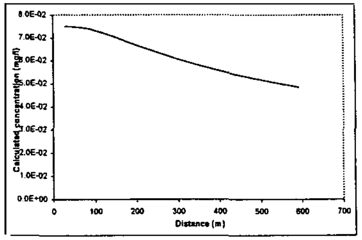
Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd	[redacted]	l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	1.00E+00	fraction
Organic carbon partition coefficient	Koc	3.16E+04	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$	[redacted]	l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Soil water partition coefficient	Kd	3.16E+04	l/kg

Dispersivity

Calculate dependant on distance to compliance point (0), specify dispersivity (1), or calc after Xu & Eckstein (2) ? 2

		Enter value	Calc value Xu & Eckstein	
Longitudinal dispersivity	ax	[redacted]	9.73E+00	m
Transverse dispersivity	az		9.73E-01	m
Vertical dispersivity	ay		9.73E-02	m

For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report ax = $0.83(\log_{10}x)^{2.414}$; 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.

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	**Concentration**
	mg/l
29.6	7.5E-02
59.2	7.5E-02
P.6	7.4E-02
118.4	7.2E-02
148.0	7.0E-02
177.6	6.8E-02
207.2	6.6E-02
236.8	6.4E-02
266.4	6.3E-02
296.0	6.1E-02
325.6	5.9E-02
366.2	5.8E-02
384.8	5.6E-02
414.4	5.5E-02
444.0	5.4E-02
473.6	5.3E-02
503.2	5.1E-02
532.8	5.0E-02
562.4	4.9E-02
6020	4.8E-02

This sheet calculates the Tier3 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

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 Tier 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.

Site being assessed.	Bless Area 1 A murphy K20
Completed by.	AJ
Date:	24 11 2005
Version	12

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R&D Publication20 Remedial Targets Worksheet, Release2.2a

Tier 3 -Groundwater

ENVIRONMENT AGENCY

Input Parameters (using pull dorm menu)	Variable	Value	Unit	Source
Contaminant Target Concentration	C_T	6.25E-06	mg/l	

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

Ogata Banks — Equations in R&D Pub. 20

Enter '1' to simulate vertical dispersion in one direction, '2' for two directions (pull down menu): 1

Enter '1' if biodegradation rate is for the substance in water,
'0' if rate is for decay in field conditions (i.e. field data from aquifer) (pull down menu): 0

				Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	1.30E+00	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	4.00E+02	days	
Calculated decay rate	λ	1.73E-03	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	1.90E+02	m	
Plume thickness at source	Sy	1.00E+01	m	
Saturated aquifer thickness	da	1.08E+01	m	
Bulk density of aquifer materials	ρ	1.70E+00	g/cm^3	
Effective porosity of aquifer	n	1.82E-01	fraction	
Hydraulic gradient	i	1.25E-02	fraction	
Hydraulic conductivity of aquifer	K	2.00E+01	m/d	
Distance to compliance point	x	5.92E+02	m	
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	5.13E+01	l/kg	*see options*
Longitudinal dispersivity	ax	9.730	m	*see options*
Transverse dispersivity	az	0.973	m	*see options*
Vertical dispersivity	ay	0.097	m	*see options*

Calculated Parameters	Variable		
Groundwater flow velocity	v	1.37E+00	m/d
Retardation factor	Rf	4.80E+02	fraction
Decay rate used	λ	1.73E-03	d^{-1}
Rate of contaminant flow due to retardation	u	2.86E-03	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	4.49E-53	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	2.48E-53	mg/l
Attenuation factor (one way vertical dispersion, C_0/C_{ED})	AF	2.89E+52	
Attenuation factor (two way vertical dispersion, C_0/C_{ED})	AF	5.23E+52	

Remedial Targets

Remedial Target	LTC3	1.81E+47	mg/l	For comparison with measured groundwater concentration.

Ogata Banks

Distance to compliance point		592	m	
Concentration of contaminant at compliance point	$C_{ED}/C0$	4.49E-53	mg/l	Ogata Banks
after		9.9E+99	days	

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

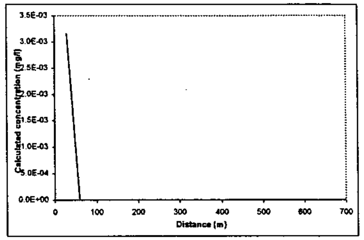
Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd		l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	1.00E+00	fraction
Organic carbon partition coefficient	Koc	5.13E+01	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$		l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Soil water partition coefficient	Kd	5.13E+01	l/kg

Dispersivity

Calculate dependant on distance to compliance point (0), specify dispersivity (1), or calc after Xu & Eckstein (2) ? 2

		Enter value	Calc value Xu & Eckstein	
Longitudinal dispersivity	ax		9.73E+00	m
Transverse dispersivity	az		9.73E-01	m
Vertical dispersivity	ay		9.73E-02	m

For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report ax = $0.83(\log_{10}x)^{2.414}$; 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.

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration mg/l
29.6	3.2E-03
63.2	7.7E-06
88.8	1.8E-08
118.4	4.4E-11
148.0	1.0E-13
177.6	2.5E-16
207.2	5.8E-19
236.8	1.4E-21
266.4	3.3E-24
296.0	7.7E-27
326.9	1.8E-29
366.2	4.3E-32
384.8	1.0E-34
414.4	2.5E-37
444.0	5.8E-40
473.9	1.4E-42
603.2	3.3E-45
632.8	7.9E-48
662.4	1.9E-50
692.0	4.5E-53

This sheet calculates the Tier3 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

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 Tier 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.

Site being assessed	Bless Area 1 Murphys K20
Completed by.	AJ
Date:	24 11 2005
Version	12

R&D Publication 20 Remedial Targets Worksheet, Release2.2a

Tier 3 -Groundwater

ENVIRONMENT AGENCY

Input Parameters (using pull down menu)

	Variable	Value	Unit	Source
Contaminant		Phenol		
Target Concentration	C_T	5.00E-04	mg/l	

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

Ogata Banks — Equations in R&D Pub. 20

Enter '1' to simulate vertical dispersion in one direction, '2' for two directions (pull down menu): 1

Enter '1' if biodegradation rate is for the substance in water,
'0' if rate is for decay in field conditions (i.e. field data from aquifer) (pull down menu): 0

	Variable	Value	Unit	Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	5.00E-01	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	1.00E+01	days	
Calculated decay rate	λ	6.93E-02	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	1.90E+02	m	
Plume thickness at source	Sy	1.00E+01	m	
Saturated aquifer thickness	da	1.08E+01	m	
Bulk density of aquifer materials	ρ	1.70E+00	g/cm^3	
Effective porosity of aquifer	n	1.82E-01	fraction	
Hydraulic gradient	i	1.25E-02	fraction	
Hydraulic conductivity of aquifer	K	2.00E+01	m/d	
Distance to compliance point	x	5.92E+02	m	
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	1.05E-01	l/kg	*see options*
Longitudinal dispersivity	ax	9.730	m	*see options*
Transverse dispersivity	az	0.973	m	*see options*
Vertical dispersivity	ay	0.097	m	*see options*

Calculated Parameters

	Variable		
Groundwater flow velocity	v	1.37E+00	m/d
Retardation factor	Rf	1.98E+00	fraction
Decay rate used	λ	6.93E-02	d^{-1}
Rate of contaminant flow due to retardation	u	6.94E-01	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	3.32E-17	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	1.83E-17	mg/l
Attenuation factor (one way vertical dispersion, C_0/C_{ED})	AF	1.51E+16	
Attenuation factor (two way vertical dispersion, C_0/C_{ED})	AF	2.73E+16	

Remedial Targets

Remedial Target	LTC3	7.54E+12	mg/l	For comparison with measured groundwater concentration.
Ogata Banks				
Distance to compliance point		**592**	**m**	
Concentration of contaminant at compliance point	$C_{ED}/C0$	**3.32E-17**	**mg/l**	Ogata Banks
after		**9.9E+99**	**days**	

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

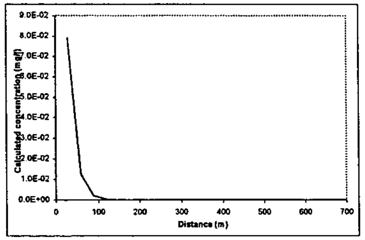
Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd		l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	1.00E+00	fraction
Organic carbon partition coefficient	Koc	1.05E-01	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$		l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Soil water partition coefficient	Kd	1.05E-01	l/kg

Dispersivity

Calculate dependant on distance to compliance point (0), specify dispersivity (1), or calc after Xu & Eckstein (2) ?: 2

		Enter value	Calc value Xu & Eckstein	
Longitudinal dispersivity	ax		9.73E+00	m
Transverse dispersivity	az		9.73E-01	m
Vertical dispersivity	ay		9.73E-02	m

For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report ax = $0.83(\log_{10}x)^{2.414}$; 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.

This sheet calculates the Tier3 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

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 Tier 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.

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration mg/l
29.6	7.9E-02
59.2	1.3E-02
88.8	2.0E-03
118.4	3.1E-04
148.0	4.7E-05
177.0	7.3E-06
207.2	1.1E-06
236.8	1.7E-07
266.4	2.7E-08
296.0	4.1E-09
325.6	6.4E-10
355.2	9.8E-11
384.8	1.5E-11
414.4	2.4E-12
444.0	3.7E-13
473.0	5.7E-14
503.2	8.8E-15
532.8	1.4E-15
562.4	2.1E-16
592.0	3.3E-17

Site being assessed:	Bless Area 1 A murphy K20
Completed by	AJ
Date:	24 11 2005
Version	12

R&D Publication 20 Remedial Targets Worksheet, Release2.2a

Tier 3 - Groundwater

ENVIRONMENT AGENCY

Input Parameters (using pull down menu)	Variable	Value	Unit	Source
Contaminant		Phosphorus		
Target Concentration	C_T	2.20E+00	mg/l	

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

Ogata Banks — Equations in R&D Pub. 20

Enter '1' to simulate vertical dispersion in one direction, '2' for two directions (pull down menu): 1

Enter '1' if biodegradation rate is for the substance in water,
'0' if rate is for decay in field conditions (i.e. field data from aquifer) (pull down menu): 0

	Variable	Value	Unit	Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	1.03E+00	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	9.90E+99	days	
Calculated decay rate	λ	7.00E-101	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	1.90E+02	m	
Plume thickness at source	Sy	1.00E+01	m	
Saturated aquifer thickness	da	1.08E+01	m	
Bulk density of aquifer materials	ρ	1.70E+00	g/cm^3	
Effective porosity of aquifer	n	1.82E-01	fraction	
Hydraulic gradient	i	1.25E-02	fraction	
Hydraulic conductivity of aquifer	K	2.00E+01	m/d	
Distance to compliance point	x	5.92E+02	m	
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	0.00E+00	l/kg	*see options*
Longitudinal dispersivity	ax	9.730	m	*see options*
Transverse dispersivity	az	0.973	m	*see options*
Vertical dispersivity	ay	0.097	m	*see options*

Calculated Parameters	Variable		
Groundwater flow velocity	v	1.37E+00	m/d
Retardation factor	Rf	1.00E+00	fraction
Decay rate used	λ	7.00E-101	d^{-1}
Rate of contaminant flow due to retardation	u	1.37E+00	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	6.65E-01	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	3.68E-01	mg/l
Attenuation factor (one way vertical dispersion, C_O/C_{ED})	AF	1.55E+00	
Attenuation factor (two way vertical dispersion, C_O/C_{ED})	AF	2.80E+00	

Remedial Targets

Remedial Target	LTC3	3.41E+00	mg/l	For comparison with measured groundwater concentration.
Ogata Banks				
Distance to compliance point		592	m	
Concentration of contaminant at compliance point	$C_{ED}/C0$	6.65E-01	mg/l	Ogata Banks
after		9.9E+99	days	

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

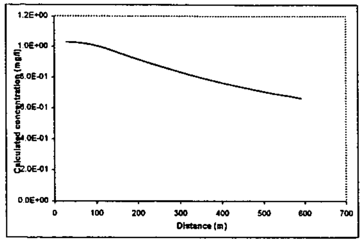
Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd	[redacted]	l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	1.00E+00	fraction
Organic carbon partition coefficient	Koc	0.00E+00	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$	[redacted]	l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Soil water partition coefficient	Kd	0.00E+00	l/kg

Dispersivity

Calculate dependant on distance to compliance point (0), specify dispersivity (1), or calc after Xu & Eckstein (2) ? 2

		Enter value	Calc value Xu & Eckstein	
Longitudinal dispersivity	ax	[redacted]	9.73E+00	m
Transverse dispersivity	az		9.73E-01	m
Vertical dispersivity	ay		9.73E-02	m

For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report ax = $0.83(\log_{10}x)^{2.414}$; 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.

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration mg/l
29.6	1.0E+00
69.2	1.0E+00
88.8	1.0E+00
118.4	9.9E-01
148.0	9.7E-01
177.8	9.4E-01
288.8	8.9E-01
2U.4	8.6E-01
296.0	8.4E-01
326.8	8.1E-01
355.2	7.9E-01
384.8	7.7E.M
414.4	7.6E-01
444.0	7.4E-01
473.9	7.2E-01
503.2	7.1E-01
532.8	6.9E-01
562.4	6.8E-01
592.0	6.6E-01

This sheet calculates the Tier3 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

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 Tier 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.

Site being assessed.	Bless Area 1 A murphy K20
Completed by	AJ
Date:	24 11 2005
Version.	12

R&D Publication 20 Remedial Targets Worksheet, Release 2.2a

ENVIRONMENT AGENCY

Tier 3 - Groundwater

Input Parameters (using pull down menu)	Variable	Value	Unit	Source
Contaminant		Pyrene		
Target Concentration	C_T	6.25E-06	mg/l	

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

Ogata Banks — Equations in R&D Pub. 20

Enter '1' to simulate vertical dispersion in one direction, '2' for two directions (pull down menu): 1

Enter '1' if biodegradation rate is for the substance in water,
'0' if rate is for decay in field conditions (i.e. field data from aquifer) (pull down menu): 0

	Variable	Value	Unit	Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	6.00E-01	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	3.80E+03	days	
Calculated decay rate	λ	1.82E-04	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	1.90E+02	m	
Plume thickness at source	Sy	1.00E+01	m	
Saturated aquifer thickness	da	1.08E+01	m	
Bulk density of aquifer materials	ρ	1.70E+00	g/cm^3	
Effective porosity of aquifer	n	1.82E-01	fraction	
Hydraulic gradient	i	1.25E-02	fraction	
Hydraulic conductivity of aquifer	K	2.00E+01	m/d	
Distance to compliance point	x	5.92E+02	m	
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	1.38E+02	l/kg	*see options*
Longitudinal dispersivity	ax	9.730	m	*see options*
Transverse dispersivity	az	0.973	m	*see options*
Vertical dispersivity	v	0.097	m	*see options*

Calculated Parameters	Variable		
Groundwater flow velocity	v	1.37E+00	m/d
Retardation factor	Rf	1.29E+03	fraction
Decay rate used	λ	1.82E-04	d^{-1}
Rate of contaminant flow due to retardation	u	1.06E-03	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	1.64E-24	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	9.07E-25	mg/l
Attenuation factor (one way vertical dispersion, C_0/C_{ED})	AF	3.66E+23	
Attenuation factor (two way vertical dispersion, C_0/C_{ED})	AF	6.62E+23	

Remedial Targets

Remedial Target Ogata Banks	LTC3	2.29E+19	mg/l	For comparison with measured groundwater concentration.
Distance to compliance point		**592**	**m**	
Concentration of contaminant at compliance point	$C_{ED}/C0$	**1.64E-24**	**mg/l**	Ogata Banks
after		**9.9E+99**	**days**	

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

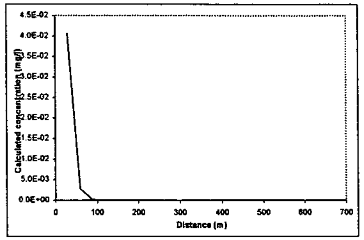
Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd		l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	1.00E+00	fraction
Organic carbon partition coefficient	Koc	1.38E+02	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$		l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Soil water partition coefficient	Kd	1.38E+02	l/kg

Dispersivity

Calculate dependant on distance to compliance point (0), specify dispersivity (1), or calc after Xu & Eckstein (2) ? 2

		Enter value	Calc value Xu & Eckstein	
Longitudinal dispersivity	ax		9.73E+00	m
Transverse dispersivity	az		9.73E-01	m
Vertical dispersivity	ay		9.73E-02	m

For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report ax = $0.83(\log_{10}x)^{2.414}$; 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.

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration
	mg/l
29.6	4.1E-02
59.2	2.8E-03
88.8	1.8E-04
146.0	8.2E-07
177.6	5.3E-08
207.2	3.6E-09
230.6	2.3E-10
259.4	1.5E-11
296.0	1.0E-12
325.6	6.6E-14
355.2	4.4E-15
384.8	2.9E-16
414.4	1.9E-17
444.0	1.3E-18
473.0	8.4E-20
503.2	5.6E-21
532.8	3.7E-22
562.4	2.5E-23
602.0	1.6E-24

This sheet calculates the Tier3 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
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 Tier 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.

Site being assessed	Bless Area 1 Murphys K20
Completed by	AJ
Date	24 11 2005
Version	12

R&D Publication 20 Remedial Targets Worksheet, Release 2.2a

Tier 3 - Groundwater

ENVIRONMENT AGENCY

Input Parameters (using pull down menu)	Variable	Value	Unit	Source
Contaminant		Selenium		
Target Concentration	C_T	1.00E-02	mg/l	

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

Ogata Banks — Equations in R&D Pub. 20

Enter '1' to simulate vertical dispersion in one direction, '2' for two directions (pull down menu): 1

Enter '1' if biodegradation rate is for the substance in water,
'0' if rate is for decay in field conditions (i.e. field data from aquifer) (pull down menu): 0

	Variable	Value	Unit	Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	2.00E-03	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	9.90E+99	days	
Calculated decay rate	λ	7.00E-101	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	1.90E+02	m	
Plume thickness at source	Sy	1.00E+01	m	
Saturated aquifer thickness	da	1.08E+01	m	
Bulk density of aquifer materials	ρ	1.70E+00	g/cm^3	
Effective porosity of aquifer	n	1.82E-01	fraction	
Hydraulic gradient	i	1.25E-02	fraction	
Hydraulic conductivity of aquifer	K	2.00E+01	m/d	
Distance to compliance point	x	5.92E+02	m	
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	9.55E+00	l/kg	*see options*
Longitudinal dispersivity	ax	9.730	m	*see options*
Transverse dispersivity	az	0.973	m	*see options*
Vertical dispersivity	ay	0.097	m	*see options*

Calculated Parameters	Variable		
Groundwater flow velocity	v	1.37E+00	m/d
Retardation factor	Rf	9.02E+01	fraction
Decay rate used	λ	7.00E-101	d^{-1}
Rate of contaminant flow due to retardation	u	1.52E-02	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	1.29E-03	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	7.14E-04	mg/l
Attenuation factor (one way vertical dispersion, C_0/C_{ED})	*Af*	1.55E+00	
Attenuation factor (two way vertical dispersion, C_0/C_{ED})	*Af*	2.80E+00	

Remedial Targets

Remedial Target LTC3 1.55E-02 mg/l For comparison with measured groundwater concentration.
Ogata Banks

Distance to compliance point 592 m

Concentration of contaminant at compliance point $C_{ED}/C0$ **1.29E-03 mg/l** Ogata Banks
after 9.9E+99 days

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

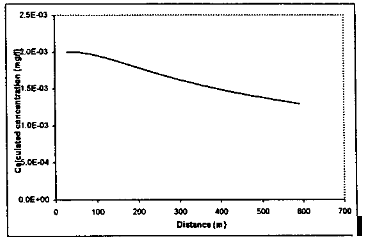
Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd		l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	1.00E+00	fraction
Organic carbon partition coefficient	Koc	9.55E+00	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$		l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Soil water partition coefficient	Kd	9.55E+00	l/kg

Dispersivity

Calculate dependant on distance to compliance point (0), specify dispersivity (1), or calc after Xu & Eckstein (2) ? 2

		Enter value	Calc value Xu & Eckstein	
Longitudinal dispersivity	**ax**		9.73E+00	m
Transverse dispersivity	**az**		9.73E-01	m
Vertical dispersivity	**ay**		9.73E-02	m

For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report ax = $0.83(\log_{10}x)^{2.414}$; 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.

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration
	mg/l
29.6	2.0E-03
68.2	2.0E-03
88.8	2.0E-03
118.4	1.9E-03
146.0	I.SE-O1
177.6	1.8E-03
207.2	1.8E-W
236.8	1.7E-03
266.4	1.7E-03
296.0	1.6E-03
325.6	1.6E-03
355.2	1.5E-03
384.8	1.6E-01
414.4	1.5E-03
444.0	1.4E-03
473.0	1.4E-03
503.2	1.4E-03
532.8	1.3E-03
562.4	1.3E-03
592.0	1.3E-03

This sheet calculates the Tier3 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

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 Tier 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.

Site being assessed	Bless Area 1 A murphy K20
Completed by	AJ
Date	24 11 2005
Version	12

R&D Publication 20 Remedial Targets Worksheet, Release 2.2a

Tier 3 - Groundwater

ENVIRONMENT AGENCY

Input Parameters (using pull down menu)	Variable	Value	Unit	Source
Contaminant		Strontium		
Target Concentration	C_T	1.00E+00	mg/l	

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

Ogata Banks — Equations in R&D Pub. 20

Enter '1' to simulate vertical dispersion in one direction, '2' for two directions (pull down menu): 1

Enter '1' if biodegradation rate is for the substance in water,
'0' if rate is for decay in field conditions (i.e. field data from aquifer) (pull down menu: 0

				Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	4.90E-01	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	9.90E+99	days	
Calculated decay rate	λ	7.00E-101	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	1.90E+02	m	
Plume thickness at source	Sy	1.00E+01	m	
Saturated aquifer thickness	da	1.08E+01	m	
Bulk density of aquifer materials	ρ	1.70E+00	g/cm^3	
Effective porosity of aquifer	n	1.82E-01	fraction	
Hydraulic gradient	i	1.25E-02	fraction	
Hydraulic conductivity of aquifer	K	2.00E+01	m/d	
Distance to compliance point	x	5.92E+02	m	
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	0.00E+00	l/kg	*see options*
Longitudinal dispersivity	ax	9.730	m	*see options*
Transverse dispersivity	az	0.973	m	*see options*
Vertical dispersivity	ay	0.097	m	*see options*

Calculated Parameters	Variable		
Groundwater flow velocity	v	1.37E+00	m/d
Retardation factor	Rf	1.00E+00	fraction
Decay rate used	λ	7.00E-101	d^{-1}
Rate of contaminant flow due to retardation	u	1.37E+00	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	3.16E-01	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	1.75E-01	mg/l
Attenuation factor (one way vertical dispersion, C_0/C_{ED})	AF	1.55E+00	
Attenuation factor (two way vertical dispersion, C_0/C_{ED})	AF	2.80E+00	

Remedial Targets

Remedial Target	LTC3	1.55E+00	mg/l	For comparison with measured groundwater concentration.
Ogata Banks				
Distance to compliance point		592	m	
Concentration of contaminant at compliance point	$C_{ED}/C0$	3.16E-01	mg/l	Ogata Banks
after		9.9E+99	days	

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

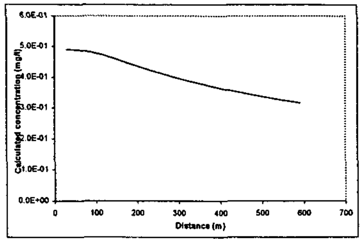
Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd	[redacted]	l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	1.00E+00	fraction
Organic carbon partition coefficient	Koc	0.00E+00	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$	[redacted]	l/kg
Sorption coefficient for ionised species	$K_{oc,i}$	[redacted]	l/kg
pH value	pH	[redacted]	
acid dissociation constant	pKa	[redacted]	
Soil water partition coefficient	Kd	0.00E+00	l/kg

Dispersivity

Calculate dependant on distance to compliance point (0), specify dispersivity (1), or calc after Xu & Eckstein (2) ? 2

		Enter value	Calc value Xu & Eckstein	
Longitudinal dispersivity	ax	[redacted]	9.73E+00	m
Transverse dispersivity	az	[redacted]	9.73E-01	m
Vertical dispersivity	ay	[redacted]	9.73E-02	m

For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report ax = 0.83$(\log_{10}x)^{2.414}$; 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.

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration
	mg/l
29.6	4.9E-01
59.2	4.9E-01
64.8	4.8E-01
118.4	4.7E-01
178.8	4.6E-01
207.2	4.3E-01
236.8	4.2E-01
266.4	4.1E-01
296.0	4.0E-01
325.6	3.9E-01
355.2	3.8E-01
384.8	3.7E-01
414.4	3.6E-01
444.0	3.5E-01
473.8	3.4E-01
503.2	3.4E-01
632.8	3.3E-01
682.0	3.2E-01

This sheet calculates the Tier3 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

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 Tier 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.

Site being assessed	Bloss Area 1 A murphy K20
Completed by:	AJ
Date.	24 11 2005
Version	12

R&D Publication20 Remedial Targets Worksheet, Release2.2a

ENVIRONMENT AGENCY

Tier 3 - Groundwater

Input Parameters (using pull down menu)	Variable	Value	Unit	Source
Contaminant		Sulphate		
Target Concentration	C_T	2.00E+02	mg/l	

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

Ogata Banks | Equations in R&D Pub. 20

Enter '1' to simulate vertical dispersion in one direction, '2' for two directions (pull down menu) | 1

Enter '1' if biodegradation rate is for the substance in water,
'0' if rate is for decay in field conditions (i.e. field data from aquifer) (pull down menu | 0

	Variable	Value	Unit	Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	4.20E+01	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	9.90E+99	days	
Calculated decay rate	λ	7.00E-101	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	1.90E+02	m	
Plume thickness at source	Sy	1.00E+01	m	
Saturated aquifer thickness	da	1.08E+01	m	
Bulk density of aquifer materials	ρ	1.70E+00	g/cm^3	
Effective porosity of aquifer	n	1.82E-01	fraction	
Hydraulic gradient	i	1.25E-02	fraction	
Hydraulic conductivity of aquifer	K	2.00E+01	m/d	
Distance to compliance point	x	5.92E+02	m	
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	0.00E+00	l/kg	*see options*
Longitudinal dispersivity	ax	9.730	m	*see options*
Transverse dispersivity	az	0.973	m	*see options*
Vertical dispersivity	ay	0.097	m	*see options*

Calculated Parameters	Variable		
Groundwater flow velocity	v	1.37E+00	m/d
Retardation factor	Rf	1.00E+00	fraction
Decay rate used	λ	7.00E-101	d^{-1}
Rate of contaminant flow due to retardation	u	1.37E+00	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	2.71E+01	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	1.50E+01	mg/l
Attenuation factor (one way vertical dispersion, C_0/C_{ED})	AF	1.55E+00	
Attenuation factor (two way vertical dispersion, C_0/C_{ED})	AF	2.80E+00	

Remedial Targets

Remedial Target	LTCS	3.10E+02	mg/l	For comparison with measured groundwater concentration.
Ogata Banks				
Distance to compliance point		**592**	**m**	
Concentration of contaminant at compliance point	$C_{ED}/C0$	**2.71E+01**	**mg/l**	Ogata Banks
after		**9.9E+99**	**days**	

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

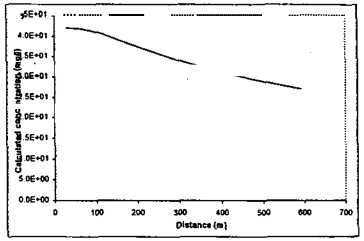
Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd	[redacted]	l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	1.00E+00	fraction
Organic carbon partition coefficient	Koc	0.00E+00	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$	[redacted]	l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Soil water partition coefficient	Kd	0.00E+00	l/kg

Dispersivity

Calculate dependant on distance to compliance point (0), | 2
specify dispersivity (1), or calc after Xu & Eckstein (2) ?

		Enter value	Calc value Xu & Eckstein	
Longitudinal dispersivity	ax	[redacted]	9.73E+00	m
Transverse dispersivity	az		9.73E-01	m
Vertical dispersivity	ay		9.73E-02	m

For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report ax = $0.83(\log_{10}x)^{2.414}$; 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.

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration
	mg/l
29.6	4.2E+01
59.2	4.2E+01
88.8	4.1E+01
118.4	4.0E+01
148.0	3.9E+01
177.6	3.8E+01
207.2	3.7E+01
236.8	3.6E+01
266.4	3.5E+01
296.0	3.4E+01
325.6	3.3E+01
355.2	3.2E+01
384.8	3.2E+01
414.4	3.1E+01
444.0	3.0E+01
473.6	2.9E+01
503.2	2.9E+01
532.8	2.8E+01
562.4	2.8E+01
592.0	2.7E+01

This sheet calculates the Tier3 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

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 Tier 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.

Site being assessed	Bless Area 1 A murphy K20
Completed by	AJ
Date:	24 11 2005
Version	12

R&D Publication 20 Remedial Targets Worksheet, Release 2.2a

Tier 3 - Groundwater

ENVIRONMENT AGENCY

Input Parameters (using pull down menu)

Input Parameters	Variable	Value	Unit	Source
Contaminant		Sulphide		
Target Concentration	C_T	2.50E-04	mg/l	

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

Ogata Banks — Equations in R&D Pub. 20

Enter '1' to simulate vertical dispersion in one direction, '2' for two directions (pull down menu): 1

Enter '1' if biodegradation rate is for the substance in water,
'0' if rate is for decay in field conditions (i.e. field data from aquifer) (pull down menu: 0

Parameter	Variable	Value	Unit	Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	1.50E-01	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	9.90E+99	days	
Calculated decay rate	λ	7.00E-101	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	1.90E+02	m	
Plume thickness at source	Sy	1.00E+01	m	
Saturated aquifer thickness	da	1.08E+01	m	
Bulk density of aquifer materials	ρ	1.70E+00	g/cm^3	
Effective porosity of aquifer	n	1.82E-01	fraction	
Hydraulic gradient	i	1.25E-02	fraction	
Hydraulic conductivity of aquifer	K	2.00E+01	m/d	
Distance to compliance point	x	5.92E+02	m	
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	0.00E+00	l/kg	*see options*
Longitudinal dispersivity	ax	9.730	m	*see options*
Transverse dispersivity	az	0.973	m	*see options*
Vertical dispersivity	ay	0.097	m	*see options*

Calculated Parameters

Calculated Parameters	Variable	Value	Unit
Groundwater flow velocity	v	1.37E+00	m/d
Retardation factor	Rf	1.00E+00	fraction
Decay rate used	λ	7.00E-101	d^{-1}
Rate of contaminant flow due to retardation	u	1.37E+00	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	9.68E-02	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	5.35E-02	mg/l
Attenuation factor (one way vertical dispersion, C_0/C_{ED})	AF	1.55E+00	
Attenuation factor (two way vertical dispersion, C_0/C_{ED})	AF	2.80E+00	

Remedial Targets

Remedial Target LTC3 3.87E-04 mg/l — For comparison with measured groundwater concentration.
Ogata Banks

Distance to compliance point 592 m

Concentration of contaminant at compliance point $C_{ED}/C0$ 9.68E-02 mg/l Ogata Banks
after 9.9E+99 days

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

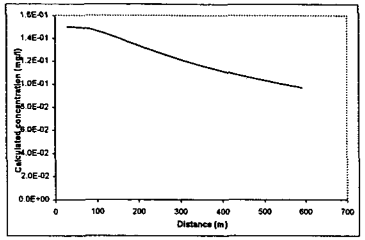
	Variable	Value	Unit
Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd		l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	1.00E+00	fraction
Organic carbon partition coefficient	Koc	0.00E+00	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$		l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Soil water partition coefficient	Kd	0.00E+00	l/kg

Dispersivity

Calculate dependant on distance to compliance point (0), specify dispersivity (1), or calc after Xu & Eckstein (2) ? 2

		Enter value	Calc value Xu & Eckstein	
Longitudinal dispersivity	ax		9.73E+00	m
Transverse dispersivity	az		9.73E-01	m
Vertical dispersivity	ay		9.73E-02	m

For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report $ax = 0.83(\log_{10}x)^{2.414}$; 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.

This sheet calculates the Tier3 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

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 Tier 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.

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration
	mg/l
29.6	1.5E-01
59.2	1.5E-01
88.8	1.5E-01
118.4	1.4E-01
148.0	1.4E-01
177.6	1.4E-01
207.2	1.3E-01
236.8	1.3E-01
266.4	1.3E-01
296.0	1.2E-01
325.6	1.2E-01
355.2	1.2E-01
384.8	1.1E-01
414.4	1.1E-01
444.0	1.1E-01
473.6	1.1E-01
503.2	1.0E-01
532.8	1.0E-01
562.4	9.9E-02
592.0	9.7E-02

Site being assessed	Bless Area 1 A murphy K20
Completed by	AJ
Date.	24 11 2005
Version	12

R&D Publication 20 Remedial Targets Worksheet, Release 2.2a

Tier 3 - Groundwater

ENVIRONMENT AGENCY

Input Parameters (using pull down menu)	Variable	Value	Unit	Source
Contaminant		tert Butylbenzene		
Target Concentration	C_T	1.00E-03	mg/l	

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

Ogata Banks — Equations in R&D Pub. 20

Enter '1' to simulate vertical dispersion in one direction, '2' for two directions (pull down menu): 1

Enter '1' if biodegradation rate is for the substance in water,
'0' if rate is for decay in field conditions (i.e. field data from aquifer) (pull down menu: 0

	Variable	Value	Unit	Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	9.90E-99	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	9.99E+99	days	
Calculated decay rate	λ	6.94E-101	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	1.90E+02	m	
Plume thickness at source	Sy	1.00E+01	m	
Saturated aquifer thickness	da	1.08E+01	m	
Bulk density of aquifer materials	ρ	1.70E+00	g/cm^3	
Effective porosity of aquifer	n	1.82E-01	fraction	
Hydraulic gradient	i	1.25E-02	fraction	
Hydraulic conductivity of aquifer	K	2.00E+01	m/d	
Distance to compliance point	x	5.92E+02	m	
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	2.14E-01	l/kg	*see options*
Longitudinal dispersivity	ax	9.730	m	*see options*
Transverse dispersivity	az	0.973	m	*see options*
Vertical dispersivity	ay	0.097	m	*see options*

Calculated Parameters	Variable		
Groundwater flow velocity	v	1.37E+00	m/d
Retardation factor	Rf	3.00E+00	fraction
Decay rate used	λ	6.94E-101	d^{-1}
Rate of contaminant flow due to retardation	u	4.58E-01	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	6.39E-99	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	3.53E-99	mg/l
Attenuation factor (one way vertical dispersion, C_0/C_{ED})	AF	1.55E+00	
Attenuation factor (two way vertical dispersion, C_0/C_{ED})	AF	2.80E+00	

Remedial Targets

Remedial Target Ogata Banks	LTC3	1.55E-03	mg/l	For comparison with measured groundwater concentration.
Distance to compliance point		592	m	
Concentration of contaminant at compliance point	$C_{ED}/C0$	6.39E-99	mg/l	Ogata Banks
after		9.9E+99	days	

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

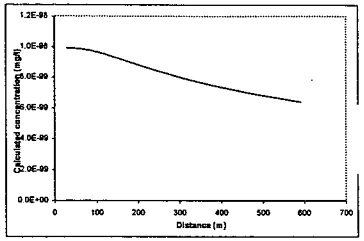
Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd		l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	1.00E+00	fraction
Organic carbon partition coefficient	Koc	2.14E-01	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$		l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Soil water partition coefficient	Kd	2.14E-01	l/kg

Dispersivity

Calculate dependant on distance to compliance point (0), specify dispersivity (1), or calc after Xu & Eckstein (2) ? 2

		Enter value	Calc value Xu & Eckstein	
Longitudinal dispersivity	ax		9.73E+00	m
Transverse dispersivity	az		9.73E-01	m
Vertical dispersivity	ay		9.73E-02	m

For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report ax = $0.83(\log_{10}x)^{2.414}$; 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.

This sheet calculates the Tier3 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

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 Tier 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.

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration mg/l
29.6	3.YE-W
61.2	9.9E-99
88.8	9.7E-99
111.4	9.6E-99
148.0	9.3E-99
177.6	9.0E-99
207.2	8.8E-99
236.8	8.5E-99
266.4	8.3E-99
296.0	8.0E-99
325.6	7.8E-99
355.2	7.6E-99
384.8	7.4E-99
414.4	7.3E-99
444.0	7.1E-99
473.6	6.9E-99
503.2	6.8E-99
532.8	6.7E-99
562.4	6.5E-99
592.0	6.4E-99

Site being assessed:	Bless Area 1 A murphy K20
Completed by:	AJ
Date.	24 11.2005
Version	12

R&D Publication 20 Remedial Targets Worksheet, Release 2.2a

Tier 3 -Groundwater

ENVIRONMENT
AGENCY

Input Parameters (using pull down menu)	Variable	Value	Unit	Source
Contaminant		2 methylnapthalene		
Target Concentration	C_T	1.00E-02	mg/l	

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

Ogata Banks — Equations in R&D Pub. 20

Enter '1' to simulate vertical dispersion in one direction, '2' for two directions (pull down menu) 1

Enter '1' if biodegradation rate is for the substance in water,
'0' if rate is for decay in field conditions (i.e. field data from aquifer) (pull down menu 0

				Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	1.00E-03	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	2.58E+02	days	
Calculated decay rate	λ	2.69E-03	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	1.90E+02	m	
Plume thickness at source	Sy	1.00E+01	m	
Saturated aquifer thickness	da	1.08E+01	m	
Bulk density of aquifer materials	ρ	1.70E+00	g/cm^3	
Effective porosity of aquifer	n	1.82E-01	fraction	
Hydraulic gradient	i	1.25E-02	fraction	
Hydraulic conductivity of aquifer	K	2.00E+01	m/d	
Distance to compliance point	x	5.92E+02	m	
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	7.24E+00	l/kg	*see options*
Longitudinal dispersivity	ax	9.730	m	*see options*
Transverse dispersivity	az	0.973	m	*see options*
Vertical dispersivity	ay	0.097	m	*see options*

Calculated Parameters	Variable		
Groundwater flow velocity	v	1.37E+00	m/d
Retardation factor	Rf	6.87E+01	fraction
Decay rate used	λ	2.69E-03	d^{-1}
Rate of contaminant flow due to retardation	u	2.00E-02	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	1.13E-23	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	6.27E-24	mg/l
Attenuation factor (one way vertical dispersion, C_0/C_{ED})	AF	8.81E+19	
Attenuation factor (two way vertical dispersion, C_0/C_{ED})	AF	1.59E+20	

Remedial Targets

Remedial Target	LTC3	8.81E+17	mg/l	For comparison with measured groundwater concentration.
Ogata Banks				
Distance to compliance point		592	m	
Concentration of contaminant at compliance point	$C_{ED}/C0$	1.13E-23	mg/l	Ogata Banks
after		9.9E+99	days	

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

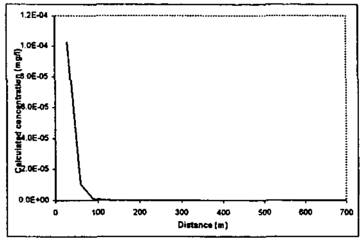
Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd		l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	1.00E+00	fraction
Organic carbon partition coefficient	Koc	7.24E+00	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$		l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Soil water partition coefficient	Kd	7.24E+00	l/kg

Dispersivity

Calculate dependant on distance to compliance point (0), specify dispersivity (1), or calc after Xu & Eckstein (2) ? 2

		Enter value	Calc value Xu & Eckstein	
Longitudinal dispersivity	ax		9.73E+00	m
Transverse dispersivity	az		9.73E-01	m
Vertical dispersivity	ay		9.73E-02	m

For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report ax = $0.83(\log_{10}x)^{2.414}$; 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.

This sheet calculates the Tier3 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

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 Tier 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.

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration
	mg/l
29.6	1.0E-04
59.2	1.1E-05
88.8	1.1E-06
118.4	1.1E-07
148.0	1.1E-08
207.2	1.1E-09
239.8	1.1E-11
266.4	1.1E-12
296.0	1.1E-13
325.6	1.1E-14
316.2	1.1E-15
384.8	1.1E-16
414.4	1.1E-17
444.0	1.1E-18
473.1	1.1E-19
503.2	1.1E-20
532.8	1.1E-21
562.4	1.1E-22
592.0	1.1E-23

Site being assessed	Bloss Area 1 Murphys K20
Completed by:	AJ
Date	24 11 2005
Version:	12

VIRONMENT
ENCY

R&D Publication 20 Remedial Targets Worksheet, Release 2.2a

Tier 3 -Groundwater

Input Parameters (using pull down menu)	Variable	Value	Unit	Source
Contaminant		Aliphatic C8-C10		
Target Concentration	C_T	7.14E-04	mg/l	

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

Ogata Banks — Equations in R&D Pub. 20

Enter '1' to simulate vertical dispersion in one direction, '2' for two directions (pull down menu): 1

Enter '1' if biodegradation rate is for the substance in water, '0' if rate is for decay in field conditions (i.e. field data from aquifer) (pull down menu): 0

	Variable	Value	Unit	Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	9.90E-99	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	1.83E+03	days	
Calculated decay rate	λ	3.80E-04	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	1.90E+02	m	
Plume thickness at source	Sy	1.00E+01	m	
Saturated aquifer thickness	da	1.08E+01	m	
Bulk density of aquifer materials	ρ	1.70E+00	g/cm^3	
Effective porosity of aquifer	n	1.82E-01	fraction	
Hydraulic gradient	i	1.25E-02	fraction	
Hydraulic conductivity of aquifer	K	2.00E+01	m/d	
Distance to compliance point	x	5.92E+02	m	
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	1.15E+02	l/kg	*see options*
Longitudinal dispersivity	ax	9.730	m	*see options*
Transverse dispersivity	az	0.973	m	*see options*
Vertical dispersivity	ay	0.097	m	*see options*

Calculated Parameters	Variable		
Groundwater flow velocity	v	1.37E+00	m/d
Retardation factor	Rf	1.07E+03	fraction
Decay rate used	λ	3.80E-04	d^{-1}
Rate of contaminant flow due to retardation	u	1.28E-03	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	1.63E-132	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	9.03E-133	mg/l
Attenuation factor (one way vertical dispersion, C_0/C_{ED})	AF	6.06E+33	
Attenuation factor (two way vertical dispersion, C_0/C_{ED})	AF	1.10E+34	

Remedial Targets

Remedial Target	LTC3	4.33E+39	mg/l

For comparison with measured groundwater concentration.

Ogata Banks

Distance to compliance point		592	m	
Concentration of contaminant at compliance point	$C_{ED}/C0$	1.63E-132	mg/l	Ogata Banks
after		9.9E+99	days	

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

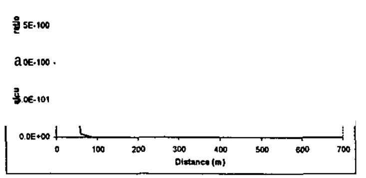
Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd		l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	1.00E+00	fraction
Organic carbon partition coefficient	Koc	1.15E+02	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$		l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Soil water partition coefficient	Kd	1.15E+02	l/kg

Dispersivity

Calculate dependant on distance to compliance point (0), specify dispersivity (1), or calc after Xu & Eckstein (2) ? 2

		Enter value	Calc value Xu & Eckstein	
Longitudinal dispersivity	ax		9.73E+00	m
Transverse dispersivity	az		9.73E-01	m
Vertical dispersivity	ay		9.73E-02	m

For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report ax = 0.83$(log_{10}x)^{2.414}$; 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.

This sheet calculates the Tier3 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
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 Tier 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.

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration mg/l
29.6	2.1E-100
69.2	4.38402
88.8	8.9E-104
118.4	1.8E-106
[illegible]	3.5E-109
207.2	1.6E-110
218.8	3.1E-112
266.4	1.38414
296.0	1.38-116
386.9	2.9E-117
384.8	1.1E-120
414.4	2.2E-122
444.0	4.5E-124
473.9	9.3E-126
503.2	1.9E-127
662.4	8.0E-131
592.0	1.6E-132

Site being assessed	Bless Area 1 A murphy K20
Completed by	AJ
Date	24 11 2005
Version	12

R&D Publication 20 Remedial Targets Worksheet, Release 2.2a

ENVIRON
AGENCY

Tier 3 - Groundwater

Input Parameters (using pull down menu)	Variable	Value	Unit	Source
Contaminant		Aliphatic C10-C12		
Target Concentration	C_T	7.14E-04	mg/l	

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

Ogata Banks | Equations in R&D Pub. 20

Enter '1' to simulate vertical dispersion in one direction, '2' for two directions (pull down menu) 1

Enter '1' if biodegradation rate is for the substance in water,
'0' if rate is for decay in field conditions (i.e. field data from aquifer) (pull down menu 0

	Variable	Value	Unit	Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	9.90E-99	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	1.83E+03	days	
Calculated decay rate	λ	3.80E-04	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	1.90E+02	m	
Plume thickness at source	Sy	1.00E+01	m	
Saturated aquifer thickness	da	1.08E+01	m	
Bulk density of aquifer materials	ρ	1.70E+00	g/cm^3	
Effective porosity of aquifer	n	1.82E-01	fraction	
Hydraulic gradient	i	1.25E-02	fraction	
Hydraulic conductivity of aquifer	K	2.00E+01	m/d	
Distance to compliance point	x	5.92E+02	m	
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	9.12E+02	l/kg	*see options*
Longitudinal dispersivity	ax	9.730	m	*see options*
Transverse dispersivity	az	0.973	m	*see options*
Vertical dispersivity	ay	0.097	m	*see options*

Calculated Parameters	Variable		
Groundwater flow velocity	v	1.37E+00	m/d
Retardation factor	Rf	8.52E+03	fraction
Decay rate used	λ	3.80E-04	d^{-1}
Rate of contaminant flow due to retardation	u	1.61E-04	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	6.81E-213	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	3.77E-213	mg/l
Attenuation factor (one way vertical dispersion, C_0/C_{ED})	AF	1.45E+114	
Attenuation factor (two way vertical dispersion, C_0/C_{ED})	AF	2.63E+114	

Remedial Targets

Remedial Target Ogata Banks	LTC3	1.04E+111	mg/l	For comparison with measured groundwater concentration.
Distance to compliance point		592	m	
Concentration of contaminant at compliance point	$C_{ED}/C0$	6.81E-213	mg/l	Ogata Banks
after		9.9E+99	days	

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

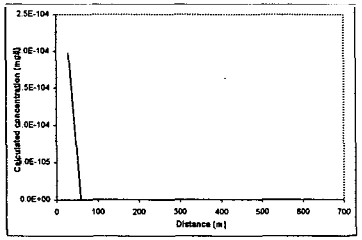
Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd	[redacted]	l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	1.00E+00	fraction
Organic carbon partition coefficient	Koc	9.12E+02	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$	[redacted]	l/kg
Sorption coefficient for ionised species	$K_{oc,i}$	[redacted]	l/kg
pH value	pH	[redacted]	
acid dissociation constant	pKa	[redacted]	
Soil water partition coefficient	Kd	9.12E+02	l/kg

Dispersivity

Calculate dependant on distance to compliance point (0), 2
specify dispersivity (1), or calc after Xu & Eckstein (2) ?

		Enter value	Calc value Xu & Eckstein	
Longitudinal dispersivity	ax	[redacted]	9.73E+00	m
Transverse dispersivity	az	[redacted]	9.73E-01	m
Vertical dispersivity	ay	[redacted]	9.73E-02	m

For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report ax = $0.83(\log_{10}x)^{2.414}$; 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.

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration mg/l
29.6	2.0E-104
59.2	4.0E-110
88.8	7.8E-116
118.4	1.5E-121
148.0	3.0E-127
177.6	5.8E-133
207.2	1.1E-138
236.8	2.2E-144
266.4	4.3E-150
296.0	8.3E-156
325.6	1.6E-161
355.2	3.2E-167
384.8	6.2E-173
414.4	1.2E-178
444.0	2.4E-184
473.6	4.6E-190
503.2	9.0E-196
532.8	1.8E-201
562.4	3.5E-207
592.0	6.8E-213

This sheet calculates the Tier3 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

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 Tier 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.

Site being assessed:	Bless Area 1 A murphy K20
Completed by.	AJ
Date	24 11 2005
Version:	12

R&D Publication20 Remedial Targets Worksheet, Release 2.2a

Tier 3 - Groundwater

ENVIRONMENT AGENCY

Input Parameters (using pull down menu)

	Variable	Value	Unit	Source
Contaminant		Aliphatic C12-C16		
Target Concentration	C_T	7.14E-04	mg/l	

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

Ogata Banks — Equations in R&D Pub. 20

Enter '1' to simulate vertical dispersion in one direction, '2' for two directions (pull down menu): 1

Enter '1' if biodegradation rate is for the substance in water,
'0' if rate is for decay in field conditions (i.e. field data from aquifer) (pull down menu): 0

	Variable	Value	Unit	Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	3.47E-02	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	1.83E+03	days	
Calculated decay rate	λ	3.80E-04	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	1.90E+02	m	
Plume thickness at source	Sy	1.00E+01	m	
Saturated aquifer thickness	da	1.08E+01	m	
Bulk density of aquifer materials	ρ	1.70E+00	g/cm^3	
Effective porosity of aquifer	n	1.82E-01	fraction	
Hydraulic gradient	i	1.25E-02	fraction	
Hydraulic conductivity of aquifer	K	2.00E+01	m/d	
Distance to compliance point	x	5.92E+02	m	
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	1.82E+04	l/kg	*see options*
Longitudinal dispersivity	ax	9.730	m	*see options*
Transverse dispersivity	az	0.973	m	*see options*
Vertical dispersivity	ay	0.097	m	*see options*

Calculated Parameters

	Variable		
Groundwater flow velocity	v	1.37E+00	m/d
Retardation factor	Rf	1.70E+05	fraction
Decay rate used	λ	3.80E-04	d^{-1}
Rate of contaminant flow due to retardation	u	8.08E-06	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	#NUM!	m00
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	#NUM!	m00
Attenuation factor (one way vertical dispersion, C_O/C_{ED})	AF	#NUM!	
Attenuation factor (two way vertical dispersion, C_O/C_{ED})	AF	#NUM!	

Remedial Targets

Remedial Target LTCS #NUM! mg/l For comparison with measured groundwater concentration.
Ogata Banks

Distance to compliance point 592 m

Concentration of contaminant at compliance point $C_{ED}/C0$ **#NUM! mg/l** Ogata Banks
after 9.9E+99 days

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

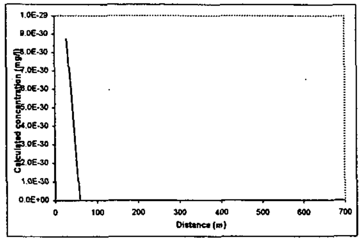
Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd	[redacted]	l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	1.00E+00	fraction
Organic carbon partition coefficient	Koc	1.82E+04	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$	[redacted]	l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Soil water partition coefficient	Kd	1.82E+04	l/kg

Dispersivity

Calculate dependant on distance to compliance point (0), specify dispersivity (1), or calc after Xu & Eckstein (2) ? 2

		Enter value	Calc value Xu & Eckstein	
Longitudinal dispersivity	ax	[redacted]	9.73E+00	m
Transverse dispersivity	az		9.73E-01	m
Vertical dispersivity	ay		9.73E-02	m

For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report ax = $0.83(\log_{10}x)^{2.414}$; 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.

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration
	mg/l
29.6	8.8E-30
59.2	2.2E-57
88.8	5.5E-85
118.4	1.4E-112
148.0	3.4E-140
177.6	8.2E-168
207.2	2.0E-195
236.8	5.0E-223
266.4	1.2E-250
296.0	3.0E-278
325.6	#NUM!
355.2	#NUM!
384.8	#NUM!
414.4	#NUM!
444.0	#NUM!
473.6	#NUM!
503.2	#NUM!
532.8	#NUM!
562.4	#NUM!
592.0	#NUM!

This sheet calculates the Tier3 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

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 Tier 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.

Site being assessed	Bless Area 1 A murphy K20
Completed by.	AJ
Date:	24 11 2005
Version	12

R&D Publication 20 Remedial Targets Worksheet, Release 2.2a

Tier 3 - Groundwater

ENVIRONMENT AGENCY

Input Parameters (using pull down menu)

	Variable	Value	Unit	Source
Contaminant		mmoniacal Nitrogen as		
Target Concentration	C_T	1.20E-01	mg/l	

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

Ogata Banks — Equations in R&D Pub. 20

Enter '1' to simulate vertical dispersion in one direction, '2' for two directions (pull down menu): 1

Enter '1' if biodegradation rate is for the substance in water,
'0' if rate is for decay in field conditions (i.e. field data from aquifer) (pull down menu): 0

	Variable	Value	Unit	Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	5.50E+01	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	2.19E+03	days	
Calculated decay rate	λ	3.17E-04	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	8.00E+01	m	
Plume thickness at source	Sy	2.10E+01	m	
Saturated aquifer thickness	da	2.17E+01	m	
Bulk density of aquifer materials	ρ	1.70E+00	g/cm^3	
Effective porosity of aquifer	n	1.82E-01	fraction	
Hydraulic gradient	i	1.33E-02	fraction	
Hydraulic conductivity of aquifer	K	2.00E+01	m/d	
Distance to compliance point	x	1.20E+03	m	
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	5.00E-01	l/kg	*see options*
Longitudinal dispersivity	ax	12.538	m	*see options*
Transverse dispersivity	az	1.254	m	*see options*
Vertical dispersivity	ay	0.125	m	*see options*

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	[redacted]	l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	1.00E+00	fraction
Organic carbon partition coefficient	Koc	5.00E-01	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$	[redacted]	l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Soil water partition coefficient	Kd	5.00E-01	l/kg

Dispersivity

Calculate dependant on distance to compliance point (0), specify dispersivity (1), or calc after Xu & Eckstein (2) ? 2

		Enter value	Calc value Xu & Eckstein	
Longitudinal dispersivity	ax	[redacted]	1.25E+01	m
Transverse dispersivity	az		1.25E+00	m
Vertical dispersivity	ay		1.25E-01	m

For calculated value, assumes ax = 0.1 * x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report ax = $0.83(\log_{10}x)^{2.414}$; az = ax/10, ay = ax/100 are assumed

Calculated Parameters Variable

	Variable	Value	Unit
Groundwater flow velocity	v	1.46E+00	m/d
Retardation factor	Rf	5.67E+00	fraction
Decay rate used	λ	3.17E-04	d^{-1}
Rate of contaminant flow due to retardation	u	2.58E-01	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	5.33E+00	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	3.13E+00	mg/l
Attenuation factor (one way vertical dispersion, C_0/C_{ED})	AF	1.03E+01	
Attenuation factor (two way vertical dispersion, C_0/C_{ED})	AF	1.76E+01	

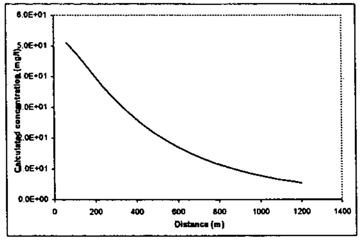
Remedial Targets

Remedial Target LTC3 1.24E+00 mg/l — For comparison with measured groundwater concentration.
Ogata Banks

Distance to compliance point 1200 m

Concentration of contaminant at compliance point $C_{ED}/C0$ **6.33E+00 mg/l** Ogata Banks
after 9.9E+99 days

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.



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.

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	**Concentration** **mg/l**
60.0	5.1E+01
120.0	4.7E+01
180.0	4.2E+01
240.0	3.7E+01
300.0	3.2E+01
360.0	2.8E+01
420.0	2.5E+01
480.0	2.2E+01
540.0	1.9E+01
600.0	1.7E+01
660.0	1.5E+01
720.0	1.3E+01
760.0	1.2E+01
840.0	1.0E+01
900.0	9.3E+00
960.0	8.3E+00
1020.0	7.4E+00
1080.0	6.6E+00
1140.0	5.9E+00
11W.0	5.3E+00

This sheet calculates the Tier3 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
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 Tier 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

Site being assessed	Bless Area 4 Downshire well K20
Completed by.	AJ
Date	24 11 2005
Version	12

R&D Publication20 Remedial Targets Worksheet, Release 2.2a

ENVIRONMENT AGENCY

Tier 3 -Groundwater

Input Parameters (using pull down menu)	Variable	Value	Unit	Source
Contaminant		Aromatic C8-C10		
Target Concentration	C_T	7.14E-04	mg/l	

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

Ogata Banks — Equations in R&D Pub. 20

Enter '1' to simulate vertical dispersion in one direction, '2' for two directions (pull down menu): 1

Enter '1' if biodegradation rate is for the subetance in water,
'0' if rate is for decay in field conditions (i.e. field data from aquifer) (pull down menu: 0

	Variable	Value	Unit	Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	9.90E-99	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	1.83E+03	days	
Calculated decay rate	λ	3.80E-04	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	8.00E+01	m	
Plume thickness at source	Sy	2.10E+01	m	
Saturated aquifer thickness	da	2.17E+01	m	
Bulk density of aquifer materials	ρ	1.70E+00	g/cm^3	
Effective porosity of aquifer	n	1.82E-01	fraction	
Hydraulic gradient	i	1.33E-02	fraction	
Hydraulic conductivity of aquifer	K	2.00E+01	m/d	
Distance to compliance point	x	1.20E+03	m	
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	5.75E+00	l/kg	*see options*
Longitudinal dispersivity	ax	12.536	m	*see options*
Transverse dispersivity	az	1.254	m	*see options*
Vertical dispersivity	ay	0.125	m	*see options*

Calculated Parameters	Variable		
Groundwater flow velocity	v	1.46E+00	m/d
Retardation factor	Rf	5.47E+01	fraction
Decay rate used	λ	3.80E-04	d^{-1}
Rate of contaminant flow due to retardation	u	2.67E-02	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	1.55E-105	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	9.11E-106	mg/l
Attenuation factor (one way vertical dispersion, C_0/C_{ED})	AF	6.39E+06	
Attenuation factor (two way vertical dispersion, C_0/C_{ED})	AF	1.09E+07	

Remedial Targets

Remedial Target Ogata Banks	LTC3	4.56E+03	mg/l	For comparison with measured groundwater concentration.
Distance to compliance point		1200	m	
Concentration of contaminant at compliance point	$C_{ED}/C0$	1.56E-105	mg/l	Ogata Banks
after		9.9E+99	days	

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

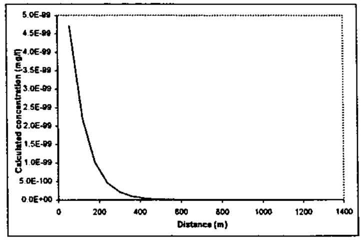
Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd		l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	1.00E+00	fraction
Organic carbon partition coefficient	Koc	5.75E+00	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$		l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Soil water partition coefficient	Kd	5.75E+00	l/kg

Dispersivity

Calculate dependant on distance to compliance point (0), specify dispersivity (1), or calc after Xu & Eckstein (2) ? 2

		Enter value	Calc value Xu & Eckstein	
Longitudinal dispersivity	ax		1.25E+01	m
Transverse dispersivity	az		1.25E+00	m
Vertical dispersivity	ay		1.25E-01	m

For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report ax = 0.83$(\log_{10}x)^{2.414}$; 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.

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration
	mg/l
60.0	4.7E-99
120.0	2.2E-99
180.0	1.0E-99
380.0	8.6E-100
360.0	9.3E-101
420.0	4.2E-101
480.0	1.9E-101
540.0	8.6E-102
600.0	3.9E-102
660.0	1.8E-102
720.0	8.0E-103
780.0	3.6E-103
840.0	1.7E-103
900.0	7.6E-104
960.0	3.5E-104
1020.0	1.6E-104
1080.0	3.8E-105
1200.0	1.6E-105

This sheet calculates the Tier3 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

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 Tier 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.

Site being assessed.	Bless Area 4 Downshire well K20
Completed by	AJ
Date	24 11 2005
Version:	12

R&D Publication 20 Remedial Targets Worksheet, Release 2.2a

Tier 3 -Groundwater

ENVIRONMENT AGENCY

Input Parameters (using pull down menu)	Variable	Value	Unit	Source
Contaminant		Aromatic C10-C12		
Target Concentration	C_T	7.14E-04	mg/l	

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

Ogata Banks — Equations in R&D Pub. 20

Enter '1' to simulate vertical dispersion in one direction, '2' for two directions (pull down menu): 1

Enter '1' if biodegradation rate is for the substance in water,
'0' if rate is for decay in field conditions (i.e. field data from aquifer) (pull down menu: 0

				Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	9.90E-99	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	1.83E+03	days	
Calculated decay rate	λ	3.80E-04	days^{-1}	
Width of plume in aquifer at source (perpendicular to flow)	Sz	8.00E+01	m	
Plume thickness at source	Sy	2.10E+01	m	
Saturated aquifer thickness	da	2.17E+01	m	
Bulk density of aquifer materials	ρ	1.70E+00	g/cm^3	
Effective porosity of aquifer		1.82E-01	fraction	
Hydraulic gradient		1.33E-02	fraction	
Hydraulic conductivity of aquifer	K	2.00E+01	m/d	
Distance to compliance point		1.20E+03	m	
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	9.12E+00	l/kg	*see options*
Longitudinal dispersivity	ax	12.536	m	*see options*
Transverse dispersivity	az	1.254	m	*see options*
Vertical dispersivity	ay	0.125	m	*see options*

Calculated Parameters	Variable		
Groundwater flow velocity	v	1.46E+00	m/d
Retardation factor	Rf	8.62E+01	fraction
Decay rate used	λ	3.80E-04	d^{-1}
Rate of contaminant flow due to retardation	u	1.70E-02	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	1.30E-108	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	7.61E-109	mg/l
Attenuation factor (one way vertical dispersion, C_O/C_{ED})	AF	7.64E+09	
Attenuation factor (two way vertical dispersion, C_O/C_{ED})	AF	1.30E+10	

Remedial Targets

Remedial Target	LTC3	5.46E+08	mg/l	For comparison with measured groundwater concentration.
Ogata Banks				
Distance to compliance point		1200	m	
Concentration of contaminant at compliance point	C_{ED}/C0	1.30E-108	mg/l	Ogata Banks
after		9.9E+99	days	

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

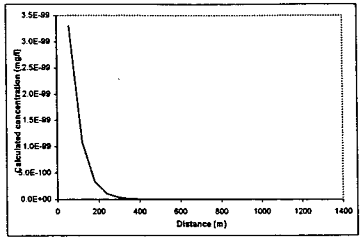
Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd	[redacted]	l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	1.00E+00	fraction
Organic carbon partition coefficient	Koc	9.12E+00	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$	[redacted]	l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Soil water partition coefficient	Kd	9.12E+00	l/kg

Dispersivity

Calculate dependant on distance to compliance point (0), specify dispersivity (1), or calc after Xu & Eckstein (2) ? 2

		Enter value	Calc value Xu & Eckstein	
Longitudinal dispersivity	ax	[redacted]	1.25E+01	m
Transverse dispersivity	az		1.25E+00	m
Vertical dispersivity	ay		1.25E-01	m

For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report ax = 0.83(log$_{10}$x)$^{2.414}$; 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.

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration
	mg/l
60.0	3.3E-99
120.0	1.1E-99
180.0	3.5E-100
240.0	1.1E-100
300.0	3.5E-101
360.0	1.1E-101
420.0	3.5E-102
480.0	1.1E-102
540.0	3.5E-103
600.0	1.1E-103
660.0	3.6E-104
720.0	1.1E-104
780.0	3.6E-105
840.0	1.2E-105
900.0	3.7E-106
960.0	1.2E-106
1020.0	3.9E-107
1080.0	1.2E-107
1140.0	4.0E-108
1200.0	1.3E-108

This sheet calculates the Tier3 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

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 Tier 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.

Site being assessed:	Bless Area 4 Downshire well K20
Completed by.	AJ
Date:	24 11 2005
Version	12

R&D Publication20 Remedial Targets Worksheet, Release2.2a

Tier 3 -Groundwater

ENVIRONMENT AGENCY

Input Parameters (using pull down menu)	Variable	Value	Unit	Sours.
Contaminant		Total Cyanide		
Target Concentration	C_T	1.00E-02	mg/l	

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

Ogata Banks — Equations in R&D Pub. 20

Enter '1' to simulate vertical dispersion in one direction, '2' for two directions (pull down menu): 1

Enter '1' if biodegradation rate is for the substance in water,
'0' if rate is for decay in field conditions (i.e. field data from aquifer) (pull down menu): 0

	Variable	Value	Unit	Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	9.90E-99	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	2.92E+01	days	
Calculated decay rate	λ	2.38E-02	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	8.00E+01	m	
Plume thickness at source	Sy	2.10E+01	m	
Saturated aquifer thickness	da	2.17E+01	m	
Bulk density of aquifer materials	ρ	1.70E+00	g/cm^3	
Effective porosity of aquifer		1.82E-01	fraction	
Hydraulic gradient		1.33E-02	fraction	
Hydraulic conductivity of aquifer	K	2.00E+01	m/d	
Distance to compliance point		1.20E+03	m	
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction		0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	7.94E+09	l/kg	*see options*
Longitudinal dispersivity	ax	12.536	m	*see options*
Transverse dispersivity	az	1.254	m	*see options*
Vertical dispersivity	av	0.125	m	*see options*

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	[redacted]	l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	1.00E+00	fraction
Organic carbon partition coefficient	Koc	7.94E+09	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$	[redacted]	l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Soil water partition coefficient	Kd	7.94E+09	l/kg

Dispersivity

Calculate dependant on distance to compliance point (0), specify dispersivity (1), or calc after Xu & Eckstein (2) ? 2

		Enter value	Calc value Xu & Eckstein	
Longitudinal dispersivity	ax	[redacted]	1.25E+01	m
Transverse dispersivity	az		1.25E+00	m
Vertical dispersivity	ay		1.25E-01	m

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

Xu & Eckstein (1995) report $ax = 0.83(\log_{10}x)^{2.414}$; az = ax/10, ay = ax/100 are assumed

Calculated Parameters	Variable		
Groundwater flow velocity	v	1.46E+00	m/d
Retardation factor	Rf	7.42E+10	fraction
Decay rate used	λ	2.38E-02	d^{-1}
Rate of contaminant flow due to retardation	u	1.97E-11	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	#NUM!	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	#NUM!	mg/l
Attenuation factor (one way vertical dispersion, C_0/C_{ED})	AF	#NUM!	
Attenuation factor (two way vertical dispersion, C_0/C_{ED})	AF	#NUM!	

Remedial Targets

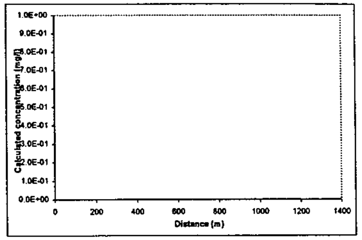
Remedial Target LTC3 #NUM! mg/l — For comparison with measured groundwater concentration.

Ogata Banks

Distance to compliance point 1200 m

Concentration of contaminant at compliance point $C_{ED}/C0$ **#NUM! mg/l** Ogata Banks
after **9.9E+99 days**

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.



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.

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration mg/l
60.0	#NUM!
120.0	#NUM!
180.0	#NUM!
240.0	#NUM!
300.0	#NUM!
360.0	#NUM!
420.0	#NUM!
480.0	#NUM!
540.0	#NUM!
600.0	#NUM!
660.0	#NUM!
720.0	#NUM!
780.0	#NUM!
840.0	#NUM!
900.0	#NUM!
960.0	#NUM!
1020.0	#NUM!
1080.0	#NUM!
1140.0	#NUM!
1200.0	#NUM!

This sheet calculates the Tier3 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

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 Tier 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.

Site being assessed:	Bless Area 4 Downshire well K20
Completed by	AJ
Date:	24 11 2005
Version	12

R&D Publication 20 Remedial Targets Worksheet, Release 2.2a

Tier 3 - Groundwater

ENVIRONMENT AGENCY

Input Parameters (using pull down menu)	Variable	Value	Unit	So——
Contaminant		Aromatic C12-C16		
Target Concentration	C_T	7.14E-04	mg/l	

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

Ogata Banks — Equations in R&D Pub. 20

Enter '1' to simulate vertical dispersion in one direction, '2' for two directions (pull down menu) 1

Enter '1' if biodegradation rate is for the substance in water,
'0' if rate is for decay in field conditions (i.e. field data from aquifer) (pull down menu 0

				Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	9.90E-99	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	1.83E+03	days	
Calculated decay rate	λ	3.80E-04	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	8.00E+01	m	
Plume thickness at source	Sy	2.10E+01	m	
Saturated aquifer thickness	da	2.17E+01	m	
Bulk density of aquifer materials	ρ	1.70E+00	g/cm^3	
Effective porosity of aquifer	n	1.82E-01	fraction	
Hydraulic gradient	i	1.33E-02	fraction	
Hydraulic conductivity of aquifer	K	2.00E+01	m/d	
Distance to compliance point	x	1.20E+03	m	
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	1.82E+01	l/kg	*see options*
Longitudinal dispersivity	ax	12.536	m	*see options*
Transverse dispersivity	az	1.254	m	*see options*
Vertical dispersivity	ay	0.125	m	*see options*

Calculated Parameters	Variable		
Groundwater flow velocity	v	1.46E+00	m/d
Retardation factor	Rf	1.71E+02	fraction
Decay rate used	λ	3.80E-04	d^{-1}
Rate of contaminant flow due to retardation	u	8.55E-03	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	1.14E-115	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	6.68E-116	mg/l
Attenuation factor (one way vertical dispersion, C_O/C_{ED})	AF	8.72E+16	
Attenuation factor (two way vertical dispersion, C_O/C_{ED})	AF	1.48E+17	

Remedial Targets

Remedial Target	LTCS	6.23E+13	mg/l	For comparison with measured groundwater concentration.
Ogata Banks				
Distance to compliance point		1200	m	
Concentration of contaminant at compliance point	$C_{ED}/C0$	1.14E-115	mg/l	Ogata Banks
after		9.9E+99	days	

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

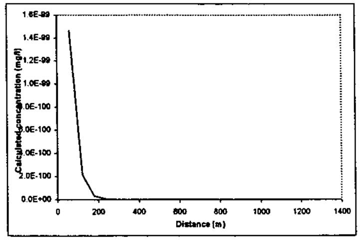
Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd	[redacted]	l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	1.00E+00	fraction
Organic carbon partition coefficient	Koc	1.82E+01	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$	[redacted]	l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Soil water partition coefficient	Kd	1.82E+01	l/kg

Dispersivity

Calculate dependant on distance to compliance point (0), specify dispersivity (1), or calc after Xu & Eckstein (2) ? 2

		Enter value	Calc value Xu & Eckstein	
Longitudinal dispersivity	ax	[redacted]	1.25E+01	m
Transverse dispersivity	az		1.25E+00	m
Vertical dispersivity	ay		1.25E-01	m

For calculated value, assumes ax = 0.1 * x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report ax = $0.83(\log_{10}x)^{2.414}$; 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.

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration
	mg/l
60.0	1.6E-99
120.0	2.1E-100
160.0	3.1E-101
240.0	4.3E-102
300.0	6.1E-103
360.0	8.5E-104
420.0	1.2E-104
480.0	1.7E-105
540.0	2.4E-106
600.0	3.3E-107
6W.0	4.7E-108
720.0	6.6E-109
780.0	9.4E-110
840.0	1.3E-110
900.0	1.9E-111
960.0	LIE-112
1020.0	3.9E-113
1080.0	5.5E-114
1200.0	1.1E-115

This sheet calculates the Tier3 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

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 Tier 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.

Site being assessed	Bless Area 4 Downshire well K20
Completed by	AJ
Date:	24 11 2005
Version.	12

R&D Publication 20 Remedial Targets Worksheet, Release 2.2a

Tier 3 - Groundwater

Input Parameters (using pull down menu)	Variable	Value	Unit	Source
Contaminant		Aromatic C16-C21		
Target Concentration	C_T	7.14E-04	mg/l	

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

Ogata Banks — Equations in R&D Pub. 20

Enter '1' to simulate vertical dispersion in one direction, '2' for two directions (pull down menu) 1

Enter '1' if biodegradation rate is for the substance in water,
'0' if rate is for decay in field conditions (i.e. field data from aquifer) (pull down menu) 0

	Variable	Value	Unit	Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	9.90E-99	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	3.65E+03	days	
Calculated decay rate	λ	1.90E-04	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	8.00E+01	m	
Plume thickness at source	Sy	2.10E+01	m	
Saturated aquifer thickness	da	2.17E+01	m	
Bulk density of aquifer materials	ρ	1.70E+00	g/cm^3	
Effective porosity of aquifer	n	1.82E-01	fraction	
Hydraulic gradient	i	1.33E-02	fraction	
Hydraulic conductivity of aquifer	K	2.00E+01	m/d	
Distance to compliance point	x	1.20E+03	m	
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	5.75E+01	l/kg	*see options*
Longitudinal dispersivity	ax	12.536	m	*see options*
Transverse dispersivity	az	1.254	m	*see options*
Vertical dispersivity	av	0.125	m	*see options*

Calculated Parameters	Variable		
Groundwater flow velocity	v	1.46E+00	m/d
Retardation factor	Rf	5.38E+02	fraction
Decay rate used	λ	1.90E-04	d^{-1}
Rate of contaminant flow due to retardation	u	2.71E-03	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	1.84E-122	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	1.08E-122	mg/l
Attenuation factor (one way vertical dispersion, C_0/C_{ED})	AF	5.38E+23	
Attenuation factor (two way vertical dispersion, C_0/C_{ED})	AF	9.14E+23	

Remedial Targets

Remedial Target Ogata Banks	LTC3	3.94E+20	mg/l	For comparison with measured groundwater concentration.
Distance to compliance point		1200	m	
Concentration of contaminant at compliance point	$C_{ED}/C0$	1.84E-122	mg/l	Ogata Banks
after		9.9E+99	days	

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 m)

Calculate for non-polar organic chemicals

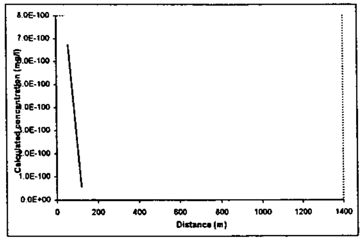
Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd		l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	1.00E+00	fraction
Organic carbon partition coefficient	Koc	5.75E+01	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$		l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Soil water partition coefficient	Kd	5.75E+01	l/kg

Dispersivity

Calculate dependant on distance to compliance point (0), specify dispersivity (1), or calc after Xu & Eckstein (2) ? 2

		Enter value	Calc value Xu & Eckstein	
Longitudinal dispersivity	ax		1.25E+01	m
Transverse dispersivity	az		1.25E+00	m
Vertical dispersivity	ay		1.25E-01	m

For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report ax = $0.83(\log_{10}x)^{2.414}$; 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.

This sheet calculates the Tier3 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

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 Tier 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.

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration
	mg/l
60.0	6.7E-100
120.0	4.5E-101
180.0	2.9E-102
240.0	1.9E-103
300.0	1.2E-104
360.0	7.8E-106
420.0	5.0E-107
480.0	3.2E-108
540.0	2.1E-109
600.0	1.3E-110
660.0	8.8E-112
720.0	5.6E-113
780.0	3.6E-114
840.0	2.4E-115
900.0	1.5E-116
960.0	1.0E-117
1020.0	6.6E-119
1080.0	4.3E-120
1140.0	2.8E-121
1200.0	1.8E-122

Site being assessed	Bless Area 4 Downshire well K20
Completed by	AJ
Date.	24 11 2005
Version.	12

R&D Publication 20 Remedial Targets Worksheet, Release 2.2a

Tier 3 - Groundwater

ENVIRONMENT AGENCY

Input Parameters (using pull down menu)	Variable	Value	Unit	Source
Contaminant		Aromatic C21-C35		
Target Concentration	C_T	7.14E-04	mg/l	

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

Ogata Banks — Equations in R&D Pub. 20

Enter '1' to simulate vertical dispersion in one direction, '2' for two directions (pull down menu): 1

Enter '1' if biodegradation rate is for the substance in water,
'0' if rate is for decay in field conditions (i.e. field data from aquifer) (pull down menu): 0

	Variable	Value	Unit	Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	9.90E-99	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	3.65E+03	days	
Calculated decay rate	λ	1.90E-04	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	8.00E+01	m	
Plume thickness at source	Sy	2.10E+01	m	
Saturated aquifer thickness	da	2.17E+01	m	
Bulk density of aquifer materials	ρ	1.70E+00	g/cm^3	
Effective porosity of aquifer	n	1.82E-01	fraction	
Hydraulic gradient	i	1.33E-02	fraction	
Hydraulic conductivity of aquifer	K	2.00E+01	m/d	
Distance to compliance point	x	1.20E+03	m	
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	4.57E+02	l/kg	*see options*
Longitudinal dispersivity	ax	12.536	m	*see options*
Transverse dispersivity	az	1.254	m	*see options*
Vertical dispersivity	ay	0.125	m	*see options*

Calculated Parameters	Variable		
Groundwater flow velocity	v	1.46E+00	m/d
Retardation factor	Rf	4.27E+03	fraction
Decay rate used	λ	1.90E-04	d^{-1}
Rate of contaminant flow due to retardation	u	3.42E-04	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	6.46E-190	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	3.80E-190	mg/l
Attenuation factor (one way vertical dispersion, C_O/C_{ED})	AF	1.53E+91	
Attenuation factor (two way vertical dispersion, C_O/C_{ED})	AF	2.60E+81	

Remedial Targets

Remedial Target	LTC3	1.09E+88	mg/l	For comparison with measured groundwater concentration.
Ogata Banks				

Distance to compliance point		**1200**	**m**	
Concentration of contaminant at compliance point	$C_{ED}/C0$	**6.46E-190**	**mg/l**	Ogata Banks
after		**9.9E+99**	**days**	

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

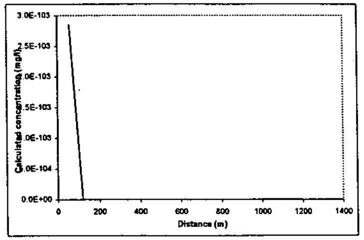
Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd	[redacted]	l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	1.00E+00	fraction
Organic carbon partition coefficient	Koc	4.57E+02	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$	[redacted]	l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Soil water partition coefficient	Kd	4.57E+02	l/kg

Dispersivity

Calculate dependant on distance to compliance point (0), specify dispersivity (1), or calc after Xu & Eckstein (2) ? 2

		Enter value	Calc value Xu & Eckstein	
Longitudinal dispersivity	ax	[redacted]	1.25E+01	m
Transverse dispersivity	az		1.25E+00	m
Vertical dispersivity	ay		1.25E-01	m

For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report $ax = 0.83(\log_{10}x)^{2.414}$; 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.

This sheet calculates the Tier3 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

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 Tier 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.

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration
60.0	2.mg/l03
120.0	8.2E-108
240.0	6.1E-117
300.0	1.7E-121
150.0	4.5E-126
420.0	1.2E-130
480.0	3.4E-135
640.0	9.2E-140
660.0	6.9E-149
780.0	5.2E-158
840.0	1.4E-162
900.0	3.9E-167
960.0	1.1E-171
1020.0	3.0E-176
1080.0	8.4E-181
1140.0	2.3E-185
1200.0	6.5E-190

Site being assessed	Bless Area 4 Downshire well K20
Completed by	AJ
Date	24 11 2005
Version	12

R&D Publication 20 Remedial Targets Worksheet, Release 2.2a

Tier 3 - Groundwater

ENVIRONMENT AGENCY

Input Parameters (using pull down menu)	Variable	Value	Unit	Source
Contaminant		Arsenic		
Target Concentration	C_T	1.00E-02	mg/l	

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

Ogata Banks — Equations in R&D Pub. 20

Enter '1' to simulate vertical dispersion in one direction, '2' for two directions (pull down menu): 1

Enter '1' if biodegradation rate is for the substance in water,
'0' if rate is for decay in field conditions (i.e. field data from aquifer) (pull down menu): 0

				Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	9.90E-99	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	9.90E+99	days	
Calculated decay rate	λ	7.00E-101	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	8.00E+01	m	
Plume thickness at source	Sy	2.10E+01	m	
Saturated aquifer thickness	da	2.17E+01	m	
Bulk density of aquifer materials	ρ	1.70E+00	g/cm^3	
Effective porosity of aquifer	n	1.82E-01	fraction	
Hydraulic gradient	i	1.33E-02	fraction	
Hydraulic conductivity of aquifer	K	2.00E+01	m/d	
Distance to compliance point	x	1.20E+03	m	
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	1.17E+02	l/kg	*see options*
Longitudinal dispersivity	ax	12.536	m	*see options*
Transverse dispersivity	az	1.254	m	*see options*
Vertical dispersivity	ay	0.125	m	*see options*

Calculated Parameters	Variable		
Groundwater flow velocity	v	1.46E+00	m/d
Retardation factor	Rf	1.10E+03	fraction
Decay rate used	λ	7.00E-101	d^{-1}
Rate of contaminant flow due to retardation	u	1.33E-03	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	4.09E-99	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	2.41E-99	mg/l
Attenuation factor (one way vertical dispersion, C_O/C_{ED})	AF	2.42E+00	
Attenuation factor (two way vertical dispersion, C_O/C_{ED})	AF	4.11E+00	

Remedial Targets

Remedial Target	LTC3	2.42E-02	mg/l	For comparison with measured groundwater concentration.
Ogata Banks				
Distance to compliance point		1200	m	
Concentration of contaminant at compliance point	$C_{ED}/C0$	4.09E-99	mg/l	Ogata Banks
after		9.9E+99	days	

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

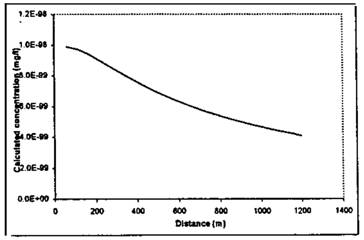
Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd	[redacted]	l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	1.00E+00	fraction
Organic carbon partition coefficient	Koc	1.17E+02	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$	[redacted]	l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Soil water partition coefficient	Kd	1.17E+02	l/kg

Dispersivity

Calculate dependant on distance to compliance point (0), specify dispersivity (1), or calc after Xu & Eckstein (2) ? 2

		Enter value	Calc value Xu & Eckstein	
Longitudinal dispersivity	ax	[redacted]	1.25E+01	m
Transverse dispersivity	az		1.25E+00	m
Vertical dispersivity	ay		1.25E-01	m

For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report $ax = 0.83(\log_{10}x)^{2.414}$; 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.

This sheet calculates the Tier3 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

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 Tier 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.

Calculated concentrations for distance-concentration graph

Ogata Banks
DistanceConcentration

Distance	mg/l
60.0	9.9E-99
120.0	9.7E-99
180.0	9.3E-99
240.0	8.8E-99
300.0	8.3E-99
360.0	7.9E-99
420.0	7.4E-99
480.0	7.0E-99
540.0	6.6E-99
600.0	6.3E-99
660.0	6.0E-99
720.0	5.7E-99
7110.0	5.4E-99
840.0	5.2E-99
900.0	5.0E-99
960.0	4.8E-99
1020.0	4.6E-99
10110.0	4.4E-99
1140.0	4.2E-99
1200.0	4.1E-99

Site being assessed	Bless Area 4 Downshire well K20
Completed by:	AJ
Date:	24 11 2005
Version:	12

R&D Publication 20 Remedial Targets Worksheet, Release 2.2a

Tier 3 • Groundwater

ENVIRONMENT AGENCY

Input Parameters (using pull down menu)	Variable	Value	Unit	Source
Contaminant		Flouride		
Target Concentration	C_T	1.00E+00	mg/l	

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

Ogata Banks — Equations in R&D Pub. 20

Enter '1' to simulate vertical dispersion in one direction, '2' for two directions (pull down menu): 1

Enter '1' if biodegradation rate is for the substance in water, '0' if rate is for decay in field conditions (i.e. field data from aquifer) (pull down menu): 0

	Variable	Value	Unit	Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	1.70E+00	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	9.90E+99	days	
Calculated decay rate	λ	7.00E-101	days^{-1}	
Width of plume in aquifer at source (perpendicular to flow)	Sz	8.00E+01	m	
Plume thickness at source	Sy	2.10E+01	m	
Saturated aquifer thickness	da	2.17E+01	m	
Bulk density of aquifer materials	ρ	1.70E+00	g/cm^3	
Effective porosity of aquifer	n	1.82E-01	fraction	
Hydraulic gradient	i	1.33E-02	fraction	
Hydraulic conductivity of aquifer	K	2.00E+01	m/d	
Distance to compliance point	x	1.20E+03	m	
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	0.00E+00	l/kg	*see options*
Longitudinal dispersivity	ax	12.536	m	*see options*
Transverse dispersivity	az	1.254	m	*see options*
Vertical dispersivity	ay	0.125	m	*see options*

Calculated Parameters	Variable		
Groundwater flow velocity	v	1.46E+00	m/d
Retardation factor	Rf	1.00E+00	fraction
Decay rate used	λ	7.00E-101	d^{-1}
Rate of contaminant flow due to retardation	u	1.46E+00	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	7.03E-01	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	4.13E-01	mg/l
Attenuation factor (one way vertical dispersion, C_0/C_{ED})	AF	2.42E+00	
Attenuation factor (two way vertical dispersion, C_0/C_{ED})	AF	4.11E+00	

Remedial Targets

Remedial Target LTC3 2.42E+00 mg/l For comparison with measured groundwater concentration.
Ogata Banks

Distance to compliance point 1200 m

Concentration of contaminant at compliance point $C_{ED}/C0$ **7.03E-01** mg/l Ogata Banks
after **9.9E+99** **days**

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

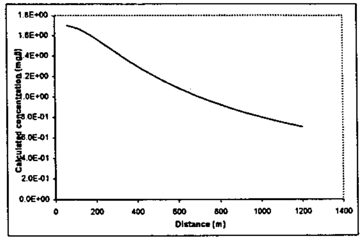
Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd	[redacted]	l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	1.00E+00	fraction
Organic carbon partition coefficient	Koc	0.00E+00	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$	[redacted]	l/kg
Sorption coefficient for ionised species	$K_{oc,i}$	[redacted]	l/kg
pH value	pH	[redacted]	
acid dissociation constant	pKa	[redacted]	
Soil water partition coefficient	Kd	0.00E+00	l/kg

Dispersivity

Calculate dependant on distance to compliance point (0), specify dispersivity (1), or calc after Xu & Eckstein (2) ? 2

		Enter value	Calc value Xu & Eckstein	
Longitudinal dispersivity	ax	[redacted]	1.25E+01	m
Transverse dispersivity	az	[redacted]	1.25E+00	m
Vertical dispersivity	ay	[redacted]	1.25E-01	m

For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report ax = 0.83$(\log_{10}x)^{2.414}$; 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.

This sheet calculates the Tier3 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

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 Tier 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.

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration
	mg/l
60.0	1.7E+00
120.0	1.7E+00
180.0	1.6E+00
240.0	1.5E+00
300.0	1.4E+00
360.0	1.4E+00
420.0	1.3E+00
480.0	1.2E+00
540.0	1.1E+00
600.0	1.1E+00
660.0	1.0E+00
720.0	9.8E-01
780.0	9.3E-01
840.0	8.9E-01
900.0	8.5E-01
960.0	8.2E-01
1020.0	7.9E-01
1080.0	7.6E-01
1140.0	7.3E-01
1200.0	7.0E-01

Site being assessed	Bless Area 4 Downshire well K20
Completed by:	AJ
Date.	24 11 2005
Version	12

ENVIRONMENT
AGENCY

R8D Publication20 Remedial Targets Worksheet, Release 2.2a

Tier 3 - Groundwater

Input Parameters(using pulldown menu)	Variable	Value	Unit	Source
Contaminant		Nickel		
Target Concentration	C_T	2.00E-02	mg/l	

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

Ogata Banks — Equations in R&D Pub. 20

Enter '1' to simulate vertical dispersion in one direction, '2' for two directions (pull down menu) 1

Enter '1' if biodegradation rate is for the substance in water,
'0' if rate is for decay in field conditions (i.e. field data from aquifer) (pull down menu 0

	Variable	Value	Unit	Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	6.00E-03	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	9.90E+99	days	
Calculated decay rate	λ	7.00E-101	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	8.00E+01	m	
Plume thickness at source	Sy	2.10E+01	m	
Saturated aquifer thickness	da	2.17E+01	m	
Bulk density of aquifer materials	ρ	1.70E+00	g/cm^3	
Effective porosity of aquifer	n	1.82E-01	fraction	
Hydraulic gradient	i	1.33E-02	fraction	
Hydraulic conductivity of aquifer	K	2.00E+01	m/d	
Distance to compliance point	x	1.20E+03	m	
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	0.00E+00	l/kg	*see options*
Longitudinal dispersivity	ax	12.536	m	*see options*
Transverse dispersivity	az	1.254	m	*see options*
Vertical dispersivity	ay	0.125	m	*see options*

Calculated Parameters	Variable		
Groundwater flow velocity	v	1.46E+00	m/d
Retardation factor	Rf	1.00E+00	fraction
Decay rate used	λ	7.00E-101	d^{-1}
Rate of contaminant flow due to retardation	u	1.46E+00	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	2.48E-03	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	1.46E-03	mg/l
Attenuation factor (one way vertical dispersion, C_O/C_{ED})	AF	2.42E+00	
Attenuation factor (two way vertical dispersion, C_O/C_{ED})	AF	4.11E+00	

Remedial Targets

Remedial Target LTC3 4.84E-02 mg/l — For comparison with measured groundwater concentration.
Ogata Banks

Distance to compliance point		1200	m	
Concentration of contaminant at compliance point	$C_{ED}/C0$	2.48E-03	mg/l	Ogata Banks
after		9.9E+99	days	

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

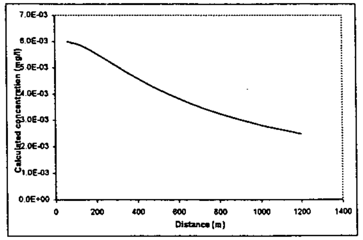
Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd	[redacted]	l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	1.00E+00	fraction
Organic carbon partition coefficient	Koc	0.00E+00	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$	[redacted]	l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Soil water partition coefficient	Kd	0.00E+00	l/kg

Dispersivity

Calculate dependant on distance to compliance point (0), 2
specify dispersivity (1), or calc after Xu & Eckstein (2) ?

		Enter value	Calc value Xu & Eckstein	
Longitudinal dispersivity	ax	[redacted]	1.25E+01	m
Transverse dispersivity	az		1.25E+00	m
Vertical dispersivity	ay		1.25E-01	m

For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report ax = 0.83$(\log_{10}x)^{2.414}$; 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.

This sheet calculates the Tier3 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
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 Tier 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.

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration
	mg/l
[illegible]	6.0E-03
11100	5.6E-03
240.0	5.3E-03
3W.0	5.1E-03
360.0	4.8E-03
420.0	4.6E-03
480.0	4.3E-03
540.0	4.0E-03
600.0	3.8E-03
660.0	3.6E-03
720.0	3.5E-03
71100	3.3E-03
840.0	3.2E-03
900.0	3.0E-03
960.0	2.9E-03
1020.0	2.8E-03
10110.0	2.7E-03
1140.0	2.6E-03
1200.0	2.5E-03

Site being assessed:	Bless Area 4 Downshire well K20
Completed by	AJ
Date:	24 11 2005
Version	12

R&D Publication20 Remedial Targets Worksheet, Release 2.2a

Tier 3 -Groundwater

ENVIRONMENT AGENCY

Input Parameters (using pull down menu)

	Variable	Value	Unit	Source
Contaminant		Phenol		
Target Concentration	C_T	5.00E-04	mg/l	

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

Ogata Banks — Equations in R&D Pub. 20

Enter '1' to simulate vertical dispersion in one direction, '2' for two directions (pull down menu): 1

Enter '1' if biodegradation rate is for the substance in water,
'0' if rate is for decay in field conditions (i.e. field data from aquifer) (pull down menu): 0

	Variable	Value	Unit	Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	9.90E-99	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	1.00E+01	days	
Calculated decay rate	λ	6.93E-02	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	8.00E+01	m	
Plume thickness at source	Sy	2.10E+01	m	
Saturated aquifer thickness	da	2.17E+01	m	
Bulk density of aquifer materials	ρ	1.70E+00	g/cm^3	
Effective porosity of aquifer	n	1.62E-01	fraction	
Hydraulic gradient	i	1.33E-02	fraction	
Hydraulic conductivity of aquifer	K	2.00E+01	m/d	
Distance to compliance point	x	1.20E+03	m	
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	1.05E-01	l/kg	*see options*
Longitudinal dispersivity	ax	12.536	m	*see options*
Transverse dispersivity	az	1.254	m	*see options*
Vertical dispersivity	ay	0.125	m	*see options*

Calculated Parameters

	Variable		
Groundwater flow velocity	v	1.46E+00	m/d
Retardation factor	Rf	1.98E+00	fraction
Decay rate used	λ	6.93E-02	d^{-1}
Rate of contaminant flow due to retardation	u	7.39E-01	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	5.69E-128	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	3.35E-128	mg/l
Attenuation factor (one way vertical dispersion, C_0/C_{ED})	AF	1.74E+29	
Attenuation factor (two way vertical dispersion, C_0/C_{ED})	AF	2.96E+29	

Remedial Targets

Remedial Target	LTC3	8.70E+25	mg/l	For comparison with measured groundwater concentration.
Ogata Banks				

Distance to compliance point		1200	m	
Concentration of contaminant at compliance point	$C_{ED}/C0$	5.69E-128	mg/l	Ogata Banks
after		9.9E+99	days	

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

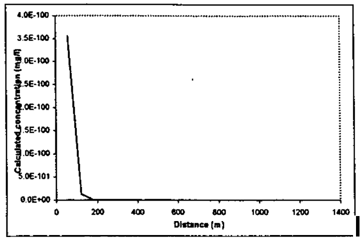
Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd		l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	1.00E+00	fraction
Organic carbon partition coefficient	Koc	1.05E-01	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$		l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Soil water partition coefficient	Kd	1.05E-01	l/kg

Dispersivity

Calculate dependant on distance to compliance point (0), specify dispersivity (1), or calc after Xu & Eckstein (2) ? 2

		Enter value	Calc value Xu & Eckstein	
Longitudinal dispersivity	ax		1.25E+01	m
Transverse dispersivity	az		1.25E+00	m
Vertical dispersivity	ay		1.25E-01	m

For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report $ax = 0.83(\log_{10}x)^{2.414}$; 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.

This sheet calculates the Tier3 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

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 Tier 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.

Calculated concentrations for distance-concentration graph

Ogata Banks

Distance	Concentration mg/l
60.0	3.6E-100
120.0	1.3E-101
180.0	4.4E-103
240.0	1.5E-104
300.0	5.1E-106
360.0	1.7E-107
420.0	5.9E-109
480.0	2.0E-110
540.0	6.9E-112
600.0	2.4E-113
660.0	8.1E-115
720.0	2.8E-116
780.0	9.5E-118
840.0	3.3E-119
900.0	1.1E-120
960.0	3.9E-122
1020.0	1.4E-123
1080.0	4.7E-125
1140.0	1.6E-126
1200.0	5.7E-128

Site being assessed	Bless Area 4 Downshire well K20
Completed by.	AJ
Date	24 11 2005
Version	12

R&D Publication20 Remedial Targets Worksheet, Release 2.2a

Tier 3 -Groundwater

ENVIRONMENT AGENCY

Input Parameters (using pull down menu)	Variable	Value	Unit	Source
Contaminant		Strontium		
Target Concentration	C_T	1.00E+00	mg/l	

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

Ogata Banks | Equations in R&D Pub. 20

Enter '1' to simulate vertical dispersion in one direction, '2' for two directions (pull down menu) 1

Enter '1' if biodegradation rate is for the substance in water,
'0' if rate is for decay in field conditions (i.e. field data from aquifer) (pull down menu 0

				Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	5.70E-01	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	9.90E+99	days	
Calculated decay rate	λ	7.00E-101	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	8.00E+01	m	
Plume thickness at source	Sy	2.10E+01	m	
Saturated aquifer thickness	da	2.17E+01	m	
Bulk density of aquifer materials	ρ	1.70E+00	g/cm^3	
Effective porosity of aquifer	n	1.82E-01	fraction	
Hydraulic gradient	i	1.33E-02	fraction	
Hydraulic conductivity of aquifer	K	2.00E+01	m/d	
Distance to compliance point	x	1.20E+03	m	
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	0.00E+00	l/kg	*see options*
Longitudinal dispersivity	ax	12.536	m	*see options*
Transverse dispersivity	az	1.254	m	*see options*
Vertical dispersivity	ay	0.125	m	*see options*

Calculated Parameters	Variable		
Groundwater flow velocity	v	1.46E+00	m/d
Retardation factor	Rf	1.00E+00	fraction
Decay rate used	λ	7.00E-101	d^{-1}
Rate of contaminant flow due to retardation	u	1.46E+00	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	2.36E-01	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	1.39E-01	mg/l
Attenuation factor (one way vertical dispersion, C_0/C_{ED})	AF	2.42E+00	
Attenuation factor (two way vertical dispersion, C_0/C_{ED})	AF	4.11E+00	

Remedial Targets

Remedial Target	LTC3	2.42E+00	mg/l	For comparison with measured groundwater concentration.
Ogata Banks				
Distance to compliance point		1200	m	
Concentration of contaminant at compliance point	$C_{ED}/C0$	2.36E-01	mg/l	Ogata Banks
after		9.9E+99	days	

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

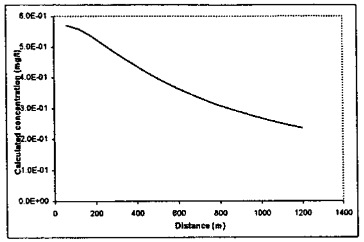
Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd		l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	1.00E+00	fraction
Organic carbon partition coefficient	Koc	0.00E+00	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$		l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Soil water partition coefficient	Kd	0.00E+00	l/kg

Dispersivity

Calculate dependant on distance to compliance point (0), specify dispersivity (1), or calc after Xu & Eckstein (2) ? 2

		Enter value	Calc value Xu & Eckstein	
Longitudinal dispersivity	ax		1.25E+01	m
Transverse dispersivity	az		1.25E+00	m
Vertical dispersivity	ay		1.25E-01	m

For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report ax = $0.83(\log_{10}x)^{2.414}$; 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.

This sheet calculates the Tier3 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

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 Tier 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.

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration
	mg/l
60.0	5.7E-01
120.0	5.6E-01
180.0	5.4E-01
240.0	5.1E-01
300.0	4.8E-01
360.0	4.6E-01
420.0	4.3E-01
480.0	4.0E-01
540.0	3.8E-01
600.0	3.6E-01
660.0	3.5E-01
720.0	3.3E-01
780.0	3.1E-01
840.0	3.0E-01
900.0	2.9E-01
960.0	2.7E-01
1020.0	2.6E-01
1080.0	2.5E-01
1140.0	2.4E-01
1200.0	2.4E-01

Site being assessed	Bless Area 4 Downshire well K20
Completed by	AJ
Date:	24 11 2005
Version	12

R&D Publication 20 Remedial Targets Worksheet. Release 2.2a

Tier 3 - Groundwater

ENVIRONMENT AGENCY

Input Parameters (using pull down menu)	Variable	Value	Unit	Source
Contaminant		Sulphide		
Target Concentration	C_T	2.50E-04	mg/l	

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

Ogata Banks Equations in R&D Pub. 20

				Source of parameter value
Enter '1' to simulate vertical dispersion in one direction, '2' for two directions (pull down menu)		1		
Enter '1' if biodegradation rate is for the substance in water, '0' if rate is for decay in field conditions (i.e. field data from aquifer) (pull down menu		0		
Initial contaminant concentration in groundwater at plume core	C_0	2.00E-01	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	9.90E+99	days	
Calculated decay rate	λ	7.00E-101	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	8.00E+01	m	
Plume thickness at source	Sy	2.10E+01	m	
Saturated aquifer thickness	da	2.17E+01	m	
Bulk density of aquifer materials	ρ	1.70E+00	g/cm^3	
Effective porosity of aquifer	n	1.82E-01	fraction	
Hydraulic gradient	i	1.33E-02	fraction	
Hydraulic conductivity of aquifer	K	2.00E+01	m/d	
Distance to compliance point	x	1.20E+03	m	
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater		9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	0.00E+00	l/kg	*see options*
Longitudinal dispersivity	ax	12.536	m	*see options*
Transverse dispersivity	az	1.254	m	*see options*
Vertical dispersivity	ay	0.125	m	*see options*

Calculated Parameters	Variable		
Groundwater flow velocity	v	1.46E+00	m/d
Retardation factor	Rf	1.00E+00	fraction
Decay rate used	λ	7.00E-101	d^{-1}
Rate of contaminant flow due to retardation	u	1.46E+00	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	8.27E-02	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	4.86E-02	mg/l
Attenuation factor (one way vertical dispersion, C_O/C_{ED})	AF	2.42E+00	
Attenuation factor (two way vertical dispersion, C_O/C_{ED})	AF	4.11E+00	

Remedial Targets

Remedial Target	**LTC3**	**6.05E-04**	**mg/l**	For comparison with measured groundwater concentration.
Ogata Banks				
Distance to compliance point		**1200**	**m**	
Concentration of contaminant at compliance point	$C_{ED}/C0$	**8.27E-02**	**mg/l**	Ogata Banks
after		**9.9E+99**	**days**	

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

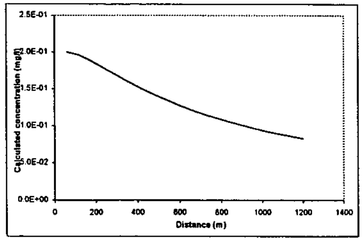
Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd		l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	1.00E+00	fraction
Organic carbon partition coefficient	Koc	0.00E+00	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$		l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Soil water partition coefficient	Kd	0.00E+00	l/kg

Dispersivity

Calculate dependant on distance to compliance point (0), specify dispersivity (1), or calc after Xu & Eckstein (2) ? **2**

		Enter value	Calc value Xu & Eckstein	
Longitudinal dispersivity	**ax**		1.25E+01	m
Transverse dispersivity	**az**		1.25E+00	m
Vertical dispersivity	**ay**		1.25E-01	m

For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report ax = $0.83(\log_{10}x)^{2.414}$; 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.

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration
	mg/l
60.0	2.0E-01
120.0	2.0E-01
1MI.O	1.9E-01
240.0	1.8E-01
300.0	1.7E-01
420.0	1.5E-01
4U0.0	1.4E-01
540.0	1.3E-01
600.0	1.3E-01
660.0	1.2E-01
720.0	1.2E-01
780.0	1.1E-01
840.0	1.1E-01
900.0	I.OE-01
960.0	9.6E-02
1020.0	9.3E-02
1080.0	8.9E-02
1140.0	8.6E-02
12W.O	8.3E-02

This sheet calculates the Tier3 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

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 Tier 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.

Site being assessed	Bless Area 4 Downshire well K20
Completed by	AJ
Date	24 11 2005
Version.	12

R&D Publication20 Remedial Targets Worksheet, Release 2.2a

Tier 3 - Groundwater

ENVIRONMENT AGENCY

Input Parameters (using pull down menu)

Input Parameters	Variable	Value	Unit	Source
Contaminant		Aliphatic C8-C10		
Target Concentration	C_T	7.14E-04	mg/l	

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

Ogata Banks — Equations in R&D Pub. 20

Enter '1' to simulate vertical dispersion in one direction, '2' for two directions (pull down menu) 1

Enter '1' if biodegradation rate is for the substance in water,
'0' if rate is for decay in field conditions (i.e. field data from aquifer) (pull down menu) 0

	Variable	Value	Unit	Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	9.90E-99	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	1.83E+03	days	
Calculated decay rate	λ	3.80E-04	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	8.00E+01	m	
Plume thickness at source	Sy	2.10E+01	m	
Saturated aquifer thickness	da	2.17E+01	m	
Bulk density of aquifer materials	ρ	1.70E+00	g/cm^3	
Effective porosity of aquifer	n	1.82E-01	fraction	
Hydraulic gradient	i	1.33E-02	fraction	
Hydraulic conductivity of aquifer	K	2.00E+01	m/d	
Distance to compliance point	x	1.20E+03	m	
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	1.15E+02	l/kg	*see options*
Longitudinal dispersivity	ax	12.536	m	*see options*
Transverse dispersivity	az	1.254	m	*see options*
Vertical dispersivity	ay	0.125	m	*see options*

Calculated Parameters Variable

Calculated Parameters	Variable	Value	Unit
Groundwater flow velocity	v	1.46E+00	m/d
Retardation factor	Rf	1.07E+03	fraction
Decay rate used	λ	3.80E-04	d^{-1}
Rate of contaminant flow due to retardation	u	1.36E-03	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	8.56E-159	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	5.03E-159	mg/l
Attenuation factor (one way vertical dispersion, C_0/C_{ED})	AF	1.16E+60	
Attenuation factor (two way vertical dispersion, C_0/C_{ED})	AF	1.97E+60	

Remedial Targets

Remedial Target	LTC3	8.26E+56	mg/l	For comparison with measured groundwater concentration.
Ogata Banks				
Distance to compliance point		1200	m	
Concentration of contaminant at compliance point	$C_{ED}/C0$	8.56E-159	mg/l	Ogata Banks
after		9.9E+99	days	

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

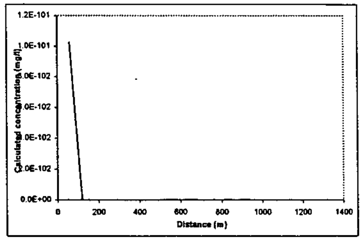
Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd	[redacted]	l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	1.00E+00	fraction
Organic carbon partition coefficient	Koc	1.15E+02	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$	[redacted]	l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Soil water partition coefficient	Kd	1.15E+02	l/kg

Dispersivity

Calculate dependant on distance to compliance point (0), specify dispersivity (1), or calc after Xu & Eckstein (2) ? 2

		Enter value	Calc value Xu & Eckstein	
Longitudinal dispersivity	ax	[redacted]	1.25E+01	m
Transverse dispersivity	az		1.25E+00	m
Vertical dispersivity	ay		1.25E-01	m

For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report ax = $0.83(\log_{10}x)^{2.414}$; 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.

Calculated concentrations for distance-concentration graph

Ogata Banks

DistarcalcConcentration	mg/l
80.0	1.0E-101
120.0	1.0E-104
180.0	1.0E-107
240.0	1.0E-110
300.0	1.0E-113
360.0	9.8E-117
420.0	9.6E-120
480.0	9.4E-123
540.0	9.3E-126
600.0	9.1E-129
660.0	9.0E-132
720.0	8.9E-135
780.0	8.8E-138
840.0	8.7E-141
900.0	8.7E-144
960.0	8.6E-147
1080.0	8.6E-153
1200.0	8.6E-159

This sheet calculates the Tier3 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

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 Tier 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.

Site being assessed	Bless Area 4 Downshire well K20
Completed by	AJ
Date	24 11.2005
Version	12

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ENVIRONMENT AGENCY

R&D Publication 20 Remedial Targets Worksheet, Release 2.2a

Tier 3 - Groundwater

Input Parameters (using pull down menu)	Variable	Value	Unit	Source
Contaminant		Aliphatic C10-C12		
Target Concentration	C_T	7.14E-04	mg/l	

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

Ogata Banks — Equations in R&D Pub. 20

Enter '1' to simulate vertical dispersion in one direction, '2' for two directions (pull down menu) — 1

Enter '1' if biodegradation rate is for the substance in water,
'0' if rate is for decay in field conditions (i.e. field data from aquifer) (pull down menu — 0

	Variable	Value	Unit	Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	9.90E-99	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	1.83E+03	days	
Calculated decay rate	λ	3.80E-04	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	8.00E+01	m	
Plume thickness at source	Sy	2.10E+01	m	
Saturated aquifer thickness	da	2.17E+01	m	
Bulk density of aquifer materials	ρ	1.70E+00	g/cm^3	
Effective porosity of aquifer	n	1.82E-01	fraction	
Hydraulic gradient	i	1.33E-02	fraction	
Hydraulic conductivity of aquifer	K	2.00E+01	m/d	
Distance to compliance point	x	1.20E+03	m	
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	9.12E+02	l/kg	*see options*
Longitudinal dispersivity	ax	12.536	m	*see options*
Transverse dispersivity	az	1.254	m	*see options*
Vertical dispersivity	ay	0.125	m	*see options*

Calculated Parameters	Variable		
Groundwater flow velocity	v	1.46E+00	m/d
Retardation factor	Rf	8.52E+03	fraction
Decay rate used	λ	3.80E-04	d^{-1}
Rate of contaminant flow due to retardation	u	1.72E-04	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	2.61E-298	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	1.54E-298	mg/l
Attenuation factor (one way vertical dispersion, C_O/C_{ED})	AF	3.79E+199	
Attenuation factor (two way vertical dispersion, C_O/C_{ED})	AF	6.44E+199	

Remedial Targets

Remedial Target	LTC3	2.70E+198	mg/l	For comparison with measured groundwater concentration.
Ogata Banks				

Distance to compliance point		1200	m	
Concentration of contaminant at compliance point	$C_{ED}/C0$	2.61E-298	mg/l	Ogata Banks
after		9.9E+99	days	

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

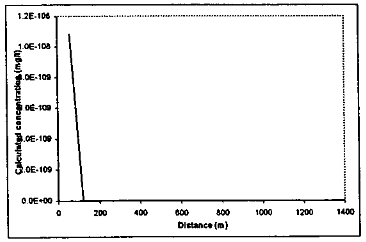
Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd		l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	1.00E+00	fraction
Organic carbon partition coefficient	Koc	9.12E+02	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$		l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Soil water partition coefficient	Kd	9.12E+02	l/kg

Dispersivity

Calculate dependant on distance to compliance point (0), specify dispersivity (1), or calc after Xu & Eckstein (2) ? — 2

		Enter value	Calc value Xu & Eckstein	
Longitudinal dispersivity	ax		1.25E+01	m
Transverse dispersivity	az		1.25E+00	m
Vertical dispersivity	ay		1.25E-01	m

For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report $ax = 0.83(\log_{10}x)^{2.414}$; az = ax/10, ay = ax/100 are assumed



Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration
60.0	1.1E-108
120.0	1.2E-118
180.0	1.2E-128
240.0	1.3E-138
300.0	1.3E-148
5w.o	1.4E-158
420.0	1.4E-168
480.0	1.5E-178
540.0	1.5E-188
600.0	1.6E-198
660.0	1.7E-208
720.0	1.7E-218
780.0	1.8E-228
840.0	1.9E-238
900.0	2.0E-248
960.0	2.2E-268
1080.0	2.5E-288
1200.0	2.6E-298

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.

This sheet calculates the Tier3 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

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 Tier 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.

Site being assessed:	Bless Area 4 Downshire well K20
Completed by	AJ
Date:	24 11 2005
Version:	12

R&D Publication 20 Remedial Targets Worksheet, Release 2.2a

Tier 3 - Groundwater

ENVIRONMENT AGENCY

Input Parameters (using pull down menu)	Variable	Value	Unit	Source
Contaminant		Aliphatic C12-C16		
Target Concentration	C_T	7.14E-04	mg/l	

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

Ogata Banks — Equations in R&D Pub. 20

Enter '1' to simulate vertical dispersion in one direction, '2' for two directions (pull down menu) 1

Enter '1' if biodegradation rate is for the substance in water,
'0' if rate is for decay in field conditions (i.e. field data from aquifer) (pull down menu 0

				Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	9.90E-99	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	1.83E+03	days	
Calculated decay rate	λ	3.80E-04	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	8.00E+01	m	
Plume thickness at source	Sy	2.10E+01	m	
Saturated aquifer thickness	da	2.17E+01	m	
Bulk density of aquifer materials	ρ	1.70E+00	g/cm^3	
Effective porosity of aquifer	n	1.82E-01	fraction	
Hydraulic gradient	i	1.33E-02	fraction	
Hydraulic conductivity of aquifer	K	2.00E+01	m/d	
Distance to compliance point	x	1.20E+03	m	
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	1.82E+04	l/kg	*see options*
Longitudinal dispersivity	ax	12.536	m	*see options*
Transverse dispersivity	az	1.254	m	*see options*
Vertical dispersivity	ay	0.125	m	*see options*

Calculated Parameters	Variable		
Groundwater flow velocity	v	1.46E+00	m/d
Retardation factor	Rf	1.70E+05	fraction
Decay rate used	λ	3.80E-04	d^{-1}
Rate of contaminant flow due to retardation	u	8.60E-06	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	#NUM!	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	#NUM!	mg/l
Attenuation factor (one way vertical dispersion, C_0/C_{ED})	AF	#NUM!	
Attenuation factor (two way vertical dispersion, C_0/C_{ED})	AF	#NUM!	

Remedial Targets

Remedial Target	LTC3	#NUM!	mg/l	For comparison with measured groundwater concentration.
Ogata Banks				
Distance to compliance point		1200	m	
Concentration of contaminant at compliance point	$C_{ED}/C0$	#NUM!	mg/l	Ogata Banks
after		9.9E+99	days	

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

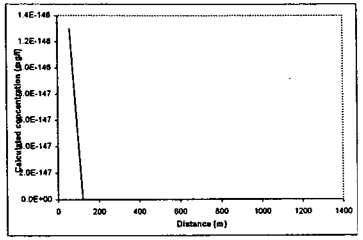
Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd		l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	1.00E+00	fraction
Organic carbon partition coefficient	Koc	1.82E+04	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$		l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Soil water partition coefficient	Kd	1.82E+04	l/kg

Dispersivity

Calculate dependant on distance to compliance point (0), specify dispersivity (1), or calc after Xu & Eckstein (2) ? 2

		Enter value	Calc value Xu & Eckstein	
Longitudinal dispersivity	ax		1.25E+01	m
Transverse dispersivity	az		1.25E+00	m
Vertical dispersivity	ay		1.25E-01	m

For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report ax = $0.83(\log_{10}x)^{2.414}$; 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.

This sheet calculates the Tier3 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

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 Tier 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.

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration
	mg/l
60.0	1.3E-146
120.0	1.7E-194
180.0	2.1E-242
240.0	2.7E-290
300.0	0.0E+00
360.0	0.0E+00
420.0	#NUM!
480.0	#NUM!
540.0	#NUM!
600.0	#NUM!
660.0	#NUM!
720.0	#NUM!
780.0	#NUM!
840.0	#NUM!
900.0	#NUM!
960.0	#NUM!
1020.0	#NUM!
1080.0	#NUM!
1140.0	#NUM!
1200.0	#NUM!

Site being assessed	Bless Area 4 Downshire well K20
Completed by:	AJ
Date:	24 11 2005
Version:	12

R&D Publication 20 Remedial Targets Worksheet, Release 2.2a

Tier 3 - Groundwater

ENVIRONMENT AGENCY

Input Parameters (using pull down menu)	Variable	Value	Unit	Source
Contaminant		Aliphatic C16-C21		
Target Concentration	C_T	7.14E-04	mg/l	

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

Ogata Banks — Equations in R&D Pub. 20

Enter '1 to simulate vertical dispersion in one direction, '2' for two directions (pull down menu): 1

Enter '1' if biodegradation rate is for the substance in water,
'0' if rate is for decay in field conditions (i.e. field data from aquifer) (pull down menu: 0

	Variable	Value	Unit	Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	9.90E-99	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	3.65E+03	days	
Calculated decay rate	λ	1.90E-04	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	8.00E+01	m	
Plume thickness at source	Sy	2.10E+01	m	
Saturated aquifer thickness	da	2.17E+01	m	
Bulk density of aquifer materials	ρ	1.70E+00	g/cm^3	
Effective porosity of aquifer	n	1.82E-01	fraction	
Hydraulic gradient	i	1.33E-02	fraction	
Hydraulic conductivity of aquifer	K	2.00E+01	m/d	
Distance to compliance point	x	1.20E+03	m	
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	2.29E+06	l/kg	***see options***
Longitudinal dispersivity	ax	12.536	m	***see options***
Transverse dispersivity	az	1.254	m	***see options***
Vertical dispersivity	ay	0.125	m	***see options***

Calculated Parameters	Variable		
Groundwater flow velocity	v	1.46E+00	m/d
Retardation factor	Rf	2.14E+07	fraction
Decay rate used	λ	1.90E-04	d^{-1}
Rate of contaminant flow due to retardation	u	6.83E-08	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	#NUM!	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	#NUM!	mg/l
Attenuation factor (one way vertical dispersion, C_0/C_{ED})	AF	#NUM!	
Attenuation factor (two way vertical dispersion, C_0/C_{ED})	AF	#NUM!	

Remedial Targets

Remedial Target LTC3 #NUM! mg/l — For comparison with measured groundwater concentration.
Ogata Banks

Distance to compliance point		1200	m	
Concentration of contaminant at compliance point	$C_{ED}/C0$	#NUM!	mg/l	Ogata Banks
after		9.9E+99	days	

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

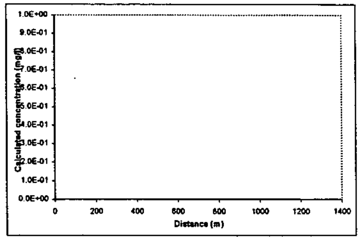
Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd		l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	1.00E+00	fraction
Organic carbon partition coefficient	Koc	2.29E+06	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$		l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Soil water partition coefficient	Kd	2.29E+06	l/kg

Dispersivity

Calculate dependant on distance to compliance point (0), specify dispersivity (1), or calc after Xu & Eckstein (2) ? 2

		Enter value	Calc value Xu & Eckstein	
Longitudinal dispersivity	ax		1.25E+01	m
Transverse dispersivity	az		1.25E+00	m
Vertical dispersivity	ay		1.25E-01	m

For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report ax = $0.83(\log_{10}x)^{2.414}$; 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.

This sheet calculates the Tier3 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

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 Tier 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.

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration
	mg/l
60.0	#NUM!
120.0	#NUM!
180.0	#NUM!
240.0	#NUM!
3W.0	#NUM!
360.0	#NUM!
410.0	#NUM!
480.0	#NUM!
540.0	#NUM!
600.0	#NUM!
650.0	#NUM!
720.0	#NUM!
71100	#NUM!
840.0	#NUM!
900.0	#NUM!
960.0	#NUM!
1020.0	#NUM!
1080.0	#NUM!
1140.0	#NUM!
1200.0	#NUM!

Site being assessed:	Bless Area 4 Downshire well K20
Completed by	AJ
Date.	24 11 2005
Version	12

R&D Publication 20 Remedial Targets Worksheet, Release 2.2a

Tier 3 - Groundwater

ENVIRONMENT AGENCY

Input Parameters (using pull down menu)

	Variable	Value	Unit	Source
Contaminant		Aliphatic C21-C35		
Target Concentration	C_T	7.14E-04	mg/l	

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

Ogata Banks — Equations in R&D Pub. 20

Enter '1' to simulate vertical dispersion in one direction, '2' for two directions (pull down menu): 1

Enter '1' if biodegradation rate is for the substance in water,
'0' if rate is for decay in field conditions (i.e. field data from aquifer) (pull down menu): 0

	Variable	Value	Unit	Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	9.90E-99	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	3.65E+03	days	
Calculated decay rate	λ	1.90E-04	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	8.00E+01	m	
Plume thickness at source	Sy	2.10E+01	m	
Saturated aquifer thickness	da	2.17E+01	m	
Bulk density of aquifer materials	ρ	1.70E+00	g/cm^3	
Effective porosity of aquifer	n	1.82E-01	fraction	
Hydraulic gradient	i	1.33E-02	fraction	
Hydraulic conductivity of aquifer	K	2.00E+01	m/d	
Distance to compliance point	x	1.20E+03	m	
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	2.29E+06	l/kg	*see options*
Longitudinal dispersivity	ax	12.536	m	*see options*
Transverse dispersivity	az	1.254	m	*see options*
Vertical dispersivity	ay	0.125	m	*see options*

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

Calculate for non-polar organic chemicals

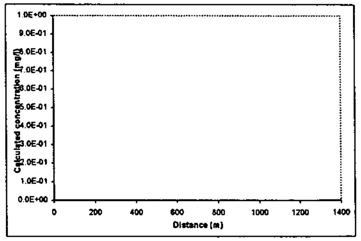
Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd		l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	1.00E+00	fraction
Organic carbon partition coefficient	Koc	2.29E+06	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$		l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Soil water partition coefficient	Kd	2.29E+06	l/kg

Dispersivity

Calculate dependant on distance to compliance point (0) specify dispersivity (1), or calc after Xu & Eckstein (2) ? 2

		Enter value	Calc value Xu & Eckstein	
Longitudinal dispersivity	ax		1.25E+01	m
Transverse dispersivity	az		1.25E+00	m
Vertical dispersivity	ay		1.25E-01	m

For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report ax = $0.83(\log_{10}x)^{2.414}$; 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.

This sheet calculates the Tier3 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

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 Tier 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.

Calculated Parameters

	Variable		
Groundwater flow velocity	v	1.46E+00	m/d
Retardation factor	Rf	2.14E+07	fraction
Decay rate used	λ	1.90E-04	d^{-1}
Rate of contaminant flow due to retardation	u	6.83E-08	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	#NUM!	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	#NUM!	mg/l
Attenuation factor (one way vertical dispersion, C_0/C_{ED})	AF	#NUM!	
Attenuation factor (two way vertical dispersion, C_0/C_{ED})	AF	#NUM!	

Site being assessed	Bless Area 4 Downshire well K20
Completed by	AJ
Date	24 11 2005
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Remedial Targets

Remedial Target LTC3 #NUM! mg/l — For comparison with measured groundwater concentration.
Ogata Banks

Distance to compliance point		**1200**	**m**	
Concentration of contaminant at compliance point	$C_{ED}/C0$	**#NUM!**	**mg/l**	Ogata Banks
after		**9.9E+99**	**days**	

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.

R&D Publication20 Remedial Targets Worksheet, Release 2.2a

Tier 3 - Groundwater

ENVIRONMENT AGENCY

Input Parameters (using pull down menu)	Variable	Value	Unit	Source
Contaminant		Aliphatic C16-C21		
Target Concentration	C_T	7.14E-04	mg/l	

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

Ogata Banks — Equations in R&D Pub. 20

Enter '1' to simulate vertical dispersion in one direction, '2' for two directions (pull down menu): 1

Enter '1' if biodegradation rate is for the substance in water,
'0' if rate is for decay in field conditions (i.e. field data from aquifer) (pull down menu): 0

	Variable	Value	Unit	Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	9.90E-99	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	3.65E+03	days	
Calculated decay rate	λ	1.90E-04	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	8.00E+01	m	
Plume thickness at source	Sy	2.10E+01	m	
Saturated aquifer thickness	da	2.17E+01	m	
Bulk density of aquifer materials	ρ	1.70E+00	g/cm^3	
Effective porosity of aquifer		1.82E-01	fraction	
Hydraulic gradient	i	1.02E-02	fraction	
Hydraulic conductivity of aquifer	K	2.00E+01	m/d	
Distance to compliance point	x	1.70E+03	m	
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	2.29E+06	l/kg	*see options*
Longitudinal dispersivity	ax	14.075	m	*see options*
Transverse dispersivity	az	1.407	m	*see options*
Vertical dispersivity	ay	0.141	m	*see options*

Calculated Parameters	Variable		
Groundwater flow velocity	v	1.12E+00	m/d
Retardation factor	Rf	2.14E+07	fraction
Decay rate used	λ	1.90E-04	d^{-1}
Rate of contaminant flow due to retardation	u	5.24E-08	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	#NUM!	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	#NUM!	mg/l
Attenuation factor (one way vertical dispersion, C_O/C_{ED})	AF	#NUM!	
Attenuation factor (two way vertical dispersion, C_O/C_{ED})	AF	#NUM!	

Remedial Targets

Remedial Target	LTC3	#NUM!	mg/l

For comparison with measured groundwater concentration.

Ogata Banks

Distance to compliance point		**1700**	**m**	
Concentration of contaminant at compliance point	$C_{ED}/C0$	**#NUM!**	**mg/l**	Ogata Banks
after		**9.9E+99**	**days**	

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

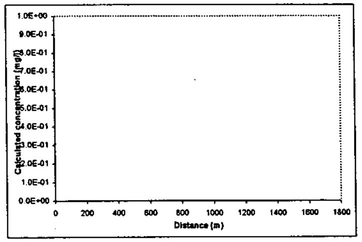
Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd		l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	1.00E+00	fraction
Organic carbon partition coefficient	Koc	2.29E+06	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$		l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Soil water partition coefficient	Kd	2.29E+06	l/kg

Dispersivity

Calculate dependant on distance to compliance point (0), specify dispersivity (1), or calc after Xu & Eckstein (2) ? 2

		Enter value	Calc value Xu & Eckstein	
Longitudinal dispersivity	ax		1.41E+01	m
Transverse dispersivity	az		1.41E+00	m
Vertical dispersivity	ay		1.41E-01	m

For calculated value, assumes ax = 0.1 * x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report $ax = 0.83(\log_{10}x)^{2.414}$; 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.

This sheet calculates the Tier3 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

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 Tier 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.

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration mg/l
85.0	#NUM!
170.0	#NUM!
255.0	#NUM!
340.0	#NUM!
425.0	#NUM!
510.0	#NUM!
595.0	#NUM!
680.0	#NUM!
765.0	#NUM!
850.0	#NUM!
935.0	#NUM!
1020.0	#NUM!
1105.0	#NUM!
1190.0	#NUM!
1275.0	#NUM!
1360.0	#NUM!
1445.0	#NUM!
1530.0	#NUM!
1615.0	#NUM!
1700.0	#NUM!

Site being assessed	Bless Area 4 Res K20
Completed by	AJ
Date	24 11 2005
Version.	12

R&D Publication20 Remedial Targets Worksheet, Release 2.2a

Tier 3 - Groundwater

ENVIRONMENT AGENCY

input Parameters (using pull down menu)	Variable	Value	Unit	Source
Contaminant Target Concentration	C_T			

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

Ogata Banks — Equations in R&D Pub. 20

Enter '1' to simulate vertical dispersion in one direction, '2' for two directions (pull down menu) 1

Enter '1' if biodegradation rate is for the substance in water,
'0' if rate is for decay in field conditions (i.e. field data from aquifer) (pull down menu 0

	Variable	Value	Unit	Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	9.90E-99	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	3.65E+03	days	
Calculated decay rate	λ	1.90E-04	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	8.00E+01	m	
Plume thickness at source	Sy	2.10E+01	m	
Saturated aquifer thickness	da	2.17E+01	m	
Bulk density of aquifer materials	ρ	1.70E+00	g/cm^3	
Effective porosity of aquifer	n	1.82E-01	fraction	
Hydraulic gradient	i	1.02E-02	fraction	
Hydraulic conductivity of aquifer	K	2.00E+01	m/d	
Distance to compliance point	x	1.70E+03	m	
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	2.29E+06	l/kg	*see options*
Longitudinal dispersivity	ax	14.075	m	*see options*
Transverse dispersivity	az	1.407	m	*see options*
Vertical dispersivity	ay	0.141	m	*see options*

Calculated Parameters

	Variable		
Groundwater flow velocity	v	1.12E+00	m/d
Retardation factor	Rf	2.14E+07	fraction
Decay rate used	λ	1.90E-04	d^{-1}
Rate of contaminant flow due to retardation	u	5.24E-08	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	#NUM!	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	#NUM!	mg/l
Attenuation factor (one way vertical dispersion, C_0/C_{ED})	AF	#NUM!	
Attenuation factor (two way vertical dispersion, C_0/C_{ED})	AF	#NUM!	

Remedial Targets

Remedial Target LTC3 #NUM! mg/l For comparison with measured groundwater concentration.
Ogata Banks

Distance to compliance point 1700 m

Concentration of contaminant at compliance point $C_{ED}/C0$ **#NUM!** **mg/l** Ogata Banks
after **9.9E+99** **days**

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

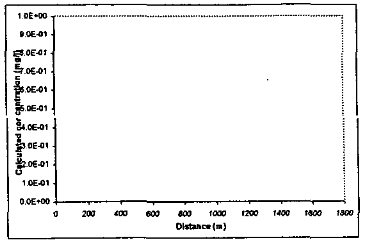
Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd	[redacted]	l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	1.00E+00	fraction
Organic carbon partition coefficient	Koc	2.29E+06	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$	[redacted]	l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Soil water partition coefficient	Kd	2.29E+06	l/kg

Dispersivity

Calculate dependant on distance to compliance point (0), specify dispersivity (1), or calc after Xu & Eckstein (2) ? 2

		Enter value	Calc value Xu & Eckstein	
Longitudinal dispersivity	ax	[redacted]	1.41E+01	m
Transverse dispersivity	az		1.41E+00	m
Vertical dispersivity	ay		1.41E-01	m

For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, av = 0.001 * x
Xu & Eckstein (1995) report *ax = 0.83(log$_{10}$x)$^{2.414}$; 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.

This sheet calculates the Tier3 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

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 Tier 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.

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration
	mg/l
85.0	#NUM!
170.0	#NUM!
255.0	#NUM!
340.0	#NUM!
425.0	#NUM!
510.0	#NUM!
595.0	#NUM!
680.0	#NUM!
765.0	#NUM!
850.0	#NUM!
935.0	#NUM!
1020.0	#NUM!
1105.0	#NUM!
1190.0	#NUM!
1275.0	#NUM!
1360.0	#NUM!
1445.0	#NUM!
1530.0	#NUM!
1615.0	#NUM!
1700.0	#NUM!

Site being assessed:	Bless Area 4 Res K20
Completed by	AJ
Date:	24 11 2005
Version:	12

R&D Publication 20 Remedial Targets Worksheet, Release 2.2a

Tier 3 -Groundwater

ENVIRONMENT AGENCY

Input Parameters (using pull down menu)

	Variable	Value	unit	Source
Contaminant		Aromatic C21-C35		
Target Concentration	C_T	7.14E-04	mg/l	

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

Ogata Banks — Equations in R&D Pub. 20

Enter '1' to simulate vertical dispersion in one direction, '2' for two directions (pull down menu): 1

Enter '1' if biodegradation rate is for the substance in water,
'0' if rate is for decay in field conditions (i.e. field data from aquifer) (pull down menu: 0

	Variable	Value	unit	Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	9.90E-99	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	3.65E+03	days	
Calculated decay rate	λ	1.90E-04	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	8.00E+01	m	
Plume thickness at source	Sy	2.10E+01	m	
Saturated aquifer thickness	da	2.17E+01	m	
Bulk density of aquifer materials	ρ	1.70E+00	g/cm^3	
Effective porosity of aquifer	n	1.82E-01	fraction	
Hydraulic gradient	i	1.02E-02	fraction	
Hydraulic conductivity of aquifer	K	2.00E+01	m/d	
Distance to compliance point	x	1.70E+03	m	
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	4.57E+02	l/kg	*see options*
Longitudinal dispersivity	ax	14.075	m	*see options*
Transverse dispersivity	az	1.407	m	*see options*
Vertical dispersivity	ay	0.141	m	*see options*

Calculated Parameters

	Variable		
Groundwater flow velocity	v	1.12E+00	m/d
Retardation factor	Rf	4.27E+03	fraction
Decay rate used	λ	1.90E-04	d^{-1}
Rate of contaminant flow due to retardation	u	2.63E-04	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	1.83E-242	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	1.02E-242	mg/l
Attenuation factor (one way vertical dispersion, C_O/C_{ED})	AF	5.40E+143	
Attenuation factor (two way vertical dispersion, C_O/C_{ED})	AF	9.70E+143	

Remedial Targets

Remedial Target	LTC3	3.95E+140	mg/l	For comparison with measured groundwater concentration.
Ogata Banks				
Distance to compliance point		1700	m	
Concentration of contaminant at compliance point	$C_{ED}/C0$	1.83E-242	mg/l	Ogata Banks
after		9.9E+99	days	

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 cull down menu)

Calculate for non-polar organic chemicals

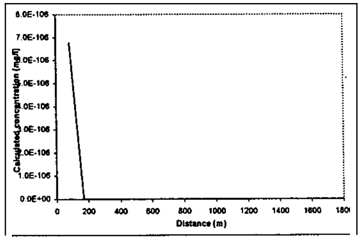
Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd	[redacted]	l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	1.00E+00	fraction
Organic carbon partition coefficient	Koc	4.57E+02	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$	[redacted]	l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Soil water partition coefficient	Kd	4.57E+02	l/kg

Dispersivity

Calculate dependant on distance to compliance point (0), specify dispersivity (1), or calc after Xu & Eckstein (2) ? 2

		Enter value	Calc value Xu & Eckstein	
Longitudinal dispersivity	ax	[redacted]	1.41E+01	m
Transverse dispersivity	az		1.41E+00	m
Vertical dispersivity	ay		1.41E-01	m

For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report ax = $0.83(log_{10}x)^{2.414}$; 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.

This sheet calculates the Tier3 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

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 Tier 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.

Calculated concentrations for distance-concentration graph

OgataBankation sheet

Distance	Concentration mg/l
85.0	6.8E-106
170.0	4.4E-113
255.0	2.8E-120
340.0	1.8E-127
425.0	1.1E-134
510.0	7.1E-142
595.0	4.5E-149
680.0	2.9E-156
765.0	1.9E-163
856.0	7.2E-170
1020.0	5.1E-185
1105.0	3.4E-192
1190.0	2.2E-199
1276.0	1.4E-206
1360.0	9.5E-214
1445.0	6.3E-221
1630.0	4.2E-228
1606.0	2.8E-248

Site being assessed	Bless Area 4 Res K20
Completed by:	AJ
Date:	24 11 2005
Version	12

R&D Publication 20 Remedial Targets Worksheet, Release 2.2a

ENVIRONMENT AGENCY

Tier 3 -Groundwater

Input Parameters (using pull dorm menu)	Variable	Value	Unit	Source
Contaminant		mmoniacal Nitrogen as		
Target Concentration	C_T	1.20E-01	mg/l	

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

Ogata Banks — Equations in R&D Pub. 20

Enter '1' to simulate vertical dispersion in one direction, '2' for two directions (pull down menu): 1

Enter '1' if biodegradation rate is for the substance in water,
'0' if rate is for decay in field conditions (i.e. field data from aquifer) (pull down menu): 0

	Variable	Value	Unit	Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	5.50E+01	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	2.19E+03	days	
Calculated decay rate	λ	3.17E-04	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	8.00E+01	m	
Plume thickness at source	Sy	2.10E+01	m	
Saturated aquifer thickness	da	2.17E+01	m	
Bulk density of aquifer materials	ρ	1.70E+00	g/cm^3	
Effective porosity of aquifer	n	1.82E-01	fraction	
Hydraulic gradient	i	1.02E-02	fraction	
Hydraulic conductivity of aquifer	K	2.00E+01	m/d	
Distance to compliance point	x	1.70E+03	m	
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	5.00E-01	l/kg	*see options*
Longitudinal dispersivity	ax	14.075	m	*see options*
Transverse dispersivity	az	1.407	m	*see options*
Vertical dispersivity	ay	0.141	m	*see options*

Calculated Parameters	Variable		
Groundwater flow velocity	v	1.12E+00	m/d
Retardation factor	Rf	5.67E+00	fraction
Decay rate used	λ	3.17E-04	d^{-1}
Rate of contaminant flow due to retardation	u	1.98E-01	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	1.11E+00	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	6.18E-01	mg/l
Attenuation factor (one way vertical dispersion, C_0/C_{ED})	AF	4.95E+01	
Attenuation factor (two way vertical dispersion, C_0/C_{ED})	AF	8.90E+01	

Remedial Targets

Remedial Target Ogata Banks	LTC3	5.94E+00	mg/l	For comparison with measured groundwater concentration.
Distance to compliance point		1700	m	
Concentration of contaminant at compliance point	$C_{ED}/C0$	1.11E+00	mg/l	Ogata Banks
after		9.9E+99	days	

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

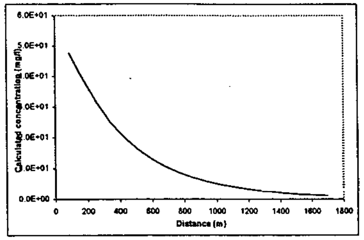
Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd		l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	1.00E+00	fraction
Organic carbon partition coefficient	Koc	5.00E-01	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$		l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Soil water partition coefficient	Kd	5.00E-01	l/kg

Dispersivity

Calculate dependant on distance to compliance point (0), specify dispersivity (1), or calc after Xu & Eckstein (2) ? 2

		Enter value	Calc value Xu & Eckstein	
Longitudinal dispersivity	ax		1.41E+01	m
Transverse dispersivity	az		1.41E+00	m
Vertical dispersivity	ay		1.41E-01	m

For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report ax = 0.83$(log_{10}x)^{2.414}$; 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.

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration
	mg/l
85.0	4.8E+01
170.0	3.9E+01
266.0	3.1E+01
340.0	2.5E+01
426.0	2.0E+01
510.0	1.6E+01
595.0	1.3E+01
680.0	1.1E+01
765.0	8.6E+00
850.0	7.0E+00
935.0	5.8E+00
1020.0	4.8E+00
1105.0	3.9E+00
1190.0	3.3E+00
1275.0	2.7E+00
1360.0	2.3E+00
1445.0	1.9E+00
1530.0	1.6E+00
1615.0	1.3E+00
1700.0	1.1E+00

This sheet calculates the Tier3 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

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 Tier 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.

Site being assessed	Bless Area 4 Res K20
Completed by:	AJ
Date.	24 11 2005
Version	12

R&D Publication 20 Remedial Targets Worksheet, Release 2.2a

Tier 3 • Groundwater

ENVIRONMENT AGENCY

Input Parameters (using pull down menu)

Input Parameters (using pull down menu)	Variable	Value	Unit	Source
Contaminant		Aromatic C8-C10		
Target Concentration	C_T	7.14E-04	mg/l	

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

Ogata Banks — Equations in R&D Pub. 20

Enter '1' to simulate vertical dispersion in one direction, '2' for two directions (pull down menu): 1

Enter '1' if biodegradation rate is for the substance in water,
'0' if rate is for decay in field conditions (i.e. field data from aquifer) (pull down menu): 0

	Variable	Value	Unit	Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	9.90E-99	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	1.83E+03	days	
Calculated decay rate	λ	3.80E-04	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	8.00E+01	m	
Plume thickness at source	Sy	2.10E+01	m	
Saturated aquifer thickness	da	2.17E+01	m	
Bulk density of aquifer materials	ρ	1.70E+00	g/cm^3	
Effective porosity of aquifer	n	1.82E-01	fraction	
Hydraulic gradient	i	1.02E-02	fraction	
Hydraulic conductivity of aquifer	K	2.00E+01	m/d	
Distance to compliance point	x	1.70E+03	m	
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	5.75E+00	l/kg	*see options*
Longitudinal dispersivity	ax	14.075	m	*see options*
Transverse dispersivity	az	1.407	m	*see options*
Vertical dispersivity	ay	0.141	m	*see options*

Calculated Parameters

Calculated Parameters	Variable	Value	Unit
Groundwater flow velocity	v	1.12E+00	m/d
Retardation factor	Rf	5.47E+01	fraction
Decay rate used	λ	3.80E-04	d^{-1}
Rate of contaminant flow due to retardation	u	2.05E-02	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	1.53E-110	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	8.52E-111	mg/l
Attenuation factor (one way vertical dispersion, C_0/C_{ED})	AF	6.46E+11	
Attenuation factor (two way vertical dispersion, C_0/C_{ED})	AF	1.16E+12	

Remedial Targets

Remedial Target LTC3 4.61E+08 mg/l — For comparison with measured groundwater concentration.
Ogata Banks

Distance to compliance point		1700	m	
Concentration of contaminant at compliance point	$C_{ED}/C0$	1.53E-110	mg/l	Ogata Banks
after		9.9E+99	days	

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

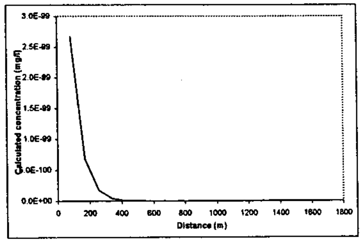
Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd	[redacted]	l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	1.00E+00	fraction
Organic carbon partition coefficient	Koc	5.75E+00	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$	[redacted]	l/kg
Sorption coefficient for ionised species	$K_{oc,i}$	[redacted]	l/kg
pH value	pH	[redacted]	
acid dissociation constant	pKa	[redacted]	
Soil water partition coefficient	Kd	5.75E+00	l/kg

Dispersivity

Calculate dependant on distance to compliance point (0), specify dispersivity (1), or calc after Xu & Eckstein (2) ? 2

		Enter value	Calc value Xu & Eckstein	
Longitudinal dispersivity	ax	[redacted]	1.41E+01	m
Transverse dispersivity	az	[redacted]	1.41E+00	m
Vertical dispersivity	ay	[redacted]	1.41E-01	m

For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report ax = $0.83(\log_{10}x)^{2.414}$; 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.

This sheet calculates the Tier3 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

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 Tier 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.

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration
	mg/l
85.0	2.7E-99
255.0	6.5E-100
340.0	4.3E-101
425.0	1.1E-101
510.0	2.7E-102
595.0	6.8E-103
680.0	1.7E-103
765.0	4.1E-104
935.0	2.8E-105
1020.0	7.3E-106
1105.0	1.9E-106
1190.0	4.9E-107
1275.0	1.3E-107
1360.0	3.3E-108
1445.0	8.6E-109
1615.0	2.2E-109
1700.0	1.5E-110

Site being assessed:	Bless Area 4 Res K20
Completed by:	AJ
Date:	24 11 2005
Version	12

R&D Publication 20 Remedial Targets Worksheet, Release 2.2a

Tier 3 - Groundwater

ENVIRONMENT AGENCY

Input Parameters (using pull down menu)	Variable	Value	Unit	Source
Contaminant		Aromatic C10-C12		
Target Concentration	C_T	7.14E-04	mg/l	

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

Ogata Banks — Equations in R&D Pub. 20

Enter '1' to simulate vertical dispersion in one direction, '2' for two directions (pull down menu) — 1

Enter '1' if biodegradation rate is for the substance in water,
'0' if rate is for decay in field conditions (i.e. field data from aquifer) (pull down menu — 0

	Variable	Value	Unit	Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	9.90E-99	m00	
Half life for degradation of contaminant in water	$t_{1/2}$	1.83E+03	days	
Calculated decay rate	λ	3.80E-04	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	8.00E+01	m	
Plume thickness at source	Sy	2.10E+01	m	
Saturated aquifer thickness	da	2.17E+01	m	
Bulk density of aquifer materials	ρ	1.70E+00	g/cm^3	
Effective porosity of aquifer	n	1.82E-01	fraction	
Hydraulic gradient	i	1.02E-02	fraction	
Hydraulic conductivity of aquifer	K	2.00E+01	m/d	
Distance to compliance point	x	1.70E+03	m	
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	9.12E+00	l/kg	*see options*
Longitudinal dispersivity	ax	14.075	m	*see options*
Transverse dispersivity	az	1.407	m	*see options*
Vertical dispersivity	ay	0.141	m	*see options*

Calculated Parameters	Variable		
Groundwater flow velocity	v	1.12E+00	m/d
Retardation factor	Rf	8.62E+01	fraction
Decay rate used	λ	3.80E-04	d^{-1}
Rate of contaminant flow due to retardation	u	1.30E-02	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	1.09E-115	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	6.08E-116	mg/l
Attenuation factor (one way vertical dispersion, C_0/C_{ED})	AF	9.06E+16	
Attenuation factor (two way vertical dispersion, C_0/C_{ED})	AF	1.63E+17	

Remedial Targets

Remedial Target LTC3 6.47E+13 mg/l — For comparison with measured groundwater concentration.

Ogata Banks

Distance to compliance point		**1700**	**m**	
Concentration of contaminant at compliance point	$C_{ED}/C0$	**1.09E-115**	**mg/l**	Ogata Banks
after		**9.9E+99**	**days**	

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

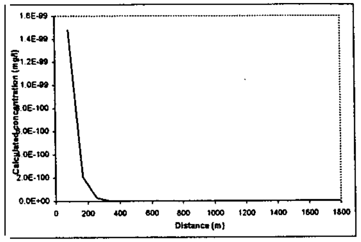
Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd		l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	1.00E+00	fraction
Organic carbon partition coefficient	Koc	9.12E+00	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$		l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Soil water partition coefficient	Kd	9.12E+00	l/kg

Dispersivity

Calculate dependant on distance to compliance point (0), specify dispersivity (1), or calc after Xu & Eckstein (2) ? — 2

		Enter value	Calc value Xu & Eckstein	
Longitudinal dispersivity	ax		1.41E+01	m
Transverse dispersivity	az		1.41E+00	m
Vertical dispersivity	ay		1.41E-01	m

For calculated value, assumes ax = 0.1 * x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report $ax = 0.83(\log_{10}x)^{2.414}$; 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.

Calculated concentrations for distance-concentration graph

Ogata Banks

DistanceConcentration	mg/l
[illegible]	[illegible]
2U.0	2.9E-101
340.0	4.0E-102
425.0	5.5E-103
598.0	7.7E-104
680.0	1.5E-105
7MJ	2.1E-106
856.0	4.2E-108
1006.0	6.6E-109
1190.0	1.2E-110
1275.0	1.7E-111
1100.0	2.5E-112
1446.0	3.6E-113
1615.0	7.5E-115
1700.0	1.1E-115

This sheet calculates the Tier3 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

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 Tier 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

Site being assessed	Bless Area 4 Res K20
Completed by:	AJ
Date.	24 11 2005
Version:	12

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Environment Agency

R&D Publication 20 Remedial Targets Worksheet, Release 2.2a

Tier 3 - Groundwater

Input Parameters (using pull down menu)	Variable	Value	Unit	Source
Contaminant		Aromatic C12-C16		
Target Concentration	C_T	7.14E-04	mg/l	

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

Ogata Banks — Equations in R&D Pub. 20

Enter '1' to simulate vertical dispersion in one direction, '2' for two directions (pull down menu) 1

Enter '1' if biodegradation rate is for the substance in water, '0' if rate is for decay in field conditions (i.e. field data from aquifer) (pull down menu) 0

	Variable	Value	Unit	Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	9.90E-99	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	1.83E+03	days	
Calculated decay rate	λ	3.80E-04	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	8.00E+01	m	
Plume thickness at source	Sy	2.10E+01	m	
Saturated aquifer thickness	da	2.17E+01	m	
Bulk density of aquifer materials	ρ	1.70E+00	g/cm^3	
Effective porosity of aquifer	n	1.82E-01	fraction	
Hydraulic gradient	i	1.02E-02	fraction	
Hydraulic conductivity of aquifer	K	2.00E+01	m/d	
Distance to compliance point	x	1.70E+03	m	
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	1.82E+01	l/kg	*see options*
Longitudinal dispersivity	ax	14.075	m	*see options*
Transverse dispersivity	az	1.407	m	*see options*
Vertical dispersivity	ay	0.141	m	*see options*

Calculated Parameters	Variable		
Groundwater flow velocity	v	1.12E+00	m/d
Retardation factor	Rf	1.71E+02	fraction
Decay rate used	λ	3.80E-04	d^{-1}
Rate of contaminant flow due to retardation	u	6.56E-03	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	3.51E-127	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	1.95E-127	mg/l
Attenuation factor (one way vertical dispersion, C_0/C_{ED})	AF	2.82E+28	
Attenuation factor (two way vertical dispersion, C_0/C_{ED})	AF	5.07E+28	

Remedial Targets

Remedial Target LTC3 2.01E+25 mg/l For comparison with measured groundwater concentration.
Ogata Banks

Distance to compliance point		1700	m	
Concentration of contaminant at compliance point	$C_{ED}/C0$	3.51E-127	mg/l	Ogata Banks
after		9.9E+99	days	

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

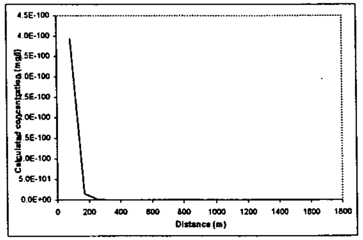
Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd		l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	1.00E+00	fraction
Organic carbon partition coefficient	Koc	1.82E+01	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$		l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Soil water partition coefficient	Kd	1.82E+01	l/kg

Dispersivity

Calculate dependant on distance to compliance point (0), specify dispersivity (1), or calc after Xu & Eckstein (2) ? 2

		Enter value	Calc value Xu & Eckstein	
Longitudinal dispersivity	ax		1.41E+01	m
Transverse dispersivity	az		1.41E+00	m
Vertical dispersivity	ay		1.41E-01	m

For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report ax = 0.83$(\log_{10}x)^{2.414}$; 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.

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration
	mg/l
85.0	3.9E-100
170.0	1.5E-101
255.0	5.5E-103
340.0	2.0E-104
425.0	7.4E-106
510.0	2.7E-107
595.0	1.0E-108
680.0	3.8E-110
765.0	1.4E-111
850.0	5.3E-113
935.0	2.0E-114
1020.0	7.6E-116
1105.0	2.9E-117
1190.0	1.1E-118
1275.0	4.2E-120
1360.0	1.6E-121
1445.0	6.1E-123
1530.0	2.4E-124
1615.0	9.1E-126
1700.0	3.5E-127

This sheet calculates the Tier3 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

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 Tier 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.

Site being assessed:	Bless Area 4 Res K20
Completed by	AJ
Date	24 11 2005
Version	12

R&D Publication 20 Remedial Targets Worksheet, Release 2.2a

Tier 3 - Groundwater

ENVIRONMENT AGENCY

Input Parameters (using pull down menu)	Variable	Value	Unit	Source
Contaminant		Aromatic C16-C21		
Target Concentration	C_T	7.14E-04	mg/l	

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

Ogata Banks — Equations in R&D Pub. 20

Enter '1' to simulate vertical dispersion in one direction, '2' for two directions (pull down menu) 1

Enter '1' if biodegradation rate is for the substance in water,
'0' if rate is for decay in field conditions (i.e. field data from aquifer) (pull down menu) 0

	Variable	Value	Unit	Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	9.90E-99	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	3.65E+03	days	
Calculated decay rate	λ	1.90E-04	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	8.00E+01	m	
Plume thickness at source	Sy	2.10E+01	m	
Saturated aquifer thickness	da	2.17E+01	m	
Bulk density of aquifer materials	ρ	1.70E+00	g/cm^3	
Effective porosity of aquifer	n	1.82E-01	fraction	
Hydraulic gradient	i	1.02E-02	fraction	
Hydraulic conductivity of aquifer	K	2.00E+01	m/d	
Distance to compliance point	x	1.70E+03	m	
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	5.75E+01	l/kg	*see options*
Longitudinal dispersivity	ax	14.075	m	*see options*
Transverse dispersivity	az	1.407	m	*see options*
Vertical dispersivity	ay	0.141	m	*see options*

Calculated Parameters	Variable		
Groundwater flow velocity	v	1.12E+00	m/d
Retardation factor	Rf	5.38E+02	fraction
Decay rate used	λ	1.90E-04	d^{-1}
Rate of contaminant flow due to retardation	u	2.08E-03	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	5.24E-138	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	2.91E-138	mg/l
Attenuation factor (one way vertical dispersion, C_O/C_{ED})	AF	1.89E+39	
Attenuation factor (two way vertical dispersion, C_O/C_{ED})	AF	3.40E+39	

Remedial Targets

Remedial Target LTC3 1.35E+36 mg/l For comparison with measured groundwater concentration.
Ogata Banks

Distance to compliance point		1700	m	
Concentration of contaminant at compliance point	$C_{ED}/C0$	6.24E-138	mg/l	Ogata Banks
after		9.9E+99	days	

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

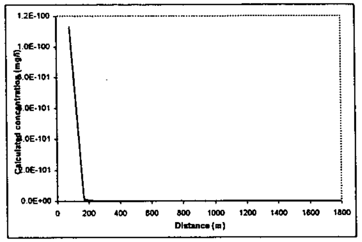
Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd		l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	1.00E+00	fraction
Organic carbon partition coefficient	Koc	5.75E+01	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$		l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Soil water partition coefficient	Kd	5.75E+01	l/kg

Dispersivity

Calculate dependant on distance to compliance point (0), specify dispersivity (1), or calc after Xu & Eckstein (2) ? 2

		Enter value	Calc value Xu & Eckstein	
Longitudinal dispersivity	ax		1.41E+01	m
Transverse dispersivity	az		1.41E+00	m
Vertical dispersivity	ay		1.41E-01	m

For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report ax = 0.83$(\log_{10}x)^{2.414}$; 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.

This sheet calculates the Tier3 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

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 Tier 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.

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration
	mg/l
85.0	1.1E-100
170.0	1.2E-102
255.0	1.3E-104
340.0	1.4E-106
425.0	1.5E-108
510.0	1.6E-110
595.0	1.6E-112
680.0	1.8E-114
765.0	1.9E-116
850.0	2.0E-118
935.0	2.2E-120
1020.0	2.4E-122
1105.0	2.6E-124
1190.0	2.9E-126
1275.0	3.2E-128
1360.0	3.5E-130
1445.0	3.9E-132
1530.0	4.3E-134
1615.0	4.7E-136
1700.0	5.2E-138

Site being assessed	Bloss Area 4 Res K20
Completed by	AJ
Date.	24 11 2005
Version	12

R&D Publication 20 Remedial Targets Worksheet, Release 2.2a

Tier 3 -Groundwater

ENVIRONMENT AGENCY

Input Parameters (using pull down menu)	Variable	Value	Unit	Source
Contaminant		Arsenic		
Target Concentration	C_T	1.00E-02	mg/l	

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

Ogata Banks | Equations in R&D Pub. 20

Enter '1' to simulate vertical dispersion in one direction, '2' for two directions (pull down menu): 1

Enter '1' if biodegradation rate is for the substance in water, '0' if rate is for decay in field conditions (i.e. field data from aquifer) (pull down menu): 0

				Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	9.90E-99	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	9.90E+99	days	
Calculated decay rate	λ	7.00E-101	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	8.00E+01	m	
Plume thickness at source	Sy	2.10E+01	m	
Saturated aquifer thickness	da	2.17E+01	m	
Bulk density of aquifer materials	ρ	1.70E+00	g/cm^3	
Effective porosity of aquifer	n	1.82E-01	fraction	
Hydraulic gradient	i	1.02E-02	fraction	
Hydraulic conductivity of aquifer	K	2.00E+01	m/d	
Distance to compliance point	x	1.70E+03	m	
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	1.17E+02	l/kg	*see options*
Longitudinal dispersivity	ax	14.075	m	*see options*
Transverse dispersivity	az	1.407	m	*see options*
Vertical dispersivity	ay	0.141	m	*see options*

Calculated Parameters	Variable		
Groundwater flow velocity	v	1.12E+00	m/d
Retardation factor	Rf	1.10E+03	fraction
Decay rate used	λ	7.00E-101	d^{-1}
Rate of contaminant flow due to retardation	u	1.02E-03	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	2.87E-99	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	1.59E-99	mg/l
Attenuation factor (one way vertical dispersion, C_0/C_{ED})	AF	3.45E+00	
Attenuation factor (two way vertical dispersion, C_0/C_{ED})	AF	6.21E+00	

Remedial Targets

Remedial Target	LTC3	3.45E-02	mg/l	For comparison with measured groundwater concentration.
Ogata Banks				
Distance to compliance point		1700	m	
Concentration of contaminant at compliance point	$C_{ED}/C0$	2.87E-99	mg/l	Ogata Banks
after		9.9E+99	days	

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

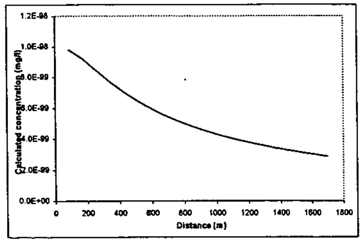
Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd		l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	1.00E+00	fraction
Organic carbon partition coefficient	Koc	1.17E+02	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$		l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Soil water partition coefficient	Kd	1.17E+02	l/kg

Dispersivity

Calculate dependant on distance to compliance point (0), specify dispersivity (1), or calc after Xu & Eckstein (2) ? 2

		Enter value	Calc value Xu & Eckstein	
Longitudinal dispersivity	ax		1.41E+01	m
Transverse dispersivity	az		1.41E+00	m
Vertical dispersivity	ay		1.41E-01	m

For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report $ax = 0.83(\log_{10}x)^{2.414}$; 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.

This sheet calculates the Tier3 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
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 Tier 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.

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration
	mg/l
85.0	9.8E-99
170.0	9.2E-99
255.0	8.4E-99
340.0	7.7E-99
425.0	7.0E-99
510.0	6.5E-99
595.0	6.0E-99
680.0	5.5E-99
765.0	5.1E-99
850.0	4.8E-99
935.0	4.5E-99
1020.0	4.2E-99
1105.0	4.0E-99
1190.0	3.8E-99
1275.0	3.6E-99
1360.0	3.4E-99
1445.0	3.3E-99
1530.0	3.1E-99
1615.0	3.0E-99
1700.0	2.9E-99

Site being assessed	Bless Area 4 Res K20
Completed by	AJ
Date.	24 11 2005
Version	12

R&D Publication20 Remedial Targets Worksheet, Release 2.2a

Tier 3 - Groundwater

ENVIRONMENT AGENCY

Input Parameters (using pull down menu)	Variable	Value	Unit	Source
Contaminant		Flouride		
Target Concentration	C_T	1.00E+00	mg/l	

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

Ogata Banks — Equations in R&D Pub. 20

Enter'l' to simulate vertical dispersion in one direction, '2' for two directions (pull down menu): 1

Enter '1' if biodegradation rate is for the substance in water,
'0' if rate is for decay in field conditions (i.e. field data from aquifer) (pull down menu): 0

	Variable	Value	Unit	Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	1.70E+00	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	9.90E+99	days	
Calculated decay rate	λ	7.00E-101	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	8.00E+01	m	
Plume thickness at source	Sy	2.10E+01	m	
Saturated aquifer thickness	da	2.17E+01	m	
Bulk density of aquifer materials	ρ	1.70E+00	g/cm^3	
Effective porosity of aquifer	n	1.82E-01	fraction	
Hydraulic gradient	i	1.02E-02	fraction	
Hydraulic conductivity of aquifer	K	2.00E+01	m/d	
Distance to compliance point	x	1.70E+03	m	
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	0.00E+00	l/kg	*see options*
Longitudinal dispersivity	ax	14.075	m	*see options*
Transverse dispersivity	az	1.407	m	*see options*
Vertical dispersivity	ay	0.141	m	*see options*

Calculated Parameters	Variable		
Groundwater flow velocity	v	1.12E+00	m/d
Retardation factor	Rf	1.00E+00	fraction
Decay rate used	λ	7.00E-101	d^{-1}
Rate of contaminant flow due to retardation	u	1.12E+00	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	4.92E-01	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	2.74E-01	mg/l
Attenuation factor (one way vertical dispersion, C_0/C_{ED})	AF	3.45E+00	
Attenuation factor (two way vertical dispersion, C_0/C_{ED})	AF	6.21E+00	

Remedial Targets

Remedial Target	LTC3	3.45E+00	mg/l	For comparison with measured groundwater concentration.
Ogata Banks				
Distance to compliance point		1700	m	
Concentration of contaminant at compliance point	$C_{ED}/C0$	4.92E-01	mg/l	Ogata Banks
after		9.9E+99	days	

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

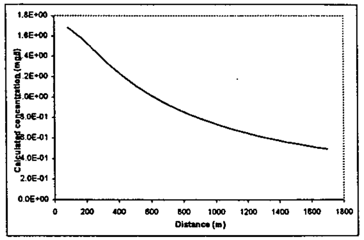
Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd		l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	1.00E+00	fraction
Organic carbon partition coefficient	Koc	0.00E+00	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$		l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Soil water partition coefficient	Kd	0.00E+00	l/kg

Dispersivity

Calculate dependant on distance to compliance point (0), specify dispersivity (1), or calc after Xu & Eckstein (2) ? 2

		Enter value	Calc value Xu & Eckstein	
Longitudinal dispersivity	ax		1.41E+01	m
Transverse dispersivity	az		1.41E+00	m
Vertical dispersivity	ay		1.41E-01	m

For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report ax = 0.83$(\log_{10}x)^{2.414}$; 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.

This sheet calculates the Tier3 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

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 Tier 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.

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration
	mg/l
85.0	1.7E+00
170.0	1.6E+00
255.0	1.5E+00
[illegible]	1.2E+00
510.0	1.1E+00
595.0	1.0E+00
680.0	9.5E-01
765.0	8.8E-01
850.0	8.2E-01
935.0	7.7E-01
1020.0	7.3E-01
1106.0	6.9E-01
1190.0	6.5E-01
1276.0	1.2E-01
1360.0	5.9E-01
1445.0	5.6E-01
1530.0	5.4E-01
1116.0	5.1E-01
1700.0	4.9E-01

Site being assessed.	Bless Area 4 Res K20
Completed by.	AJ
Date	24 11 2005
Version	12

R&D Publication 20 Remedial Targets Worksheet, Release 2.2a

Tier 3 • Groundwater

ENVIRONMENT AGENCY

Input Parameters (using pull down menu)	Variable	Value	Unit	Source
Contaminant		Nickel		
Target Concentration	C_T	2.00E-02	mg/l	

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

Ogata Banks — Equations in R&D Pub. 20

Enter '1' to simulate vertical dispersion in one direction, '2' for two directions (pull down menu): 1

Enter '1' if biodegradation rate is for the substance in water,
'0' if rate is for decay in field conditions (i.e. field data from aquifer) (pull down menu: 0

	Variable	Value	Unit	Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	6.00E-03	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	9.90E+99	days	
Calculated decay rate	λ	7.00E-101	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	8.00E+01	m	
Plume thickness at source	Sy	2.10E+01	m	
Saturated aquifer thickness	da	2.17E+01	m	
Bulk density of aquifer materials	ρ	1.70E+00	g/cm^3	
Effective porosity of aquifer	n	1.82E-01	fraction	
Hydraulic gradient	i	1.02E-02	fraction	
Hydraulic conductivity of aquifer	K	2.00E+01	m/d	
Distance to compliance point	x	1.70E+03	m	
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	0.00E+00	l/kg	*see options*
Longitudinal dispersivity	ax	14.075	m	*see options*
Transverse dispersivity	az	1.407	m	*see options*
Vertical dispersivity	ay	0.141	m	*see options*

Calculated Parameters	Variable		
Groundwater flow velocity	v	1.12E+00	m/d
Retardation factor	Rf	1.00E+00	fraction
Decay rate used	λ	7.00E-101	d^{-1}
Rate of contaminant flow due to retardation	u	1.12E+00	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	1.74E-03	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	9.67E-04	mg/l
Attenuation factor (one way vertical dispersion, C_O/C_{ED})	AF	3.45E+00	
Attenuation factor (two way vertical dispersion, C_O/C_{ED})	AF	6.21E+00	

Remedial Targets

Remedial Target	LTC3	6.91E-02	mg/l

For comparison with measured groundwater concentration.

Ogata Banks

Distance to compliance point		1700	m	
Concentration of contaminant at compliance point	$C_{ED}/C0$	1.74E-03	mg/l	Ogata Banks
after		9.9E+99	days	

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

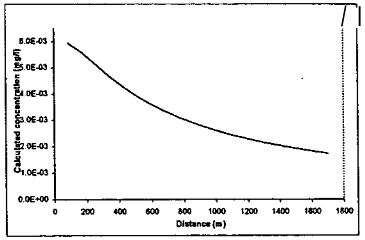
Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd	[redacted]	l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	1.00E+00	fraction
Organic carbon partition coefficient	Koc	0.00E+00	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$	[redacted]	l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Soil water partition coefficient	Kd	0.00E+00	l/kg

Dispersivity

Calculate dependant on distance to compliance point (0), specify dispersivity (1), or calc after Xu & Eckstein (2) ? 2

		Enter value	Calc value Xu & Eckstein	
Longitudinal dispersivity	ax	[redacted]	1.41E+01	m
Transverse dispersivity	az		1.41E+00	m
Vertical dispersivity	ay		1.41E-01	m

For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report $ax = 0.83(\log_{10}x)^{2.414}$; 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.

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration
	mg/l
85.0	5.9E-03
170.0	5.6E-03
255.0	5.1E-03
340.0	4.7E-03
425.0	4.3E-03
510.0	3.9E-03
595.0	3.6E-03
680.0	3.3E-03
765.0	3.1E-03
850.0	2.9E-03
935.0	2.7E-03
1020.0	2.6E-03
1190.0	2.3E-03
	2.2E-03
1258.0	
1445.0	2.0E-03
1530.0	1.9E-03
1615.0	1.8E-03

This sheet calculates the Tier3 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

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 Tier 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.

Site being assessed	Bless Area 4 Res K20
Completed by	AJ
Date:	24 11 2005
Version	12

R&D Publication20 Remedial Targets Worksheet, Release 2.2a

Tier 3 - Groundwater

ENVIRONMENT AGENCY

Input Parameters (using pull down menu)	Variable	Value	Unit	Source
Contaminant		Phenol		
Target Concentration	C_T	5.00E-04	mg/l	

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

Ogata Banks — Equations in R&D Pub. 20

Enter '1' to simulate vertical dispersion in one direction, '2' for two directions (pull down menu): 1

Enter '1' if biodegradation rate is for the substance in water,
'0' if rate is for decay in field conditions (i.e. field data from aquifer) (pull down menu): 0

	Variable	Value	Unit	Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	9.90E-99	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	1.00E+01	days	
Calculated decay rate	λ	6.93E-02	days^{-1}	
Width of plume in aquifer at source (perpendicular to flow)	Sz	8.00E+01	m	
Plume thickness at source	Sy	2.10E+01	m	
Saturated aquifer thickness	da	2.17E+01	m	
Bulk density of aquifer materials	ρ	1.70E+00	g/cm^3	
Effective porosity of aquifer	n	1.82E-01	fraction	
Hydraulic gradient	i	1.02E-02	fraction	
Hydraulic conductivity of aquifer	K	2.00E+01	m/d	
Distance to compliance point	x	1.70E+03	m	
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	1.05E-01	l/kg	*see options*
Longitudinal dispersivity	ax	14.075	m	*see options*
Transverse dispersivity	az	1.407	m	*see options*
Vertical dispersivity	ay	0.141	m	*see options*

Calculated Parameters	Variable		
Groundwater flow velocity	v	1.12E+00	m/d
Retardation factor	Rf	1.98E+00	fraction
Decay rate used	λ	6.93E-02	d^{-1}
Rate of contaminant flow due to retardation	u	5.67E-01	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	1.07E-146	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	5.97E-147	mg/l
Attenuation factor (one way vertical dispersion, C_0/C_{ED})	AF	9.22E+47	
Attenuation factor (two way vertical dispersion, C_0/C_{ED})	AF	1.66E+48	

Remedial Targets

Remedial Target	LTC3	4.81E+44	mg/l

For comparison with measured groundwater concentration.

Ogata Banks

Distance to compliance point		1700	m	
Concentration of contaminant at compliance point	$C_{ED}/C0$	1.07E-146	mg/l	Ogata Banks
after		9.9E+99	days	

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

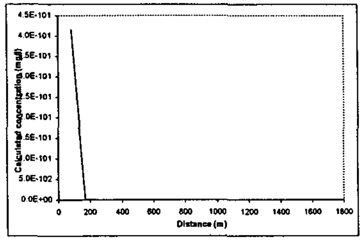
Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd		l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	1.00E+00	fraction
Organic carbon partition coefficient	Koc	1.05E-01	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$		l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Soil water partition coefficient	Kd	1.05E-01	l/kg

Dispersivity

Calculate dependant on distance to compliance point (0), specify dispersivity (1), or calc after Xu & Eckstein (2) ? 2

		Enter value	Calc value	Xu & Eckstein	
Longitudinal dispersivity	ax			1.41E+01	m
Transverse dispersivity	az			1.41E+00	m
Vertical dispersivity	ay			1.41E-01	m

For calculated value, assumes ax = 0.1 * x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report ax = 0.83(log$_{10}$x)$^{2.414}$; 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.

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration
	mg/l
85.0	4.2E-101
170.0	1.7E-103
266.0	6.5E-106
340.0	2.5E-108
426.0	9.8E-111
610.0	3.8E-113
595.0	1.5E-115
680.0	5.9E-118
706.0	2.3E-120
850.0	9.3E-123
935.0	3.7E-125
1020.0	1.5E-127
1106.0	5.9E-130
1190.0	2.4E-132
1275.0	9.7E-135
1360.0	3.9E-137
1445.0	1.6E-139
1530.0	6.5E-142
1916.0	2.6E-144
1700.0	1.1E-146

This sheet calculates the Tier3 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

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 Tier 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.

Site being assessed:	Bless Area 4 Res K20
Completed by	AJ
Date:	24 11 2005
Version	12

R&D Publication 20 Remedial Targets Worksheet, Release 2.2a

Tier 3 - Groundwater

ENVIRONMENT
AGENCY

Input Parameters (using pull down menu)

	Variable	Value	Unit	Source
Contaminant		Strontium		
Target Concentration	C_T	1.00E+00	mg/l	

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

Ogata Banks — Equations in R&D Pub. 20

Enter '1' to simulate vertical dispersion in one direction, '2' for two directions (pull down menu): 1

Enter '1' if biodegradation rate is for the substance in water,
'0' if rate is for decay in field conditions (i.e. field data from aquifer) (pull down menu): 0

	Variable	Value	Unit	Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	5.70E-01	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	9.90E+99	days	
Calculated decay rate	λ	7.00E-101	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	8.00E+01	m	
Plume thickness at source	Sy	2.10E+01	m	
Saturated aquifer thickness	da	2.17E+01	m	
Bulk density of aquifer materials	ρ	1.70E+00	g/cm^3	
Effective porosity of aquifer	n	1.82E-01	fraction	
Hydraulic gradient	i	1.02E-02	fraction	
Hydraulic conductivity of aquifer	K	2.00E+01	m/d	
Distance to compliance point	x	1.70E+03	m	
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	0.00E+00	l/kg	*see options*
Longitudinal dispersivity	ax	14.075	m	*see options*
Transverse dispersivity	az	1.407	m	*see options*
Vertical dispersivity	ay	0.141	m	*see options*

Calculated Parameters

	Variable		
Groundwater flow velocity	v	1.12E+00	m/d
Retardation factor	Rf	1.00E+00	fraction
Decay rate used	λ	7.00E-101	d^{-1}
Rate of contaminant flow due to retardation	u	1.12E+00	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	1.65E-01	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	9.18E-02	mg/l
Attenuation factor (one way vertical dispersion, C_0/C_{ED})	AF	3.45E+00	
Attenuation factor (two way vertical dispersion, C_0/C_{ED})	AF	6.21E+00	

Remedial Targets

Remedial Target	LTC3	3.45E+00	mg/l	For comparison with measured groundwater concentration.
Ogata Banks				

Distance to compliance point		**1700**	**m**	
Concentration of contaminant at compliance point	**$C_{ED}/C0$**	**1.65E-01**	**mg/l**	Ogata Banks
after		**9.9E+99**	**days**	

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

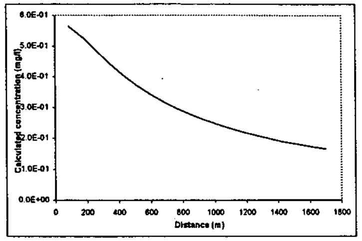
Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd	[redacted]	l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	1.00E+00	fraction
Organic carbon partition coefficient	Koc	0.00E+00	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$	[redacted]	l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Soil water partition coefficient	Kd	0.00E+00	l/kg

Dispersivity

Calculate dependant on distance to compliance point (0), specify dispersivity (1), or calc after Xu & Eckstein (2) ? 2

		Enter value	Calc value Xu & Eckstein	
Longitudinal dispersivity	ax	[redacted]	1.41E+01	m
Transverse dispersivity	az		1.41E+00	m
Vertical dispersivity	ay		1.41E-01	m

For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report ax = $0.83(\log_{10}x)^{2.414}$; 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.

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration
	mg/l
85.0	5.6E-01
170.0	5.3E-01
255.0	4.9E-01
340.0	4.4E-01
425.0	4.1E-01
510.0	3.7E-01
595.0	3.4E-01
680.0	3.2E-01
765.0	3.0E-01
850.0	2.8E-01
935.0	2.6E-01
1020.0	2.4E-01
1105.0	2.3E-01
1190.0	2.2E-01
1275.0	2.1E-01
1360.0	2.0E-01
1445.0	1.9E-01
1530.0	1.8E-01
1615.0	1.7E-01
1700.0	1.7E-01

This sheet calculates the Tier3 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

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 Tier 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.

Site being assessed:	Bless Area 4 Res K20
Completed by	AJ
Date:	24 11 2005
Version.	12

R&D Publication20 Remedial Targets Worksheet, Release 2.2a

ENVIRONMENT AGENCY

Tier 3 - Groundwater

Input Parameters (using pull down menu)	Variable	Value	Unit	Source
Contaminant		Sulphide		
Target Concentration	C_T	2.50E-04	mg/l	

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

Ogata Banks | Equations in R&D Pub. 20

Enter '1' to simulate vertical dispersion in one direction, '2' for two directions (pull down menu) | 1

Enter '1' if biodegradation rate is for the substance in water,
'0' if rate is for decay in field conditions (i.e. field data from aquifer) (pull down menu | 0

	Variable	Value	Unit	Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	2.00E-01	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	9.90E+99	days	
Calculated decay rate	λ	7.00E-101	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	8.00E+01	m	
Plume thickness at source	Sy	2.10E+01	m	
Saturated aquifer thickness	da	2.17E+01	m	
Bulk density of aquifer materials	ρ	1.70E+00	g/cm^3	
Effective porosity of aquifer	n	1.82E-01	fraction	
Hydraulic gradient	i	1.02E-02	fraction	
Hydraulic conductivity of aquifer	K	2.00E+01	m/d	
Distance to compliance point	x	1.70E+03	m	
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	0.00E+00	l/kg	*see options*
Longitudinal dispersivity	ax	14.075	m	*see options*
Transverse dispersivity	az	1.407	m	*see options*
Vertical dispersivity	ay	0.141	m	*see options*

Calculated Parameters	Variable		
Groundwater flow velocity	v	1.12E+00	m/d
Retardation factor	Rf	1.00E+00	fraction
Decay rate used	λ	7.00E-101	d^{-1}
Rate of contaminant flow due to retardation	u	1.12E+00	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	5.79E-02	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	3.22E-02	mg/l
Attenuation factor (one way vertical dispersion, C_0/C_{ED})	AF	3.45E+00	
Attenuation factor (two way vertical dispersion, C_0/C_{ED})	AF	6.21E+00	

Remedial Targets

Remedial Target	LTC3	8.83E-04	mg/l	For comparison with measured groundwater concentration.
Ogata Banks				
Distance to compliance point		1700	m	
Concentration of contaminant at compliance point	$C_{ED}/C0$	5.79E-02	mg/l	Ogata Banks
after		9.9E+99	days	

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

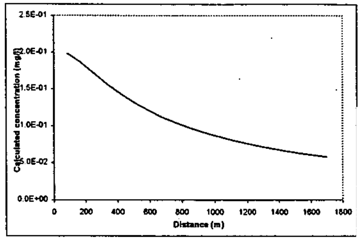
Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd		l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	1.00E+00	fraction
Organic carbon partition coefficient	Koc	0.00E+00	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$		l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Soil water partition coefficient	Kd	0.00E+00	l/kg

Dispersivity

Calculate dependant on distance to compliance point (0), specify dispersivity (1), or calc after Xu & Eckstein (2) ? | 2

		Enter value	Calc value Xu & Eckstein	
Longitudinal dispersivity	ax		1.41E+01	m
Transverse dispersivity	az		1.41E+00	m
Vertical dispersivity	ay		1.41E-01	m

For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report ax = $0.83(\log_{10}x)^{2.414}$; 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.

This sheet calculates the Tier3 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

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 Tier 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.

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration mg/l
85.0	2.0E-01
170.0	1.9E-01
255.0	1.7E-01
340.0	1.6E-01
425.0	1.4E-01
610.0	1.3E-01
595.0	1.2E-01
680.0	1.1E-01
766.0	1.0E-01
850.0	9.7E-02
U6.0	9.1E-02
1020.0	8.5E-02
1106.0	8.1E-02
1190.0	7.6E-02
1275.0	7.3E-02
1360.0	6.9E-02
1445.0	6.6E-02
1530.0	6.3E-02
1615.0	6.0E-02
1700.0	5.8E-02

Site being assessed.	Biess Area 4 Res K20
Completed by	AJ
Date:	24 11 2005
Version:	12

R&D Publication20 Remedial Targets Worksheet, Release2.2a

Tier 3 - Groundwater

ENVIRONMENT AGENCY

input Parameters (using pull down menu)	Variable	Value	Unit	Source
Contaminant		Total Cyanide		
Target Concentration	C_T	1.00E-02	mg/l	

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

Ogata Banks — Equations in R&D Pub. 20

Enter '1' to simulate vertical dispersion in one direction, '2' for two directions (pull down menu) 1

Enter '1' if biodegradation rate is for the substance in water,
'0' if rate is for decay in field conditions (i.e. field data from aquifer) (pull down menu 0

				Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	9.90E-99	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	2.92E+01	days	
Calculated decay rate	λ	2.38E-02	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	8.00E+01	m	
Plume thickness at source	Sy	2.10E+01	m	
Saturated aquifer thickness	da	2.17E+01	m	
Bulk density of aquifer materials	ρ	1.70E+00	g/cm^3	
Effective porosity of aquifer	n	1.82E-01	fraction	
Hydraulic gradient	i	1.02E-02	fraction	
Hydraulic conductivity of aquifer	K	2.00E+01	m/d	
Distance to compliance point	x	1.70E+03	m	
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	7.94E+09	l/kg	*see options*
Longitudinal dispersivity	ax	14.075	m	*see options*
Transverse dispersivity	az	1.407	m	*see options*
Vertical dispersivity	ay	0.141	m	*see options*

Calculated Parameters	Variable		
Groundwater flow velocity	v	1.12E+00	m/d
Retardation factor	Rf	7.42E+10	fraction
Decay rate used	λ	2.38E-02	d^{-1}
Rate of contaminant flow due to retardation	u	1.51E-11	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	#NUM!	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	#NUM!	mg/l
Attenuation factor (one way vertical dispersion, C_0/C_{ED})	AF	#NUM!	
Attenuation factor (two way vertical dispersion, C_0/C_{ED})	AF	#NUM!	

Remedial Targets

Remedial Target	LTC3	#NUM!	mg/l	For comparison with measured groundwater concentration.

Ogata Banks

Distance to compliance point		1700	m	
Concentration of contaminant at compliance point	$C_{ED}/C0$	#NUM!	mg/l	Ogata Banks
after		9.9E+99	days	

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

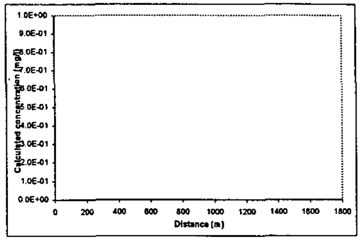
Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd	[redacted]	l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	1.00E+00	fraction
Organic carbon partition coefficient	Koc	7.94E+09	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$	[redacted]	l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Soil water partition coefficient	Kd	7.94E+09	l/kg

Dispersivity

Calculate dependant on distance to compliance point (0), 2
specify dispersivity (1), or calc after Xu & Eckstein (2) ?

		Enter value	Calc value Xu & Eckstein	
Longitudinal dispersivity	ax	[redacted]	1.41E+01	m
Transverse dispersivity	az		1.41E+00	m
Vertical dispersivity	ay		1.41E-01	m

For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report ax = $0.83(\log_{10}x)^{2.414}$; 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.

This sheet calculates the Tier3 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

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 Tier 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.

Calculated concentrations for distance-concentration graph

From Simulation sheet

Distance	Concentration
	mg/l
[illegible]	#NUM!
255.0	#NUM!
340.0	#NUM!
826.0	#NUM!
595.0	#NUM!
680.0	#NUM!
716.0	#NUM!
886.0	#NUM!
1020.0	#NUM!
1106.0	#NUM!
1276.0	#NUM!
1360.0	#NUM!
1488.0	#NUM!
1906.0	#NUM!

Site being assessed	Bless Area 4 Res K20
Completed by:	AJ
Date:	24 11 2005
Version:	12

R&D Publication 20 Remedial Targets Worksheet, Release 2.2a

ENVIRONMENT AGENCY

Tier 3 - Groundwater

Input Parameters (using pull down menu)	Variable	Value	Unit	Source
Contaminant		Aliphatic C8-C10		
Target Concentration	C_T	7.14E-04	mg/l	

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

Ogata Banks — Equations in R&D Pub. 20

Enter '1' to simulate vertical dispersion in one direction, '2' for two directions (pull down menu): 1

Enter '1' if biodegradation rate is for the substance in water,
'0' if rate is for decay in field conditions (i.e. field data from aquifer) (pull down menu: 0

	Variable	Value	Unit	Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	9.90E-99	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	1.83E+03	days	
Calculated decay rate	λ	3.80E-04	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	8.00E+01	m	
Plume thickness at source	Sy	2.10E+01	m	
Saturated aquifer thickness	da	2.17E+01	m	
Bulk density of aquifer materials	ρ	1.70E+00	g/cm^3	
Effective porosity of aquifer	n	1.82E-01	fraction	
Hydraulic gradient	i	1.02E-02	fraction	
Hydraulic conductivity of aquifer	K	2.00E+01	m/d	
Distance to compliance point	x	1.70E+03	m	
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	1.15E+02	l/kg	*see options*
Longitudinal dispersivity	ax	14.075	m	*see options*
Transverse dispersivity	az	1.407	m	*see options*
Vertical dispersivity	ay	0.141	m	*see options*

Calculated Parameters	Variable		
Groundwater flow velocity	v	1.12E+00	m/d
Retardation factor	Rf	1.07E+03	fraction
Decay rate used	λ	3.80E-04	d^{-1}
Rate of contaminant flow due to retardation	u	1.04E-03	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	1.39E-194	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	7.75E-195	mg/l
Attenuation factor (one way vertical dispersion, C_0/C_{ED})	AF	7.10E+95	
Attenuation factor (two way vertical dispersion, C_0/C_{ED})	AF	1.28E+96	

Remedial Targets

Remedial Target	LTC3	5.07E+92	mg/l	For comparison with measured groundwater concentration.
Ogata Banks				

Distance to compliance point		**1700**	**m**	
Concentration of contaminant at compliance point	$C_{ED}/C0$	**1.39E-194**	**mg/l**	Ogata Banks
after		**9.9E+99**	**days**	

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

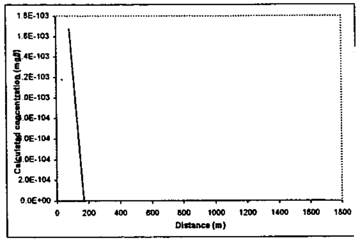
Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd	[redacted]	l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	1.00E+00	fraction
Organic carbon partition coefficient	Koc	1.15E+02	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$	[redacted]	l/kg
Sorption coefficient for ionised species	$K_{oc,i}$	[redacted]	l/kg
pH value	pH	[redacted]	
acid dissociation constant	pKa	[redacted]	
Soil water partition coefficient	Kd	1.15E+02	l/kg

Dispersivity

Calculate dependant on distance to compliance point (0), specify dispersivity (1), or calc after Xu & Eckstein (2) ? 2

		Enter value	Calc value Xu & Eckstein	
Longitudinal dispersivity	ax	[redacted]	1.41E+01	m
Transverse dispersivity	az	[redacted]	1.41E+00	m
Vertical dispersivity	ay	[redacted]	1.41E-01	m

For calculated value, assumes ax = 0.1 * x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report $ax = 0.83(\log_{10}x)^{2.414}$; 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.

This sheet calculates the Tier3 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

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 Tier 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.

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration
	mg/l
17000	2.7E-108
255.0	4.3E-113
340.0	6.7E-118
626.0	1.9E-122
595.0	2.6E-132
680.0	4.1E-137
706.0	6.6E-142
850.0	1.1E-146
935.0	1.7E-151
1020.0	2.7E-156
1105.0	4.4E-161
1190.0	7.2E-166
1275.0	1.2E-170
1360.0	1.9E-175
1445.0	3.1E-180
1530.0	5.2E-185
1615.0	8.5E-190
1700.0	1.4E-194

Site being assessed	Bless Area 4 Res K20
Completed by:	AJ
Date	24 11 2005
Version	12

R&D Publication 20 Remedial Targets Worksheet, Release 2.2a

Tier 3 - Groundwater

ENVIRONMENT AGENCY

Input Parameters (using pull down menu)

	Variable	Value	Unit	Source
Contaminant		Aliphatic C10-C12		
Target Concentration	C_T	7.14E-04	mg/l	

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

Ogata Banks — Equations in R&D Pub. 20

Enter '1' to simulate vertical dispersion in one direction, '2' for two directions (pull down menu): 1

Enter '1' if biodegradation rate is for the substance in water,
'0' if rate is for decay in field conditions (i.e. field data from aquifer) (pull down menu: 0

	Variable	Value	Unit	Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	9.90E-99	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	1.83E+03	days	
Calculated decay rate	λ	3.80E-04	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	8.00E+01	m	
Plume thickness at source	Sy	2.10E+01	m	
Saturated aquifer thickness	da	2.17E+01	m	
Bulk density of aquifer materials	ρ	1.70E+00	g/cm^3	
Effective porosity of aquifer	n	1.82E-01	fraction	
Hydraulic gradient	i	1.02E-02	fraction	
Hydraulic conductivity of aquifer	K	2.00E+01	m/d	
Distance to compliance point	x	1.70E+03	m	
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	9.12E+02	l/kg	*see options*
Longitudinal dispersivity	ax	14.075	m	*see options*
Transverse dispersivity	az	1.407	m	*see options*
Vertical dispersivity	ay	0.141	m	*see options*

Calculated Parameters

	Variable		
Groundwater flow velocity	v	1.12E+00	m/d
Retardation factor	Rf	8.52E+03	fraction
Decay rate used	λ	3.80E-04	d^{-1}
Rate of contaminant flow due to retardation	u	1.32E-04	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	#NUM!	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	#NUM!	mg/l
Attenuation factor (one way vertical dispersion, C_0/C_{ED})	AF	#NUM!	
Attenuation factor (two way vertical dispersion, C_0/C_{ED})	AF	#NUM!	

Remedial Targets

Remedial Target	LTCS	#NUM!	mg/l	For comparison with measured groundwater concentration.
Ogata Banks				

Distance to compliance point		1700	m	
Concentration of contaminant at compliance point	$C_{ED}/C0$	#NUM!	mg/l	Ogata Banks
after		9.9E+99	days	

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

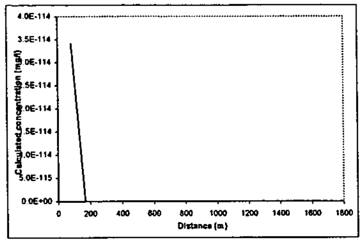
Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd	[redacted]	l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	1.00E+00	fraction
Organic carbon partition coefficient	Koc	9.12E+02	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$	[redacted]	l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Soil water partition coefficient	Kd	9.12E+02	l/kg

Dispersivity

Calculate dependant on distance to compliance point (0), specify dispersivity (1), or calc after Xu & Eckstein (2) ? 2

		Enter value	Calc value Xu & Eckstein	
Longitudinal dispersivity	ax	[redacted]	1.41E+01	m
Transverse dispersivity	az		1.41E+00	m
Vertical dispersivity	ay		1.41E-01	m

For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report $ax = 0.83(\log_{10}x)^{2.414}$; 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.

Calculated concentrations for distance-concentration graph

OgataBanks calculation sheet

Distance	Concentration
	mg/l
85.0	3.4E-114
170.0	1.1E-129
255.0	3.6E-145
340.0	1.1E-160
620.0	3.8E-176
595.0	3.8E-207
680.0	1.2E-222
765.0	3.9E-238
850.0	4.2E-269
101.0	1.4E-284
1105.0	4.6E-300
1190.0	0.0E+00
1275.0	0.0E+00
1150.0	0.0E+00
1445.0	0.0E+00
1630.0	#NUM!
1700.0	#NUM!

This sheet calculates the Tier3 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

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 Tier 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.

Site being assessed	Bless Area 4 Res K20
Completed by	AJ
Date.	24 11 2005
Version	12

R&D Publication20 RemedialTargets Worksheet, Release 2.2a

Tier 3 -Groundwater

ENVIRONMENT AGENCY

Input Parameters (using pull down menu)	Variable	Value	Unit	Source
Contaminant		Aliphatic C12-C16		
Target Concentration	C_T	7.14E-04	mg/l	

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

Ogata Banks Equations in R&D Pub. 20

Enter '1' to simulate vertical dispersion in one direction, '2' for two directions (pull down menu) 1

Enter '1' if biodegradation rate is for the substance in water,
'0' if rate is for decay in field conditions (i.e. field data from aquifer) (pull down menu) 0

				Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	9.90E-99	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	1.83E+03	days	
Calculated decay rate	λ	3.80E-04	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	8.00E+01	m	
Plume thickness at source	Sy	2.10E+01	m	
Saturated aquifer thickness	da	2.17E+01	m	
Bulk density of aquifer materials	ρ	1.70E+00	g/cm^3	
Effective porosity of aquifer	n	1.82E-01	fraction	
Hydraulic gradient	i	1.02E-02	fraction	
Hydraulic conductivity of aquifer	K	2.00E+01	m/d	
Distance to compliance point	x	1.70E+03	m	
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	1.82E+04	l/kg	*see options*
Longitudinal dispersivity	ax	14.075	m	*see options*
Transverse dispersivity	az	1.407	m	*see options*
Vertical dispersivity	av	0.141	m	*see options*

Calculated Parameters	Variable		
Groundwater flow velocity	v	1.12E+00	m/d
Retardation factor	Rf	1.70E+05	fraction
Decay rate used	λ	3.80E-04	d^{-1}
Rate of contaminant flow due to retardation	u	6.60E-06	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	#NUM!	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	#NUM!	mg/l
Attenuation factor (one way vertical dispersion, C_0/C_{ED})	AF	#NUM!	
Attenuation factor (two way vertical dispersion, C_0/C_{ED})	AF	#NUM!	

Remedial Targets

Remedial Target LTC3 #NUM! mg/l For comparison with measured groundwater concentration.
Ogata Banks

Distance to compliance point		1700	m	
Concentration of contaminant at compliance point	$C_{ED}/C0$	#NUM!	mg/l	Ogata Banks
after		9.9E+99	days	

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

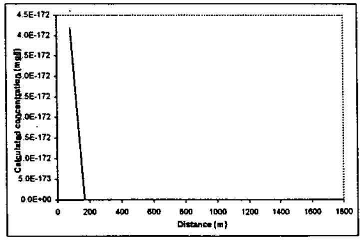
Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd		l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	1.00E+00	fraction
Organic carbon partition coefficient	Koc	1.82E+04	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$		l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Soil water partition coefficient	Kd	1.82E+04	l/kg

Dispersivity

Calculate dependant on distance to compliance point (0), 2
specify dispersivity (1), or calc after Xu & Eckstein (2) ?

		Enter value	Calc value Xu & Eckstein	
Longitudinal dispersivity	ax		1.41E+01	m
Transverse dispersivity	az		1.41E+00	m
Vertical dispersivity	ay		1.41E-01	m

For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report ax = $0.83(\log_{10}x)^{2.414}$; 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.

This sheet calculates the Tier3 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

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 Tier 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.

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration
	mg/l
85.0	4.2E-172
170.0	1.7E-245
255.0	0.0E+00
340.0	0.0E+00
425.0	#NUM!
510.0	#NUM!
595.0	#NUM!
680.0	#NUM!
765.0	#NUM!
850.0	#NUM!
935.0	#NUM!
1020.0	#NUM!
1105.0	#NUM!
1190.0	#NUM!
1275.0	#NUM!
1360.0	#NUM!
1445.0	#NUM!
1530.0	#NUM!
1615.0	#NUM!
1700.0	#NUM!

Site being assessed	Bless Area 4 Res K20
Completed by	AJ
Date:	24 11 2005
Version	12

R&D Publication 20 Remedial Targets Worksheet, Release 2.2a

Tier 3 - Groundwater

ENVIRONMENT AGENCY

Input Parameters (using pull down menu)	Variable	Value	Unit	Source
Contaminant		mmoniacal Nitrogen as		
Target Concentration	C_T	1.20E-01	mg/l	

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

Ogata Banks — Equations in R&D Pub. 20

Enter '1' to simulate vertical dispersion in one direction, '2' for two directions (pull down menu) 1

Enter '1' if biodegradation rate is for the substance in water,
'0' if rate is for decay in field conditions (i.e. field data from aquifer) (pull down menu 0

				Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	4.40E+00	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	2.19E+03	days	
Calculated decay rate	λ	3.17E-04	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	8.00E+01	m	
Plume thickness at source	Sy	5.60E+01	m	
Saturated aquifer thickness	da	5.71E+01	m	
Bulk density of aquifer materials	ρ	1.70E+00	g/cm^3	
Effective porosity of aquifer	n	1.82E-01	fraction	
Hydraulic gradient	i	1.25E-02	fraction	
Hydraulic conductivity of aquifer	K	2.00E+01	m/d	
Distance to compliance point	x	7.50E+02	m	
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	5.00E-01	l/kg	*see options*
Longitudinal dispersivity	ax	10.623	m	*see options*
Transverse dispersivity	az	1.062	m	*see options*
Vertical dispersivity	ay	0.106	m	*see options*

Calculated Parameters	Variable		
Groundwater flow velocity	v	1.37E+00	m/d
Retardation factor	Rf	5.67E+00	fraction
Decay rate used	λ	3.17E-04	d^{-1}
Rate of contaminant flow due to retardation	u	2.42E-01	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	1.14E+00	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	1.11E+00	mg/l
Attenuation factor (one way vertical dispersion, C_O/C_{ED})	AF	3.85E+00	
Attenuation factor (two way vertical dispersion, C_O/C_{ED})	AF	3.95E+00	

Remedial Targets

Remedial Target	LTC3	4.81E-01	mg/l	For comparison with measured groundwater concentration.
Ogata Banks				
Distance to compliance point		750	m	
Concentration of contaminant at compliance point	$C_{ED}/C0$	1.14E+00	mg/l	Ogata Banks
after		9.9E+99	days	

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

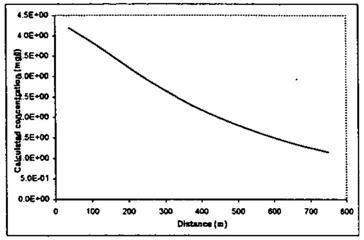
Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd		l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	1.00E+00	fraction
Organic carbon partition coefficient	Koc	5.00E-01	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$		l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Soil water partition coefficient	Kd	5.00E-01	l/kg

Dispersivity

Calculate dependant on distance to compliance point (0), specify dispersivity (1), or calc after Xu & Eckstein (2) ? 2

		Enter value	Calc value Xu & Eckstein	
Longitudinal dispersivity	ax		1.06E+01	m
Transverse dispersivity	az		1.06E+00	m
Vertical dispersivity	ay		1.06E-01	m

For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report ax = 0.83(log_{10}x)$^{2.414}$; 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.

This sheet calculates the Tier3 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

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 Tier 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.

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration
	mg/l
37.5	4.2E+00
76.0	4.0E+00
112.5	3.8E+00
150.0	3.5E+00
167.6	3.3E+00
225.0	3.1E+00
202.6	2.9E+00
300.0	2.7E+00
	2.3E+00
338.0	
412.6	2.1E+00
450.0	2.0E+00
487.6	1.8E+00
626.0	1.7E+00
562.5	1.6E+00
600.0	1.5E+00
637.5	1.4E+00
675.0	1.3E+00
7116	1.2E+00
760.0	1.1E+00

Site being assessed	Area 6 Deerpark A K20
Completed by	AJ
Date.	24 11 2005
Version	12

R&D Publication 20 Remedial Targets Worksheet, Release 2.2a

ENVIRONMENT AGENCY

Tier 3 - Groundwater

Input Parameters (using pull down menu)	Variable	Value	Unit	Source
Contaminant		Aromatic C7-C8		
Target Concentration	C_T	7.14E-04	mg/l	

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

Ogata Banks — Equations in R&D Pub. 20

W3 .. ' to simulate vertical dispersion in one direction, '2' for two directions (pull down menu) 1

Enter '1' if biodegradation rate is for the substance in water,
'0' if rate is for decay in field conditions (i.e. field data from aquifer) (pull down menu) 0

	Variable	Value	Unit	Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	7.70E-02	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	7.30E+02	days	
Calculated decay rate	λ	9.50E-04	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	8.00E+01	m	
Plume thickness at source	Sy	5.60E+01	m	
Saturated aquifer thickness	da	5.71E+01	m	
Bulk density of aquifer materials	ρ	1.70E+00	g/cm^3	
Effective porosity of aquifer	n	1.82E-01	fraction	
Hydraulic gradient	i	1.25E-02	fraction	
Hydraulic conductivity of aquifer	K	2.00E+01	m/d	
Distance to compliance point	x	7.50E+02	m	
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	9.12E-01	l/kg	*see options*
Longitudinal dispersivity	ax	10.623	m	*see options*
Transverse dispersivity	az	1.062	m	*see options*
Vertical dispersivity	ay	0.106	m	*see options*

Calculated Parameters	Variable		
Groundwater flow velocity	v	1.37E+00	m/d
Retardation factor	Rf	9.52E+00	fraction
Decay rate used	λ	9.50E-04	d^{-1}
Rate of contaminant flow due to retardation	u	1.44E-01	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	5.13E-04	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	5.00E-04	mg/l
Attenuation factor (one way vertical dispersion, C_O/C_{ED})	AF	1.50E+02	
Attenuation factor (two way vertical dispersion, C_O/C_{ED})	AF	1.54E+02	

Remedial Targets

Remedial Target	LTC3	1.07E-01	mg/l	For comparison with measured groundwater concentration.
Ogata Banks				
Distance to compliance point		750	m	
Concentration of contaminant at compliance point	$C_{ED}/C0$	5.13E-04	mg/l	Ogata Banks
after		9.9E+99	days	

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

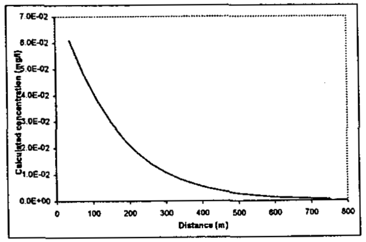
Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd		l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	1.00E+00	fraction
Organic carbon partition coefficient	Koc	9.12E-01	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$		l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Soil water partition coefficient	Kd	9.12E-01	l/kg

Dispersivity

Calculate dependant on distance to compliance point (0), specify dispersivity (1), or calc after Xu & Eckstein (2) ? 2

		Enter value	Calc value Xu & Eckstein	
Longitudinal dispersivity	ax		1.06E+01	m
Transverse dispersivity	az		1.06E+00	m
Vertical dispersivity	ay		1.06E-01	m

For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report ax = $0.83(\log_{10}x)^{2.414}$; az = ax/10, ay = ax/100 are assumed



Calculated concentrations for
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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.

This sheet calculates the Tier3 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
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 Tier 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.

Site being assessed:	Area 6 Deerpark A K20
Completed by	AJ
Date	24 11 2005
Version	12

R&D Publication 20 Remedial Targets Worksheet, Release 2.2a

Tier 3 -Groundwater

ENVIRON AGENCY

Input Parameters (using pull down menu)	**Variable**	**Value**	**Unit**	**Source**
Contaminant		Aromatic C8-C10		
Target Concentration	C_T	7.14E-04	mg/l	

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

Ogata Banks — Equations in R&D Pub. 20

Enter '1' to simulate vertical dispersion in one direction, '2' for two directions (pull down menu): 1

Enter '1' if biodegradation rate is for the substance in water,
'0' if rate is for decay in field conditions (i.e. field data from aquifer) (pull down menu): 0

				Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	2.12E-02	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	1.83E+03	days	
Calculated decay rate	λ	3.80E-04	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	*Sz*	8.00E+01	*m*	
Plume thickness at source	Sy	5.60E+01	m	
Saturated aquifer thickness	da	5.71E+01	m	
Bulk density of aquifer materials	ρ	1.70E+00	g/cm^3	
Effective porosity of aquifer	n	1.82E-01	fraction	
Hydraulic gradient	i	1.25E-02	fraction	
Hydraulic conductivity of aquifer	K	2.00E+01	m/d	
Distance to compliance point	x	7.50E+02	m	
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	5.75E+00	l/kg	*see options*
Longitudinal dispersivity	ax	10.623	m	*see options*
Transverse dispersivity	az	1.062	m	*see options*
Vertical dispersivity	ay	0.106	m	*see options*

Calculated Parameters	**Variable**		
Groundwater flow velocity	v	1.37E+00	*m/d*
Retardation factor	Rf	5.47E+01	fraction
Decay rate used	λ	3.80E-04	d^{-1}
Rate of contaminant flow due to retardation	u	2.51E-02	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	6.92E-07	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	6.74E-07	mg/l
Attenuation factor (one way vertical dispersion, C_0/C_{ED})	AF	3.06E+04	
Attenuation factor (two way vertical dispersion, C_0/C_{ED})	AF	3.15E+04	

Remedial Targets

Remedial Target LTC3 2.19E+01 mg/l — For comparison with measured groundwater concentration.

Ogata Banks

Distance to compliance point		**750**	**m**	
Concentration of contaminant at compliance point	**$C_{ED}/C0$**	**6.92E-07**	**mg/l**	Ogata Banks
after		**9.9E+99**	**days**	

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

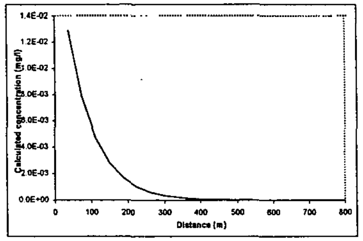
Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd		l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	1.00E+00	fraction
Organic carbon partition coefficient	Koc	5.75E+00	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$		l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Soil water partition coefficient	Kd	5.75E+00	l/kg

Dispersivity

Calculate dependant on distance to compliance point (0), specify dispersivity (1), or calc after Xu & Eckstein (2) ? 2

		Enter value	Calc value Xu & Eckstein	
Longitudinal dispersivity	**ax**		1.06E+01	m
Transverse dispersivity	**az**		1.06E+00	m
Vertical dispersivity	**ay**		1.06E-01	m

For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report ax = $0.83(\log_{10}x)^{2.414}$; 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.

Calculated concentrations for distance-concentration graph

Ogata Banks calculation sheet

Distance	**Concentration**
	mg/l
37.5	**1.3E-02**
76.0	7.8E-01
112.6	4.7E-03
160.6	**2.3E-03**
288.6	**6.0E-04**
300.0	**3.5E-04**
337.5	**2.1E-04**
376.0	I.ZE-M
462.6	**7.4E-05**
487.5	2.6E-05
525.0	1.5E-05
562.5	**9.2E-06**
600.0	**5.5E-06**
017.6	3.3E-06
675.0	1.9E-06
712.6	1.2E-06
750.0	***6.9E-07***

This sheet calculates the Tier3 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*

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 Tier 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

Site being assessed:	Area 6 Deerpark A K20
Completed by:	AJ
Date:	24 11 2005
Version:	12

R&D Publication 20 Remedial Targets Worksheet, Release 2.2a

Tier 3 - Groundwater

ENVIRONMENT AGENCY

Input Parameters (using pull *down* menu)

	Variable	Value	Unit	Source
Contaminant Target Concentration	C_T	1.00E-02	mg/l	

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

Ogata Banks — Equations in R&D Pub. 20

Enter '1' to simulate vertical dispersion in one direction, '2' for two directions (pull down menu): 1

Enter '1' if biodegradation rate is for the substance in water,
'0' if rate is for decay in field conditions (i.e. field data from aquifer) (pull down menu): 0

	Variable	Value	Unit	Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	9.90E-99	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	2.28E+02	days	
Calculated decay rate	λ	3.04E-03	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	8.00E+01	m	
Plume thickness at source	Sy	5.60E+01	m	
Saturated aquifer thickness	da	5.71E+01	m	
Bulk density of aquifer materials	ρ	1.70E+00	g/cm^3	
Effective porosity of aquifer	n	1.82E-01	fraction	
Hydraulic gradient	i	1.25E-02	fraction	
Hydraulic conductivity of aquifer	K	2.00E+01	m/d	
Distance to compliance point	x	7.50E+02	m	
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	1.32E+00	l/kg	*see options*
Longitudinal dispersivity	ax	10.623	m	*see options*
Transverse dispersivity	az	1.062	m	*see options*
Vertical dispersivity	ay	0.106	m	*see options*

Calculated Parameters

	Variable		
Groundwater flow velocity	v	1.37E+00	m/d
Retardation factor	Rf	1.33E+01	fraction
Decay rate used	λ	3.04E-03	d^{-1}
Rate of contaminant flow due to retardation	u	1.03E-01	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	1.43E-106	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	1.39E-106	mg/l
Attenuation factor (one way vertical dispersion, C_0/C_{ED})	AF	6.92E+07	
Attenuation factor (two way vertical dispersion, C_0/C_{ED})	AF	7.11E+07	

Remedial Targets

Remedial Target	LTC3	6.92E+05	mg/l

For comparison with measured groundwater concentration.

Ogata Banks

Distance to compliance point 750 m

Concentration of contaminant at compliance point	$C_{ED}/C0$	**1.43E-106**	**mg/l**	Ogata Banks
after		**9.9E+99**	**days**	

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	1.00E+00	fraction
Organic carbon partition coefficient	Koc	1.32E+00	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$		l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		

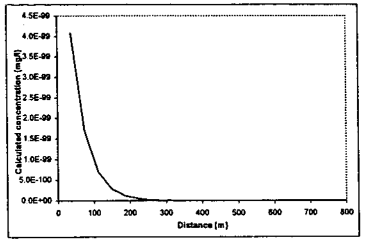
Soil water partition coefficient	Kd	1.32E+00	l/kg

Dispersivity

Calculate dependant on distance to compliance point (0), specify dispersivity (1), or calc after Xu & Eckstein (2) ? 2

		Enter value	Calc value Xu & Eckstein	
Longitudinal dispersivity	**ax**		1.06E+01	m
Transverse dispersivity	**az**		1.06E+00	m
Vertical dispersivity	**ay**		1.06E-01	m

For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report $ax = 0.83(\log_{10}x)^{2.414}$; 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.

This sheet calculates the Tier3 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

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 Tier 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.

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	**Concentration**
	mg/l
37.5	4.1E-99
75.0	1.7E-99
112.5	6.9E-100
150.0	2.8E-100
187.5	1.1E-100
225.0	4.6E-101
262.5	1.9E-101
300.0	7.6E-102
337.5	3.0E-102
375.0	1.2E-102
412.5	4.9E-103
450.0	2.0E-103
487.5	8.0E-104
525.0	3.2E-104
562.5	1.3E-104
600.0	5.3E-105
637.5	2.1E-105
675.0	8.7E-106
712.5	3.5E-106
750.0	1.4E-106

Site being assessed	Bloss 6 B Deerpark K20
Completed by	AJ
Date	24 11 2005
Version	12

R&D Publication 20 Remedial Targets Worksheet, Release 2.2a

Tier 3 - Groundwater

ENVIRONMENT AGENCY

Input Parameters (using pull down menu)

Input Parameters (using pull down menu)	Variable	Value	Unit	Source
Contaminant		Aromatic C10-C12		
Target Concentration	C_T	7.14E-04	mg/l	

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

Ogata Banks — Equations in R&D Pub. 20

Enter '1' to simulate vertical dispersion in one direction, '2' for two directions (pull down menu): 1

Enter '1' if biodegradation rate is for the substance in water,
'0' if rate is for decay in field conditions (i.e. field data from aquifer) (pull down menu): 0

	Variable	Value	Unit	Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	2.12E-02	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	1.83E+03	days	
Calculated decay rate	λ	3.80E-04	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	8.00E+01	m	
Plume thickness at source	Sy	5.60E+01	m	
Saturated aquifer thickness	da	5.71E+01	m	
Bulk density of aquifer materials	ρ	1.70E+00	g/cm^3	
Effective porosity of aquifer	n	1.82E-01	fraction	
Hydraulic gradient	i	1.25E-02	fraction	
Hydraulic conductivity of aquifer	K	2.00E+01	m/d	
Distance to compliance point	x	7.50E+02	m	
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	9.12E+00	l/kg	*see options*
Longitudinal dispersivity	ax	10.623	m	*see options*
Transverse dispersivity	az	1.062	m	*see options*
Vertical dispersivity	ay	0.106	m	*see options*

Calculated Parameters

Calculated Parameters	Variable		
Groundwater flow velocity	v	1.37E+00	m/d
Retardation factor	Rf	8.62E+01	fraction
Decay rate used	λ	3.80E-04	d^{-1}
Rate of contaminant flow due to retardation	u	1.59E-02	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	5.54E-09	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	5.39E-09	mg/l
Attenuation factor (one way vertical dispersion, C_0/C_{ED})	AF	3.83E+06	
Attenuation factor (two way vertical dispersion, C_0/C_{ED})	AF	3.93E+06	

Remedial Targets

Remedial Target	LTC3	2.73E+03	mg/l

For comparison with measured groundwater concentration.

Ogata Banks

Distance to compliance point		750	m	
Concentration of contaminant at compliance point	$C_{ED}/C0$	5.54E-09	mg/l	Ogata Banks
after		9.9E+99	days	

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

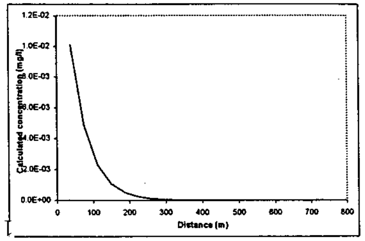
Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd		l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	1.00E+00	fraction
Organic carbon partition coefficient	Koc	9.12E+00	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$		l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Soil water partition coefficient	Kd	9.12E+00	l/kg

Dispersivity

Calculate dependant on distance to compliance point (0), specify dispersivity (1), or calc after Xu & Eckstein (2) ? 2

		Enter value	Calc value Xu & Eckstein	
Longitudinal dispersivity	ax		1.06E+01	m
Transverse dispersivity	az		1.06E+00	m
Vertical dispersivity	ay		1.06E-01	m

For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report ax = $0.83(\log_{10}x)^{2.414}$; 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.

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration
	mg/l
37.5	1.0E-02
75.0	4.8E-03
112.5	2.3E-03
150.0	1.1E-03
187.5	5.0E-04
225.0	2.3E-04
262.5	1.1E-04
300.0	5.1E-05
337.5	2.4E-05
375.0	1.1E-05
412.5	5.2E-06
450.0	2.4E-06
487.5	1.1E-06
525.0	5.2E-07
562.5	2.5E-07
600.0	1.1E-07
637.5	5.4E-08
675.0	2.5E-08
712.5	1.2E-08
750.0	5.5E-09

This sheet calculates the Tier3 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

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 Tier 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.

Site being assessed	Area 6 Deerpark A K20
Completed by.	AJ
Date	24 11 2005
Version	12

R&D Publication 20 Remedial Targets Worksheet, Release 2.2a

Tier 3 - Groundwater

ENVIRONMENT AGENCY

Input Parameters (using pull down menu)

Input Parameters (using pull down menu)	Variable	Value	Unit	Source
Contaminant		Aromatic C12-C16		
Target Concentration	C_T	7.14E-04	mg/l	

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

Ogata Banks — Equations in R&D Pub. 20

Enter '1' to simulate vertical dispersion in one direction, '2' for two directions (pull down menu): 1

Enter '1' if biodegradation rate is for the substance in water,
'0' if rate is for decay in field conditions (i.e. field data from aquifer) (pull down menu): 0

	Variable	Value	Unit	Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	2.12E-02	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	1.83E+03	days	
Calculated decay rate	λ	3.80E-04	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	8.00E+01	m	
Plume thickness at source	Sy	5.60E+01	m	
Saturated aquifer thickness	da	5.71E+01	m	
Bulk density of aquifer materials	ρ	1.70E+00	g/cm^3	
Effective porosity of aquifer	n	1.82E-01	fraction	
Hydraulic gradient	i	1.25E-02	fraction	
Hydraulic conductivity of aquifer	K	2.00E+01	m/d	
Distance to compliance point	x	7.50E+02	m	
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	1.82E+01	l/kg	***see options***
Longitudinal dispersivity	ax	10.623	m	***see options***
Transverse dispersivity	az	1.062	m	***see options***
Vertical dispersivity	ay	0.106	m	***see options***

Calculated Parameters

Calculated Parameters	Variable		
Groundwater flow velocity	v	1.37E+00	m/d
Retardation factor	Rf	1.71E+02	fraction
Decay rate used	λ	3.80E-04	d^{-1}
Rate of contaminant flow due to retardation	u	8.04E-03	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	7.96E-14	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	7.75E-14	mg/l
Attenuation factor (one way vertical dispersion, C_0/C_{ED})	AF	2.66E+11	
Attenuation factor (two way vertical dispersion, C_0/C_{ED})	AF	2.74E+11	

Remedial Targets

Remedial Target	LTC3	1.90E+08	mg/l	For comparison with measured groundwater concentration.
Ogata Banks				
Distance to compliance point		750	m	
Concentration of contaminant at compliance point	$C_{ED}/C0$	7.96E-14	mg/l	Ogata Banks
after		9.9E+99	days	

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

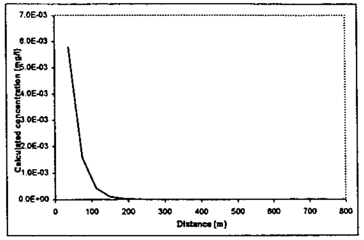
Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd		l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	1.00E+00	fraction
Organic carbon partition coefficient	Koc	1.82E+01	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$		l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Soil water partition coefficient	Kd	1.82E+01	l/kg

Dispersivity

Calculate dependant on distance to compliance point (0), specify dispersivity (1), or calc after Xu & Eckstein (2) ? 2

		Enter value	Calc value Xu & Eckstein	
Longitudinal dispersivity	ax		1.06E+01	m
Transverse dispersivity	az		1.06E+00	m
Vertical dispersivity	ay		1.06E-01	m

For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, av = 0.001 * x
Xu & Eckstein (1995) report ax = 0.83$(\log_{10}x)^{2.414}$; 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.

This sheet calculates the Tier3 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

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 Tier 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.

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration
	mg/l
87.6	5.8E-03
76.0	1.6E-03
112.5	4.3E-04
160.0	1.2E-04
187.5	3.1E-05
225.0	8.3E-06
262.5	2ZE.W
300.0	6.9E-07
337.5	1.6E-07
375.0	4.2E-08
412.5	1.1E-08
450.0	3.0E-09
487.5	8.0E-10
525.0	2.1E-10
562.5	5.7E-11
600.0	1.5E-11
637.5	4.1E-12
675.0	1.1E-12
712.1	3.0E-13
760.0	8.0E-14

Site being assessed	Area 6 Deerpark A K20
Completed by.	AJ
Date:	24 11 2005
Version	12

R&D Publication20 Remedial Targets Worksheet, Release 2.2a

Tier 3 - Groundwater

ENVIRONMENT AGENCY

Input Parameters (using pull down menu)	Variable	Value	Unit	Source
Contaminant		Aromatic C16-C21		
Target Concentration	C_T	7.14E-04	mg/l	

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

Ogata Banks — Equations in R&D Pub. 20

Enter '1' to simulate vertical dispersion in one direction, '2' for two directions (pull down menu): 1

Enter '1' if biodegradation rate is for the substance in water,
'0' if rate is for decay in field conditions (i.e. field data from aquifer) (pull down menu: 0

				Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	2.12E-02	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	3.65E+03	days	
Calculated decay rate	λ	1.90E-04	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	8.00E+01	m	
Plume thickness at source	Sy	5.60E+01	m	
Saturated aquifer thickness	da	5.71E+01	m	
Bulk density of aquifer materials	ρ	1.70E+00	g/cm^3	
Effective porosity of aquifer	n	1.82E-01	fraction	
Hydraulic gradient	i	1.25E-02	fraction	
Hydraulic conductivity of aquifer	K	2.00E+01	m/d	
Distance to compliance point	x	7.50E+02	m	
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	5.75E+01	l/kg	*see options*
Longitudinal dispersivity	ax	10.623	m	*see options*
Transverse dispersivity	az	1.062	m	*see options*
Vertical dispersivity	ay	0.106	m	*see options*

Calculated Parameters	Variable		
Groundwater flow velocity	v	1.37E+00	m/d
Retardation factor	Rf	5.38E+02	fraction
Decay rate used	λ	1.90E-04	d^{-1}
Rate of contaminant flow due to retardation	u	2.55E-03	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	1.63E-18	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	1.59E-18	mg/l
Attenuation factor (one way vertical dispersion, C_0/C_{ED})	AF	1.30E+16	
Attenuation factor (two way vertical dispersion, C_0/C_{ED})	AF	1.34E+16	

Remedial Targets

Remedial Target	LTC3	9.28E+12	mg/l	For comparison with measured groundwater concentration.
Ogata Banks				

Distance to compliance point		**750**	**m**	
Concentration of contaminant at compliance point	**$C_{ED}/C0$**	**1.63E-18**	**mg/l**	Ogata Banks
after		**9.9E+99**	**days**	

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	[redacted]	l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	1.00E+00	fraction
Organic carbon partition coefficient	Koc	5.75E+01	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$	[redacted]	l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		

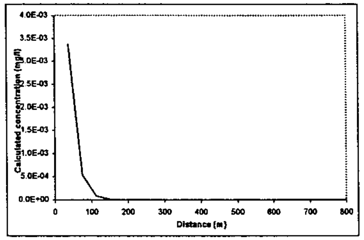
Soil water partition coefficient	Kd	5.75E+01	l/kg

Dispersivity

Calculate dependant on distance to compliance point (0), specify dispersivity (1), or calc after Xu & Eckstein (2) ? 2

		Enter value	Calc value Xu & Eckstein	
Longitudinal dispersivity	ax	[redacted]	1.06E+01	m
Transverse dispersivity	az		1.06E+00	m
Vertical dispersivity	ay		1.06E-01	m

For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report ax = 0.83$(\log_{10}x)^{2.414}$; 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.

This sheet calculates the Tier3 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

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 Tier 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.

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration
	mg/l
37.5	3.4E-03
75.0	5.4E-04
112.5	8.5E-05
150.0	1.3E-05
167.6	2.1E-06
225.0	3.2E-07
262.5	5.0E-08
300.0	7.8E-09
U7.6	1.2E-09
376.0	1.9E-10
412.6	3.0E-11
450.0	4.6E-12
487.6	7.2E-13
525.0	1.1E-13
662.6	1.7E-14
600.0	2.7E-15
837.6	4.3E-16
676.0	6.7E-17
752.6	1.6E-18

Site being assessed:	Area 6 Deerpark A K20
Completed by:	AJ
Date:	24 11 2005
Version	12

R&D Publication 20 Remedial Targets Worksheet, Release 2.2a

Tier 3 - Groundwater

ENVIRONMENT AGENCY

Input Parameters (using pull down menu)

Parameter	Variable	Value	Unit	Source
Contaminant		Aromatic C21-C35		
Target Concentration	C_T	7.14E-04	mg/l	

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

Ogata Banks — Equations in R&D Pub. 20

Ente| 1' to simulate vertical dispersion in one direction, '2' for two directions (pull down menu): 1

Enter '1' if biodegradation rate is for the substance in water,
'0' if rate is for decay in field conditions (i.e. field data from aquifer) (pull down menu: 0

				Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	2.12E-02	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	3.65E+03	days	
Calculated decay rate	λ	1.90E-04	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	8.00E+01	m	
Plume thickness at source	Sy	5.60E+01	m	
Saturated aquifer thickness	da	5.71E+01	m	
Bulk density of aquifer materials	ρ	1.70E+00	g/cm^3	
Effective porosity of aquifer	n	1.82E-01	fraction	
Hydraulic gradient	i	1.25E-02	fraction	
Hydraulic conductivity of aquifer	K	2.00E+01	m/d	
Distance to compliance point	x	7.50E+02	m	
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	4.57E+02	l/kg	*see options*
Longitudinal dispersivity	ax	10.623	m	*see options*
Transverse dispersivity	az	1.062	m	*see options*
Vertical dispersivity	av	0.106	m	*see options*

Calculated Parameters

	Variable		
Groundwater flow velocity	v	1.37E+00	m/d
Retardation factor	Rf	4.27E+03	fraction
Decay rate used	λ	1.90E-04	d^{-1}
Rate of contaminant flow due to retardation	u	3.22E-04	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	1.57E-65	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	1.53E-65	mg/l
Attenuation factor (one way vertical dispersion, C_o/C_{ED})	AF	1.35E+63	
Attenuation factor (two way vertical dispersion, C_o/C_{ED})	AF	1.39E+63	

Remedial Targets

Remedial Target	LTC3	9.65E+59	mg/l	For comparison with measured groundwater concentration.
Ogata Banks				
Distance to compliance point		**750**	**m**	
Concentration of contaminant at compliance point	$C_{ED}/C0$	**1.57E-65**	**mg/l**	Ogata Banks
after		**9.9E+99**	**days**	

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

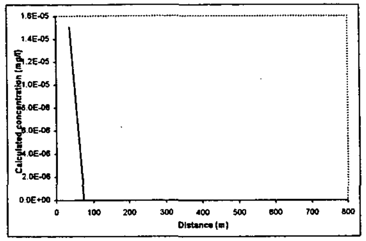
Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd		l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	1.00E+00	fraction
Organic carbon partition coefficient	Koc	4.57E+02	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$		l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	*pKa*		
Soil water partition coefficient	Kd	4.57E+02	l/kg

Dispersivity

Calculate dependant on distance to compliance point (0), specify dispersivity (1), or calc after Xu & Eckstein (2) ? 2

		Enter value	Calc value Xu & Eckstein	
Longitudinal dispersivity	**ax**		1.06E+01	m
Transverse dispersivity	**az**		1.06E+00	m
Vertical dispersivity	**ay**		1.06E-01	m

For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report ax = 0.83$(\log_{10}x)^{2.414}$; 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.

This sheet calculates the Tier3 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

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 Tier 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.

Site being assessed	Area 6 Deerpark A K20
Completed by:	AJ
Date:	24 11 2005
Version	12

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration
	mg/l
37.5	1.5E-05
75.0	1.1E-08
112.6	7.5E-12
150.0	5.3E-15
187.6	3.7E-18
225.0	2.6E-21
262.5	1.8E-24
300.0	1.2E-27
U7.6	8.5E-31
376.0	5.9E-34
412.6	4.1E-37
450.0	2.8E-40
487.6	2.0E-43
626.0	1.4E-46
562.5	9.6E-50
600.0	6.8E-53
957.6	4.6E-56
076.0	3.2E-59
712.6	2.2E-62
160.0	1.6E-65

R&D Publication 20 Remedial Targets Worksheet, Release 2.2a

ENVIRONMENT AGENCY

Tier 3 -Groundwater

Input Parameters (using pull down menu)	Variable	Value	Unit	Source
Contaminant Target Concentration	C_T	1.00E-02	mg/l	

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

Ogata Banks — Equations in R&D Pub. 20

Enter '1' to simulate vertical dispersion in one direction, '2' for two directions (pull down menu) 1

Enter '1' if biodegradation rate is for the substance in water,
'0' if rate is for decay in field conditions (i.e. field data from aquifer) (pull down menu 0

				Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	9.90E-99	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	9.90E+99	days	
Calculated decay rate	λ	7.00E-101	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	8.00E+01	m	
Plume thickness at source	Sy	5.60E+01	m	
Saturated aquifer thickness	da	5.71E+01	m	
Bulk density of aquifer materials	ρ	1.70E+00	g/cm^3	
Effective porosity of aquifer	n	1.82E-01	fraction	
Hydraulic gradient	i	1.25E-02	fraction	
Hydraulic conductivity of aquifer	K	2.00E+01	m/d	
Distance to compliance point	x	7.50E+02	m	
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	1.17E+02	l/kg	*see options*
Longitudinal dispersivity	ax	10.623	m	*see options*
Transverse dispersivity	az	1.062	m	*see options*
Vertical dispersivity	ay	0.106	m	*see options*

Calculated Parameters	Variable		
Groundwater flow velocity	v	1.37E+00	m/d
Retardation factor	Rf	1.10E+03	fraction
Decay rate used	λ	7.00E-101	d^{-1}
Rate of contaminant flow due to retardation	u	1.25E-03	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	6.77E-99	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	6.59E-99	mg/l
Attenuation factor (one way vertical dispersion, C_0/C_{ED})	AF	1.46E+00	
Attenuation factor (two way vertical dispersion, C_0/C_{ED})	AF	1.50E+00	

Remedial Targets

Remedial Target	LTC3	1.46E-02	mg/l	For comparison with measured groundwater concentration.
Ogata Banks				
Distance to compliance point		750	m	
Concentration of contaminant at compliance point	$C_{ED}/C0$	6.77E-99	mg/l	Ogata Banks
after		9.9E+99	days	

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

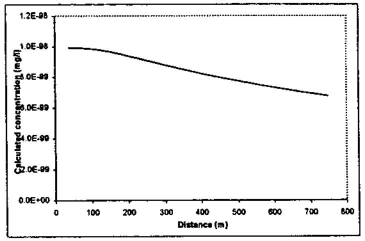
Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd		l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	1.00E+00	fraction
Organic carbon partition coefficient	Koc	1.17E+02	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$		l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Soil water partition coefficient	Kd	1.17E+02	l/kg

Dispersivity

Calculate dependant on distance to compliance point (0), specify dispersivity (1), or calc after Xu & Eckstein (2) ? 2

		Enter value	Calc value Xu & Eckstein	
Longitudinal dispersivity	**ax**		1.06E+01	m
Transverse dispersivity	**az**		1.06E+00	m
Vertical dispersivity	**ay**		1.06E-01	m

For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report ax = $0.83(\log_{10}x)^{2.414}$; 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.

This sheet calculates the Tier3 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

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 Tier 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.

Calculated concentrations for distance-concentration graph

Ogata Banks
Fromcalculation sheet

Distance	Concentration
	mg/l
37.6	9.9E-99
76.0	9.9E-99
112.5	9.8E-99
150.0	9.7E-99
167.6	9.5E-99
225.0	9.2E-99
262.5	9.OE-F)
300.0	8.8E-99
337.6	8.6E-99
376.0	8.4E-99
412.6	8.2E-99
450.0	8.OE-F)
487.6	7.8E-99
626.0	7.6E-99
562.5	7.5E-99
600.0	7.3E-F)
637.5	7.2E-99
976.0	7.0E-99
7602.6	6.8E-99

Site being assessed	Area 6 Deerpark A K20
Completed by	AJ
Date:	24 11 2005
Version	12

RBD Publication 20 Remedial Targets Worksheet, Release 2.2a

Tier 3 - Groundwater

Input Parameters (using pull down menu) **Variable** **Value** **Unit** **Source**

Contaminant		Benzene	
Target Concentration	C_T	1.00E-03	mg/l

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

Ogata Banks Equations in R&D Pub. 20

Enter '1' to simulate vertical dispersion in one direction, '2' for two directions (pull down menu) 1

Enter '1' if biodegradation rate is for the substance in water,
'0' if rate is for decay in field conditions (i.e. field data from aquifer) (pull down menu 0

	Variable	Value	Unit	Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	9.90E-99	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	7.20E+02	days	
Calculated decay rate	λ	9.63E-04	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	8.00E+01	m	
Plume thickness at source	Sy	5.60E+01	m	
Saturated aquifer thickness	da	5.71E+01	m	
Bulk density of aquifer materials	ρ	1.70E+00	g/cm^3	
Effective porosity of aquifer	n	1.82E-01	fraction	
Hydraulic gradient	i	1.25E-02	fraction	
Hydraulic conductivity of aquifer	K	2.00E+01	m/d	
Distance to compliance point	x	7.50E+02	m	
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	2.14E-01	l/kg	*see options*
Longitudinal dispersivity	ax	10.623	m	*see options*
Transverse dispersivity	az	1.062	m	*see options*
Vertical dispersivity	ay	0.106	m	*see options*

Calculated Parameters **Variable**

Groundwater flow velocity	v	1.37E+00	m/d
Retardation factor	Rf	3.00E+00	fraction
Decay rate used	λ	9.63E-04	d^{-1}
Rate of contaminant flow due to retardation	u	4.58E-01	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	1.45E-99	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	1.41E-99	mg/l
Attenuation factor (one way vertical dispersion, C_0/C_{ED})	AF	6.83E+00	
Attenuation factor (two way vertical dispersion, C_0/C_{ED})	AF	7.02E+00	

Remedial Targets

Remedial Target **LTC3** **6.83E-03** **mg/l** For comparison with measured groundwater concentration.

Ogata Banks

Distance to compliance point		**750**	**m**	
Concentration of contaminant at compliance point	$C_{ED}/C0$	**1.45E-99**	**mg/l**	Ogata Banks
after		**9.9E+99**	**days**	

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

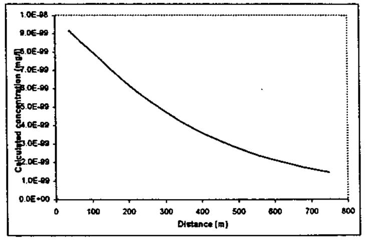
Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd		l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	1.00E+00	fraction
Organic carbon partition coefficient	Koc	2.14E-01	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$		l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Soil water partition coefficient	Kd	2.14E-01	l/kg

Dispersivity

Calculate dependant on distance to compliance point (0), specify dispersivity (1), or calc after Xu & Eckstein (2) ? 2

		Enter value	Calc value Xu & Eckstein	
Longitudinal dispersivity	ax		1.06E+01	m
Transverse dispersivity	az		1.06E+00	m
Vertical dispersivity	ay		1.06E-01	m

For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report ax = $0.83(\log_{10}x)^{2.414}$; 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.

This sheet calculates the Tier3 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

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 Tier 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.

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	**Concentration**
	mg/l
37.6	9.2E-99
76.0	8.5E-99
112.5	7.8E-99
187.6	6.4E-99
225.0	5.8E-99
262.5	5.3E-99
300.0	4.7E-99
337.5	4.3E-99
376.6	3.6E-99
450.0	3.2E-99
487.6	2.9E-99
525.0	2.6E-99
562.5	2.3E-99
600.0	2.1E-99
675.0	1.8E-99
712.6	1.6E-99
760.0	1.4E-W

Site being assessed	Area 6 Deerpark A K20
Completed by.	AJ
Date:	24 11 2005
Version	12

R&D Publication 20 Remedial Targets Worksheet, Release 2.2a

Tier 3 - Groundwater

ENVIRONMENT AGENCY

Input Parameters (using pull down menu)	Variable	Value	Unit	Source
Contaminant		Boron		
Target Concentration	C_T	1.00E+00	mg/l	

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

Ogata Banks — Equations in R&D Pub. 20

Enter '1' to simulate vertical dispersion in one direction, '2' for two directions (pull down menu): 1

Enter '1' if biodegradation rate is for the substance in water,
'0' if rate is for decay in field conditions (i.e. field data from aquifer) (pull down menu): 0

	Variable	Value	Unit	Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	1.00E-01	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	9.90E+99	days	
Calculated decay rate	λ	7.00E-101	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	8.00E+01	m	
Plume thickness at source	Sy	5.60E+01	m	
Saturated aquifer thickness	da	5.71E+01	m	
Bulk density of aquifer materials	ρ	1.70E+00	g/cm^3	
Effective porosity of aquifer	n	1.82E-01	fraction	
Hydraulic gradient	i	1.25E-02	fraction	
Hydraulic conductivity of aquifer	K	2.00E+01	m/d	
Distance to compliance point	x	7.50E+02	m	
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
~~Distance (depth) to compliance point perpendicular to flow direction~~	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	0.00E+00	l/kg	*see options*
Longitudinal dispersivity	ax	10.623	m	*see options*
Transverse dispersivity	az	1.062	m	*see options*
Vertical dispersivity	av	0.106	m	*see options*

Calculated Parameters	Variable	Value	Unit
Groundwater flow velocity	v	1.37E+00	m/d
Retardation factor	Rf	1.00E+00	fraction
Decay rate used	λ	7.00E-101	d^{-1}
Rate of contaminant flow due to retardation	u	1.37E+00	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	6.84E-02	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	6.66E-02	mg/l
Attenuation factor (one way vertical dispersion, C_0/C_{ED})	AF	1.46E+00	
Attenuation factor (two way vertical dispersion, C_0/C_{ED})	AF	1.50E+00	

Remedial Targets

Remedial Target Ogata Banks	LTC3	1.46E+00	mg/l	For comparison with measured groundwater concentration.
Distance to compliance point		750	m	
Concentration of contaminant at compliance point after	$C_{ED}/C0$	6.84E-02 9.9E+99	mg/l days	Ogata Banks

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

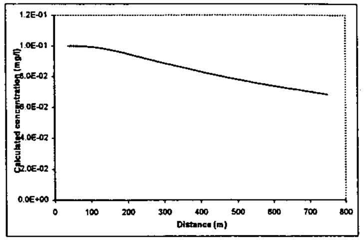
Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd		l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	1.00E+00	fraction
Organic carbon partition coefficient	Koc	0.00E+00	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$		l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Soil water partition coefficient	Kd	0.00E+00	l/kg

Dispersivity

Calculate dependant on distance to compliance point (0), specify dispersivity (1), or calc after Xu & Eckstein (2) ? 2

		Enter value	Calc value Xu & Eckstein	
Longitudinal dispersivity	ax		1.06E+01	m
Transverse dispersivity	az		1.06E+00	m
Vertical dispersivity	ay		1.06E-01	m

For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report ax = $0.83(\log_{10}x)^{2.414}$; 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.

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration
	mg/l
37.5	1.0E-01
75.0	1.0E-01
112.5	9.9E-02
150.0	9.7E-02
187.5	9.5E-02
225.0	9.3E-02
262.5	9.1E-02
300.0	8.9E-02
337.5	8.6E-02
375.0	8.4E-02
412.5	8.2E-02
450.0	8.0E-02
487.5	7.9E-02
525.0	7.7E-02
562.5	7.5E-02
600.0	7.4E-02
637.5	7.2E-02
675.0	7.1E-02
712.5	7.0E-02
7MO	6.8E-02

This sheet calculates the Tier3 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

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 Tier 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.

Site being assessed:	Area 6 Deerpark A K20
Completed by	AJ
Date:	24 11 2005
Version	12

6

R&D Publication 20 Remedial Targets Worksheet, Release 2.2a

Tier 3 -Groundwater

ENVIRONMENT AGENCY

Input Parameters (using pulldawn menu)	Variable	Value	unit	Source
Contaminant		Chlorobenzene		
Target Concentration	C_T	1.00E-03	mg/l	

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

Ogata Banks Equations in R&D Pub. 20

Enter '1' to simulate vertical dispersion in one direction, '2' for two directions (pull down menu) 1

Enter '1' if biodegradation rate is for the substance in water,
'0' if rate is for decay in field conditions (i.e. field data from aquifer) (pull down menu 0

				Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	9.90E-99	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	3.00E+02	days	
Calculated decay rate	λ	2.31E-03	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	8.00E+01	m	
Plume thickness at source	Sy	5.60E+01	m	
Saturated aquifer thickness	da	5.71E+01	m	
Bulk density of aquifer materials	ρ	1.70E+00	g/cm^3	
Effective porosity of aquifer	n	1.82E-01	fraction	
Hydraulic gradient	i	1.25E-02	fraction	
Hydraulic conductivity of aquifer	K	2.00E+01	m/d	
Distance to compliance point	x	7.50E+02	m	
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	7.94E-01	l/kg	*see options*
Longitudinal dispersivity	ax	10.623	m	*see options*
Transverse dispersivity	az	1.062	m	*see options*
Vertical dispersivity	ay	0.106	m	*see options*

Calculated Parameters	Variable		
Groundwater flow velocity	v	1.37E+00	m/d
Retardation factor	Rf	8.42E+00	fraction
Decay rate used	λ	2.31E-03	d^{-1}
Rate of contaminant flow due to retardation	u	1.63E-01	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	5.74E-103	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	5.59E-103	mg/l
Attenuation factor (one way vertical dispersion, C_O/C_{ED})	AF	1.72E+04	
Attenuation factor (two way vertical dispersion, C_O/C_{ED})	AF	1.77E+04	

Remedial Targets

Remedial Target	LTC3	1.72E+01	mg/l

For comparison with measured groundwater concentration.

Ogata Banks

Distance to compliance point		750	m	
Concentration of contaminant at compliance point	$C_{ED}/C0$	5.74E-103	mg/l	Ogata Banks
after		9.9E+99	days	

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

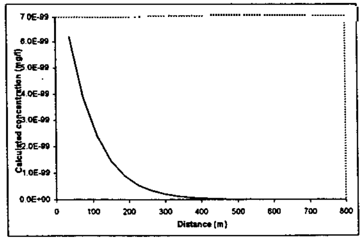
Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd	[redacted]	l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	1.00E+00	fraction
Organic carbon partition coefficient	Koc	7.94E-01	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$	[redacted]	l/kg
Sorption coefficient for ionised species	$K_{oc,i}$	[redacted]	l/kg
pH value	pH	[redacted]	
acid dissociation constant	pKa	[redacted]	
Soil water partition coefficient	Kd	7.94E-01	l/kg

Dispersivity

Calculate dependant on distance to compliance point (0), 2
specify dispersivity (1), or calc after Xu & Eckstein (2) ?

		Enter value	Calc value Xu & Eckstein	
Longitudinal dispersivity	ax	[redacted]	1.06E+01	m
Transverse dispersivity	az	[redacted]	1.06E+00	m
Vertical dispersivity	ay	[redacted]	1.06E-01	m

For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report ax = $0.83(\log_{10}x)^{2.414}$; 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.

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration
	mg/l
31.6	6.2E-99
[illegible]	3.8E-99
IW.O	1.5E-99
285.8	
	9.5E-100
262.5	3.4E-100
300.0	2.1E-100
337.6	1.3E-100
[illegible]	7.7E-101
450.0	2.9E-101
488.6	1.8E-101
562.5	6.6E-102
600.0	4.0E-102
637.5	2.5E-102
976.0	1.5E-102
112.6	9.3E-103
750.0	5.7E-103

This sheet calculates the Tier3 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

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 Tier 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.

Site being assessed	Bless 6 B Deerpark K20
Completed by	AJ
Date.	24 11 2005
Version	12

R&D Publication20 RemedialTargets Worksheet, Release2.2a

ENVIRONMENT
AGENCY

Tier 3 -Groundwater

Input Parameters (using cull down menu)	Variable	Value	Unit	Source
Contaminant		Chloroethane		
Target Concentration	C_T	1.00E-03	mg/l	

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

Ogata Banks | Equations in R&D Pub. 20

Enter '1' to simulate vertical dispersion in one direction, '2' for two directions (pull down menu) | 1

Enter '1' if biodegradation rate is for the substance in water,
'0' if rate is for decay in field conditions (i.e. field data from aquifer) (pull down menu | 0

				Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	4.00E-02	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	5.60E+01	days	
Calculated decay rate	λ	1.24E-02	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	8.00E+01	m	
Plume thickness at source	Sy	5.60E+01	m	
Saturated aquifer thickness	da	5.71E+01	m	
Bulk density of aquifer materials	ρ	1.70E+00	g/cm^3	
Effective porosity of aquifer	n	1.82E-01	fraction	
Hydraulic gradient	i	1.25E-02	fraction	
Hydraulic conductivity of aquifer	K	2.00E+01	m/d	
Distance to compliance point	x	7.50E+02	m	
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	6.46E-02	l/kg	*see options*
Longitudinal dispersivity	ax	10.623	m	*see options*
Transverse dispersivity	az	1.062	m	*see options*
Vertical dispersivity	ay	0.106	m	*see options*

Calculated Parameters	Variable		
Groundwater flow velocity	v	1.37E+00	m/d
Retardation factor	Rf	1.60E+00	fraction
Decay rate used	λ	1.24E-02	d^{-1}
Rate of contaminant flow due to retardation	u	8.57E-01	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	1.95E-06	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	1.90E-06	mg/l
Attenuation factor (one way vertical dispersion, C_0/C_{ED})	AF	2.05E+04	
Attenuation factor (two way vertical dispersion, C_0/C_{ED})	AF	2.10E+04	

Remedial Targets

Remedial Target	LTC3	2.05E+01	mg/l	For comparison with measured groundwater concentration.
Ogata Banks				

Distance to compliance point		**750**	**m**	
Concentration of contaminant at compliance point	$C_{ED}/C0$	**1.95E-06**	**mg/l**	Ogata Banks
after		**9.9E+99**	**days**	

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

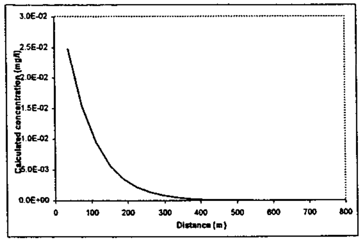
Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd	[redacted]	l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	1.00E+00	fraction
Organic carbon partition coefficient	Koc	6.46E-02	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$	[redacted]	l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Soil water partition coefficient	Kd	6.46E-02	l/kg

Dispersivity

Calculate dependant on distance to compliance point (0), | 2
specify dispersivity (1), or calc after Xu & Eckstein (2) ?

		Enter value	Calc value Xu & Eckstein	
Longitudinal dispersivity	**ax**	[redacted]	1.06E+01	m
Transverse dispersivity	**az**		1.06E+00	m
Vertical dispersivity	**ay**		1.06E-01	m

For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report $ax = 0.83(\log_{10}x)^{2.414}$; 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.

Calculated concentrations for distance-concentration graph

Ogata Banks
DistancalcConcentration

	mg/l
37.6	2.5E-02
[illegible]	9.5E-03
160.0	5.8E-03
181.6	3.5E-03
225.0	2.1E-03
262.5	1.3E-03
300.0	4.7E-04
[illegible]	2.9E-04
450.0	I.OE-M
481.6	6.3E-05
525.0	3.9E-05
600.0	
	2.4E-05
637.5	8.1E-M
076.0	5.3E-06
712.5	3.2E-06
750.0	2.0E-06

This sheet calculates the Tier3 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

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 Tier 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

Site being assessed	Blessington Appeal
Completed by.	Anna Jeffcoat
Date:	########
Version:	11

R&D Publication20 Remedial Targets Worksheet, Release 2.2a

Tier 3 - Groundwater

ENVIRONMENT AGENCY

Input Parameters (using pull down menu)

	Variable	Value	Unit	Source
Contaminant		Isopropylbenzene		
Target Concentration	C_T	1.00E-02	mg/l	

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

Ogata Banks — Equations in R&D Pub. 20

Enter '1' to simulate vertical dispersion in one direction, '2' for two directions (pull down menu): 1

Enter '1' if biodegradation rate is for the substance in water,
'0' if rate is for decay in field conditions (i.e. field data from aquifer) (pull down menu): 0

	Variable	Value	Unit	Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	9.90E-99	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	7.20E+02	days	
Calculated decay rate	λ	9.63E-04	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	8.00E+01	m	
Plume thickness at source	Sy	5.60E+01	m	
Saturated aquifer thickness	da	5.71E+01	m	
Bulk density of aquifer materials	ρ	1.70E+00	g/cm^3	
Effective porosity of aquifer	n	1.82E-01	fraction	
Hydraulic gradient	i	1.25E-02	fraction	
Hydraulic conductivity of aquifer	K	2.00E+01	m/d	
Distance to compliance point	x	7.50E+02	m	
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	2.14E-01	l/kg	*see options*
Longitudinal dispersivity	ax	10.623	m	*see options*
Transverse dispersivity	az	1.062	m	*see options*
Vertical dispersivity	ay	0.106	m	*see options*

Calculated Parameters

	Variable	Value	Unit
Groundwater flow velocity	v	1.37E+00	m/d
Retardation factor	Rf	3.00E+00	fraction
Decay rate used	λ	9.63E-04	d^{-1}
Rate of contaminant flow due to retardation	u	4.58E-01	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	1.45E-99	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	1.41E-99	mg/l
Attenuation factor (one way vertical dispersion, C_O/C_{ED})	AF	6.83E+00	
Attenuation factor (two way vertical dispersion, C_O/C_{ED})	AF	7.02E+00	

Remedial Targets

Remedial Target Ogata Banks	LTCS	6.83E-02	mg/l	For comparison with measured groundwater concentration.

Distance to compliance point		**750**	**m**	
Concentration of contaminant at compliance point	$C_{ED}/C0$	**1.45E-99**	**mg/l**	Ogata Banks
after		**9.9E+99**	**days**	

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

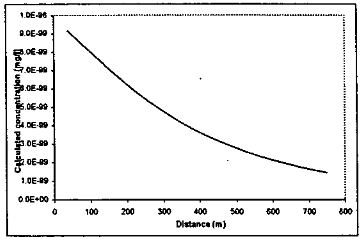
Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd	[redacted]	l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	1.00E+00	fraction
Organic carbon partition coefficient	Koc	2.14E-01	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$	[redacted]	l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Soil water partition coefficient	Kd	2.14E-01	l/kg

Dispersivity

Calculate dependant on distance to compliance point (0), specify dispersivity (1), or calc after Xu & Eckstein (2) ? 2

		Enter value	Calc value Xu & Eckstein	
Longitudinal dispersivity	ax	[redacted]	1.06E+01	m
Transverse dispersivity	az		1.06E+00	m
Vertical dispersivity	ay		1.06E-01	m

For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report ax = $0.83(\log_{10}x)^{2.414}$; 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.

This sheet calculates the Tier3 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

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 Tier 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.

Calculated concentrations for distance-concentration graph

Ogata Banks

DistaicalcConcentration	mg/l
37.6	9.2E-99
76.0	8.5E-99
112.6	7.8E-99
150.0	7.1E-99
187.5	6.4E-99
225.0	5.8E-99
262.6	5.3E-99
300.0	4.7E-99
337.6	4.3E-W
376.0	3.9E-99
412.6	3.5E-99
450.0	3.2E-99
487.6	2.9E-99
626.0	2.6E-99
602.6	2.3E-99
600.0	2.1E-M
637.5	1.SE-W
976.0	1.8E-99
712.6	1.6E-99
750.0	1.4E-99

Site being assessed.	Bless 6 B Deerpark K20
Completed by:	AJ
Date	24 11 2005
Version	12

e)

R&D Publication20 Remedial Targets Worksheet, Release 2.2a

Tier 3 - Groundwater

ENVIRONMENT AGENCY

Input Parameters (using pull down menu)	Variable	Value	Unit	Source
Contaminant		n- butylbenzene		
Target Concentration	C_T	1.00E-03	mg/l	

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

Ogata Banks — Equations in R&D Pub. 20

Enter '1' to simulate vertical dispersion in one direction, '2' for two directions (pull down menu): 1

Enter '1' if biodegradation rate is for the substance in water,
'0' if rate is for decay in field conditions (i.e. field data from aquifer) (pull down menu: 0

	Variable	Value	Unit	Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	9.90E-99	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	9.99E+99	days	
Calculated decay rate	λ	6.94E-101	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	8.00E+01	m	
Plume thickness at source	Sy	5.60E+01	m	
Saturated aquifer thickness	da	5.71E+01	m	
Bulk density of aquifer materials	ρ	1.70E+00	g/cm^3	
Effective porosity of aquifer	n	1.82E-01	fraction	
Hydraulic gradient	i	1.25E-02	fraction	
Hydraulic conductivity of aquifer	K	2.00E+01	m/d	
Distance to compliance point	x	7.50E+02	m	
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	8.91E+00	l/kg	*see options*
Longitudinal dispersivity	ax	10.623	m	*see options*
Transverse dispersivity	az	1.062	m	*see options*
Vertical dispersivity	ay	0.106	m	*see options*

Calculated Parameters	Variable		
Groundwater flow velocity	v	1.37E+00	m/d
Retardation factor	Rf	8.42E+01	fraction
Decay rate used	λ	6.94E-101	d^{-1}
Rate of contaminant flow due to retardation	u	1.63E-02	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	6.77E-99	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	6.59E-99	mg/l
Attenuation factor (one way vertical dispersion, C_O/C_{ED})	AF	1.46E+00	
Attenuation factor (two way vertical dispersion, C_O/C_{ED})	AF	1.50E+00	

Remedial Targets

Remedial Target	LTC3	1.46E-03	mg/l	For comparison with measured groundwater concentration.
Ogata Banks				
Distance to compliance point		750	m	
Concentration of contaminant at compliance point	$C_{ED}/C0$	6.77E-99	mg/l	Ogata Banks
after		9.9E+99	days	

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

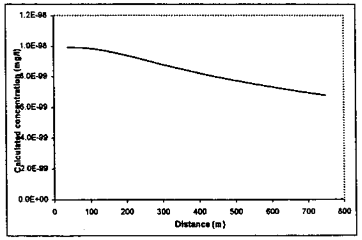
Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd		l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	1.00E+00	fraction
Organic carbon partition coefficient	Koc	8.91E+00	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$		l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Soil water partition coefficient	Kd	8.91E+00	l/kg

Dispersivity

Calculate dependant on distance to compliance point (0), specify dispersivity (1), or calc after Xu & Eckstein (2) ? 2

		Enter value	Calc value Xu & Eckstein	
Longitudinal dispersivity	ax		1.06E+01	m
Transverse dispersivity	az		1.06E+00	m
Vertical dispersivity	ay		1.06E-01	m

For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report ax = $0.83(\log_{10}x)^{2.414}$; 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.

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration
	mg/l
37.5	9.9E-99
75.0	9.9E-99
112.5	9.8E-99
150.0	9.7E-99
187.5	9.5E-99
225.0	9.2E-99
262.5	9.0E-99
300.0	8.8E-99
337.5	8.6E-99
375.0	8.4E-99
412.5	8.2E-99
450.0	8.0E-99
487.5	7.8E-99
525.0	7.6E-99
600.0	7.3E-99
637.5	7.2E-99
675.0	7.0E-99
712.5	6.9E-99
750.0	6.8E-99

This sheet calculates the Tier3 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

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 Tier 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.

Site being assessed	Bless 6 B Deerpark K20
Completed by	AJ
Date	24 11 2005
Version	12

R&D Publication 20 Remedial Targets Worksheet, Release 2.2a

Tier 3 - Groundwater

ENVIRONMENT AGENCY

Input Parameters (using pull down menu)

	Variable	Value	Unit	Source
Contaminant		Napthalene		
Target Concentration	C_T	1.00E-03	mg/l	

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

Ogata Banks — Equations in R&D Pub. 20

Enter '1 to simulate vertical dispersion in one direction, '2' for two directions (pull down menu): 1

Enter '1' if biodegradation rate is for the substance in water,
'0' if rate is for decay in field conditions (i.e. field data from aquifer) (pull down menu: 0

	Variable	Value	Unit	Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	9.90E-99	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	2.58E+02	days	
Calculated decay rate	λ	2.69E-03	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	8.00E+01	m	
Plume thickness at source	Sy	5.60E+01	m	
Saturated aquifer thickness	da	5.71E+01	m	
Bulk density of aquifer materials	ρ	1.70E+00	g/cm^3	
Effective porosity of aquifer		1.82E-01	fraction	
Hydraulic gradient	,	1.25E-02	fraction	
Hydraulic conductivity of aquifer	K	2.00E+01	m/d	
Distance to compliance point	x	7.50E+02	m	
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	7.24E+00	l/kg	*see options*
Longitudinal dispersivity	ax	10.623	m	*see options*
Transverse dispersivity	az	1.062	m	*see options*
Vertical dispersivity	ay	0.106	m	*see options*

Calculated Parameters

	Variable		
Groundwater flow velocity	v	1.37E+00	m/d
Retardation factor	Rf	6.87E+01	fraction
Decay rate used	λ	2.69E-03	d^{-1}
Rate of contaminant flow due to retardation	u	2.00E-02	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	2.89E-123	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	2.81E-123	mg/l
Attenuation factor (one way vertical dispersion, C_0/C_{ED})	AF	3.42E+24	
Attenuation factor (two way vertical dispersion, C_0/C_{ED})	AF	3.52E+24	

Remedial Targets

Remedial Target	LTC3	3.42E+21	mg/l	For comparison with measured groundwater concentration.
Ogata Banks				
Distance to compliance point		750	m	
Concentration of contaminant at compliance point	$C_{ED}/C0$	2.89E-123	mg/l	Ogata Banks
after		9.9E+99	days	

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

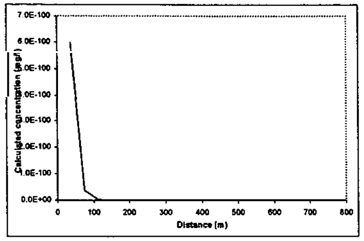
Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd		l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	1.00E+00	fraction
Organic carbon partition coefficient	Koc	7.24E+00	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$		l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Soil water partition coefficient	Kd	7.24E+00	l/kg

Dispersivity

Calculate dependant on distance to compliance point (0), specify dispersivity (1), or calc after Xu & Eckstein (2) ? 2

		Enter value	Calc value Xu & Eckstein	
Longitudinal dispersivity	ax		1.06E+01	m
Transverse dispersivity	az		1.06E+00	m
Vertical dispersivity	ay		1.06E-01	m

For calculated value, assumes ax = 0.1 * x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report ax = $0.83(\log_{10}x)^{2.414}$; 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.

This sheet calculates the Tier3 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 Tier 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.

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration mg/l
37.5	6.0E-100
75.0	3.6E-101
112.5	2.2E-102
150.0	1.3E-103
187.5	7.6E-105
225.0	4.5E-106
262.5	2.7E-107
300.0	1.6E-108
337.5	9.3E-110
375.0	5.5E-111
412.5	3.2E-112
450.0	1.9E-113
487.5	1.1E-114
525.0	6.7E-116
562.5	3.9E-117
600.0	2.3E-118
637.5	1.4E-119
675.0	8.2E-121
712.5	4.9E-122
750.0	2.9E-123

Site being assessed:	Bless 5 B Deerpark K20
Completed by:	AJ
Date	24 11 2005
Version	12

R&D Publication 20 Remedial Targets Worksheet, Release 2.2a

Tier 3 - Groundwater

ENVIRONMENT AGENCY

Input Parameters (using pull down menu)	Variable	Value	Unit	Source
Contaminant		Phenol		
Target Concentration	C_T	5.00E-04	mg/l	

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

Ogata Banks — Equations in R&D Pub. 20

Enter '1' to simulate vertical dispersion in one direction, '2' for two directions (pull down menu): 1

Enter '1' if biodegradation rate is for the substance in water,
'0' if rate is for decay in field conditions (i.e. field data from aquifer) (pull down menu): 0

	Variable	Value	Unit	Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	9.90E-99	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	1.00E+01	days	
Calculated decay rate	λ	6.93E-02	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	8.00E+01	m	
Plume thickness at source	Sy	5.60E+01	m	
Saturated aquifer thickness	da	5.71E+01	m	
Bulk density of aquifer materials	ρ	1.70E+00	g/cm^3	
Effective porosity of aquifer	n	1.82E-01	fraction	
Hydraulic gradient	i	1.25E-02	fraction	
Hydraulic conductivity of aquifer	K	2.00E+01	m/d	
Distance to compliance point	x	7.50E+02	m	
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	1.05E-01	l/kg	*see options*
Longitudinal dispersivity	ax	10.623	m	*see options*
Transverse dispersivity	az	1.062	m	*see options*
Vertical dispersivity	av	0.106	m	*see options*

Calculated Parameters	Variable		
Groundwater flow velocity	v	1.37E+00	m/d
Retardation factor	Rf	1.98E+00	fraction
Decay rate used	λ	6.93E-02	d^{-1}
Rate of contaminant flow due to retardation	u	6.94E-01	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	1.16E-118	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	1.13E-118	mg/l
Attenuation factor (one way vertical dispersion, C_0/C_{ED})	AF	8.55E+19	
Attenuation factor (two way vertical dispersion, C_0/C_{ED})	AF	8.78E+19	

Remedial Targets

Remedial Target	LTC3	4.29E+16	mg/l	For comparison with measured groundwater concentration.
Ogata Banks				
Distance to compliance point		**750**	**m**	
Concentration of contaminant at compliance point	$C_{ED}/C0$	**1.16E-118**	**mg/l**	Ogata Banks
after		**9.9E+99**	**days**	

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

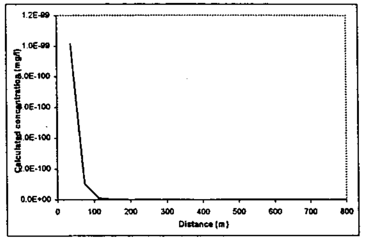
Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd		l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	1.00E+00	fraction
Organic carbon partition coefficient	Koc	1.05E-01	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$		l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Soil water partition coefficient	Kd	1.05E-01	l/kg

Dispersivity

Calculate dependant on distance to compliance point (0), specify dispersivity (1), or calc after Xu & Eckstein (2) ? 2

		Enter value	Calc value Xu & Eckstein	
Longitudinal dispersivity	**ax**		1.06E+01	m
Transverse dispersivity	**az**		1.06E+00	m
Vertical dispersivity	**ay**		1.06E-01	m

For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report ax = $0.83(\log_{10}x)^{2.414}$; 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.

This sheet calculates the Tier3 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

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 Tier 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.

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration
17.6	1.mg/l9
76.0	1.0E-100
111.6	1.1E-101
150.0	1.1E-102
187.6	1.1E-103
225.0	1.1E-104
262.5	1.1E-105
300.0	1.1E-106
337.5	1.1E-107
176.0	1.1E-108
412.6	1.1E-109
450.0	1.1E-110
487.6	1.1E-111
525.0	1.1E-112
562.5	1.1E-113
600.0	1.1E-114
917.6	1.1E-115
876.0	1.1E-116
7126	1.1E-117
760.0	1.2E-118

Site being assessed	Bless 6 B Deerpark K20
Completed by	AJ
Date:	24 11 2005
Version:	12

R&D Publication 20 Remedial Targets Worksheet, Release 2.2a

ENVIRONMENT AGENCY

Tier 3 - Groundwater

Input Parameters (using pull down menu)	Variable	Value	Unit	Source
Contaminant		Propylbenzene		
Target Concentration	C_T	1.00E-03	mg/l	

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

Ogata Banks — Equations in R&D Pub. 20

Enter '1' to simulate vertical dispersion in one direction, '2' for two directions (pull down menu) 1

Enter '1' if biodegradation rate is for the substance in water,
'0' if rate is for decay in field conditions (i.e. field data from aquifer) (pull down menu 0

				Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	9.90E-99	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	7.20E+02	days	
Calculated decay rate	λ	9.63E-04	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	8.00E+01	m	
Plume thickness at source	Sy	5.60E+01	m	
Saturated aquifer thickness	da	5.71E+01	m	
Bulk density of aquifer materials	ρ	1.70E+00	g/cm^3	
Effective porosity of aquifer	n	1.82E-01	fraction	
Hydraulic gradient	i	1.25E-02	fraction	
Hydraulic conductivity of aquifer	K	2.00E+01	m/d	
Distance to compliance point	x	7.50E+02	m	
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	2.14E-01	l/kg	*see options*
Longitudinal dispersivity	ax	10.623	m	*see options*
Transverse dispersivity	az	1.062	m	*see options*
Vertical dispersivity	ay	0.106	m	*see options*

Calculated Parameters	Variable		
Groundwater flow velocity	v	1.37E+00	*m/d*
Retardation factor	Rf	3.00E+00	fraction
Decay rate used	λ	9.63E-04	d^{-1}
Rate of contaminant flow due to retardation	u	4.58E-01	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	1.45E-99	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	1.41E-99	mg/l
Attenuation factor (one way vertical dispersion, C_0/C_{ED})	AF	6.83E+00	
Attenuation factor (two way vertical dispersion, C_0/C_{ED})	AF	7.02E+00	

Remedial Targets

Remedial Target	LTC3	6.83E-03	mg/l

For comparison with measured groundwater concentration.

Ogata Banks

Distance to compliance point		750	m	
Concentration of contaminant at compliance point	$C_{ED}/C0$	1.45E-99	mg/l	Ogata Banks
after		9.9E+99	days	

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

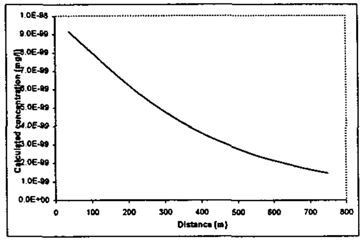
Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd	[redacted]	l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	1.00E+00	fraction
Organic carbon partition coefficient	Koc	2.14E-01	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$	[redacted]	l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Soil water partition coefficient	Kd	2.14E-01	l/kg

Dispersivity

Calculate dependant on distance to compliance point (0), specify dispersivity (1), or calc after Xu & Eckstein (2) ? 2

		Enter value	Calc value Xu & Eckstein	
Longitudinal dispersivity	ax	[redacted]	1.06E+01	m
Transverse dispersivity	az		1.06E+00	m
Vertical dispersivity	ay		1.06E-01	m

For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x.
Xu & Eckstein (1995) report $ax = 0.83(\log_{10}x)^{2.414}$; 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.

This sheet calculates the Tier3 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

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 Tier 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.

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration mg/l
37.6	9.2E-99
76.0	8.5E-99
112.6	7.8E-99
150.0	7.1E-99
225.0	6.0E-99
262.5	5.3E-99
300.0	4.7E-99
U7.6	4.3E-99
376.0	3.SE-W
412.6	3.6E-99
450.0	3.2E-99
487.6	2.9E-99
626.0	2.6E-99
562.5	2.3E-99
600.0	2.1E-99
637.5	1.9E-99
S76.0	1.8E-99
712.6	1.6E-99
760.0	1.4E-99

Site being assessed	Bless 6 B Deerpark K20
Completed by	AJ
Date	24 11 2005
Version	12

R&D Publication20 RemedialTargets Worksheet, Release2.2a

Tier 3 -Groundwater

ENVIRONMENT AGENCY

Input Parameters (using pull down manu)

	Variable	Value	Unit	Source
Contaminant		sec butylbenzene		
Target Concentration	C_T	1.00E-03	mg/l	

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

Ogata Banks — Equations in R&D Pub. 20

Enter '1' to simulate vertical dispersion in one direction, '2' for two directions (pull down menu): 1

Enter '1' if biodegradation rate is for the substance in water,
'0' if rate is for decay in field conditions (i.e. field data from aquifer) (pull down menu): 0

				Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	9.90E-99	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	7.20E+02	days	
Calculated decay rate	λ	9.63E-04	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	8.00E+01	m	
Plume thickness at source	Sy	5.60E+01	m	
Saturated aquifer thickness	da	5.71E+01	m	
Bulk density of aquifer materials	ρ	1.70E+00	g/cm^3	
Effective porosity of aquifer	n	1.82E-01	fraction	
Hydraulic gradient	i	1.25E-02	fraction	
Hydraulic conductivity of aquifer	K	2.00E+01	m/d	
Distance to compliance point	x	7.50E+02	m	
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	2.14E-01	l/kg	*see options*
Longitudinal dispersivity	ax	10.623	m	*see options*
Transverse dispersivity	az	1.062	m	*see options*
Vertical dispersivity	ay	0.106	m	*see options*

Calculated Parameters

	Variable		
Groundwater flow velocity	v	1.37E+00	m/d
Retardation factor	Rf	3.00E+00	fraction
Decay rate used	λ	9.63E-04	d^{-1}
Rate of contaminant flow due to retardation	u	4.58E-01	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	1.45E-99	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	1.41E-99	mg/l
Attenuation factor (one way vertical dispersion, C_0/C_{ED})	AF	6.83E+00	
Attenuation factor (two way vertical dispersion, C_0/C_{ED})	AF	7.02E+00	

Remedial Targets

Remedial Target LTC3 6.83E-03 mg/l — For comparison with measured groundwater concentration.
Ogata Banks

Distance to compliance point		750	m	
Concentration of contaminant at compliance point	$C_{ED}/C0$	1.45E-99	mg/l	Ogata Banks
after		9.9E+99	days	

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

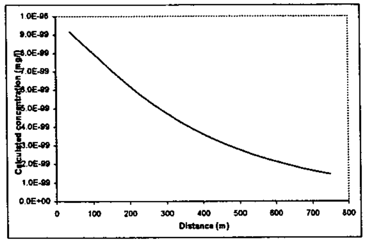
Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd	[redacted]	l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	1.00E+00	fraction
Organic carbon partition coefficient	Koc	2.14E-01	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$	[redacted]	l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Soil water partition coefficient	Kd	2.14E-01	l/kg

Dispersivity

Calculate dependant on distance to compliance point (0), specify dispersivity (1), or calc after Xu & Eckstein (2) ? 2

		Enter value	Calc value Xu & Eckstein	
Longitudinal dispersivity	ax	[redacted]	1.06E+01	m
Transverse dispersivity	az		1.06E+00	m
Vertical dispersivity	ay		1.06E-01	m

For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report ax = $0.83(\log_{10}x)^{2.414}$; 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.

Calculated concentrations for distance-concentration graph

Ogata Banks
From **calculation sheet**

Distance	**Concentration**
	mg/l
37.6	9.2E-99
76.0	8.5E-99
112.5	7.8E-99
160.0	7.1E-99
187.6	6.4E-99
225.0	5.8E-99
262.5	4.7E-99
337.5	4.3E-99
376.0	3.9E-99
412.6	3.5E-99
450.0	3.2E-99
487.6	2.9E-99
626.0	2.6E-99
562.5	2.3E-99
600.0	2.1E-99
037.6	1.9E-99
675.0	1.8E-99
712.6	1.6E-99
750.0	1.4E-99

This sheet calculates the Tier3 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

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 Tier 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.

Site being assessed	Bless 6 B Deerpark K20
Completed by:	AJ
Date:	24 11 2005
Version:	12

R&D Publication 20 Remedial Targets Worksheet, Release 2.2a

Tier 3 - Groundwater

ENVIRONMENT
AGENCY

Input Parameters (using pull down menu)	Variable	Value	Unit	Source
Contaminant Target Concentration	C_T	1.00E-02	mg/l	

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

Ogata Banks — Equations in R&D Pub. 20

Enter '1' to simulate vertical dispersion in one direction, '2' for two directions (pull down menu): 1

Enter '1' if biodegradation rate is for the substance in water,
'0' if rate is for decay in field conditions (i.e. field data from aquifer) (pull down menu): 0

				Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	3.00E+00	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	9.90E+99	days	
Calculated decay rate	λ	7.00E-101	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	8.00E+01	m	
Plume thickness at source	Sy	5.60E+01	m	
Saturated aquifer thickness	da	5.71E+01	m	
Bulk density of aquifer materials	ρ	1.70E+00	g/cm^3	
Effective porosity of aquifer	n	1.82E-01	fraction	
Hydraulic gradient	i	1.25E-02	fraction	
Hydraulic conductivity of aquifer	K	2.00E+01	m/d	
Distance to compliance point	x	7.50E+02	m	
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	9.55E+00	l/kg	*see options*
Longitudinal dispersivity	ax	10.623	m	*see options*
Transverse dispersivity	az	1.062	m	*see options*
Vertical dispersivity	ay	0.106	m	*see options*

Calculated Parameters	Variable		
Groundwater flow velocity	v	1.37E+00	m/d
Retardation factor	Rf	9.02E+01	fraction
Decay rate used	λ	7.00E-101	d^{-1}
Rate of contaminant flow due to retardation	u	1.52E-02	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	2.05E+00	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	2.00E+00	mg/l
Attenuation factor (one way vertical dispersion, C_0/C_{ED})	AF	1.46E+00	
Attenuation factor (two way vertical dispersion, C_0/C_{ED})	AF	1.50E+00	

Remedial Targets

Remedial Target	LTC3	1.46E-02	mg/l	For comparison with measured groundwater concentration.
Ogata Banks				
Distance to compliance point		**750**	**m**	
Concentration of contaminant at compliance point	$C_{ED}/C0$	**2.05E+00**	**mg/l**	Ogata Banks
after		**9.9E+99**	**days**	

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

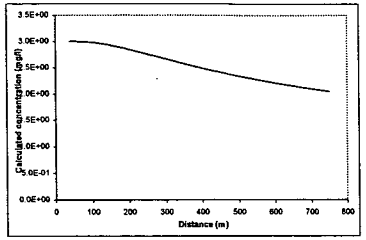
Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd	[redacted]	l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	1.00E+00	fraction
Organic carbon partition coefficient	Koc	9.55E+00	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$	[redacted]	l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Soil water partition coefficient	Kd	9.55E+00	l/kg

Dispersivity

Calculate dependant on distance to compliance point (0), specify dispersivity (1), or calc after Xu & Eckstein (2) ? 2

		Enter value	Calc value Xu & Eckstein	
Longitudinal dispersivity	**ax**	[redacted]	1.06E+01	m
Transverse dispersivity	**az**		1.06E+00	m
Vertical dispersivity	**ay**		1.06E-01	m

For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report ax = 0.83($log_{10}x$)$^{2.414}$; 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.

This sheet calculates the Tier3 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

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 Tier 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.

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration mg/l
17.6	3.0E+00
76.0	3.0E+00
160.0	2.9E+00
187.5	2.9E+00
225.0	2.8E+00
262.5	2.7E+00
300.0	2.7E+00
U7.6	2.6E+00
375.0	2.5E+00
412.5	2.5E+00
450.0	2.4E+00
487.5	2.4E+00
525.0	2.3E+00
562.5	2.3E+00
600.0	2.2E+00
637.5	2.2E+00
076.0	2.1E+00
7116	2.1E+00
760.0	2.1E+00

Site being assessed	Area 6 Deerpark A K20
Completed by:	AJ
Date:	24 11 2005
Version	12

R&D Publication 20 Remedial Targets Worksheet, Release 2.2a

Tier 3 - Groundwater

ENVIRON AGENCY

Input Parameters (using pull down menu)	Variable	Value	Unit	Source
Contaminant		Strontium		
Target Concentration	C_T	1.00E+00	mg/l	

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

Ogata Banks — Equations in R&D Pub. 20

Enter '1 to simulate vertical dispersion in one direction, '2' for two directions (pull down menu)	1
Enter '1' if biodegradation rate is for the substance in water, '0' if rate is for decay in field conditions (i.e. field data from aquifer) (pull down menu	0

	Variable	Value	Unit	Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	2.30E+01	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	9.90E+99	days	
Calculated decay rate	λ	7.00E-101	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	8.00E+01	m	
Plume thickness at source	Sy	5.60E+01	m	
Saturated aquifer thickness	da	5.71E+01	m	
Bulk density of aquifer materials	ρ	1.70E+00	g/cm^3	
Effective porosity of aquifer	n	1.82E-01	fraction	
Hydraulic gradient	i	1.25E-02	fraction	
Hydraulic conductivity of aquifer	K	2.00E+01	m/d	
Distance to compliance point	x	7.50E+02	m	
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	0.00E+00	l/kg	*see options*
Longitudinal dispersivity	ax	10.623	m	*see options*
Transverse dispersivity	az	1.062	m	*see options*
Vertical dispersivity	ay	0.106	m	*see options*

Calculated Parameters	Variable		
Groundwater flow velocity	v	1.37E+00	m/d
Retardation factor	Rf	1.00E+00	fraction
Decay rate used	λ	7.00E-101	d^{-1}
Rate of contaminant flow due to retardation	u	1.37E+00	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	1.57E+01	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	1.53E+01	mg/l
Attenuation factor (one way vertical dispersion, C_0/C_{ED})	AF	1.46E+00	
Attenuation factor (two way vertical dispersion, C_0/C_{ED})	AF	1.50E+00	

Remedial Targets

Remedial Target	LTC3	1.46E+00	mg/l

For comparison with measured groundwater concentration.

Ogata Banks

Distance to compliance point		750	m	
Concentration of contaminant at compliance point	$C_{ED}/C0$	1.57E+01	mg/l	Ogata Banks
after		9.9E+99	days	

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

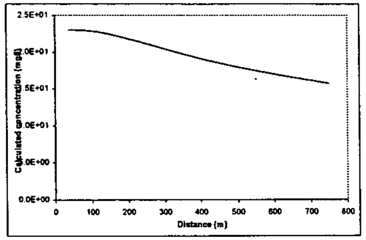
Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd	[redacted]	l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	1.00E+00	fraction
Organic carbon partition coefficient	Koc	0.00E+00	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$	[redacted]	l/kg
Sorption coefficient for ionised species	$K_{oc,i}$	[redacted]	l/kg
pH value	pH	[redacted]	
acid dissociation constant	pKa	[redacted]	
Soil water partition coefficient	Kd	0.00E+00	l/kg

Dispersivity

Calculate dependant on distance to compliance point (0), specify dispersivity (1), or calc after Xu & Eckstein (2) ? — 2

		Enter value	Calc value Xu & Eckstein	
Longitudinal dispersivity	ax	[redacted]	1.06E+01	m
Transverse dispersivity	az	[redacted]	1.06E+00	m
Vertical dispersivity	ay	[redacted]	1.06E-01	m

For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report ax = $0.83(\log_{10}x)^{2.414}$; 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.

This sheet calculates the Tier3 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
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 Tier 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.

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration mg/l
37.6	2.3E+01
76.0	2.3E+01
112.5	2.3E+01
150.0	2.2E+01
187.6	2.2E+01
225.0	2.1E+01
292.6	2.1E+01
300.0	2.0E+01
337.5	2.0E+01
376.0	1.9E+01
412.6	1.9E+01
450.0	1.8E+01
487.6	1.8E+01
525.0	1.8E+01
562.5	1.7E+01
9W.0	1.7E+01
637.5	1.7E+01
976.0	1.6E+01
712.5	1.6E+01
71.0	1.6E+01

Site being assessed:	Area 6 Deerpark A K20
Completed by	AJ
Date.	24 11 2005
Version	12

R&D Publication20 Remedial Targets Worksheet, Release2.2a

Tier 3 - Groundwater

ENVIRONMENT
AGENCY

Input Parameters (using pull down menu)	Variable	Value	Unit	Source
Contaminant		Styrene		
Target Concentration	C_T	5.00E-02	mg/l	

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

Ogata Banks — Equations in R&D Pub. 20

Enter '1' to simulate vertical dispersion in one direction, '2' for two directions (pull down menu): 1

Enter '1' if biodegradation rate is for the substance in water,
'0' if rate is for decay in field conditions (i.e. field data from aquifer) (pull down menu): 0

	Variable	Value	Unit	Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	9.90E-99	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	2.10E+02	days	
Calculated decay rate	λ	3.30E-03	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	8.00E+01	m	
Plume thickness at source	Sy	5.60E+01	m	
Saturated aquifer thickness	da	5.71E+01	m	
Bulk density of aquifer materials	ρ	1.70E+00	g/cm^3	
Effective porosity of aquifer	n	1.82E-01	fraction	
Hydraulic gradient	i	1.25E-02	fraction	
Hydraulic conductivity of aquifer	K	2.00E+01	m/d	
Distance to compliance point	x	7.50E+02	m	
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	4.64E+00	l/kg	*see options*
Longitudinal dispersivity	ax	10.623	m	*see options*
Transverse dispersivity	az	1.062	m	*see options*
Vertical dispersivity	ay	0.106	m	*see options*

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

Calculate for non-polar organic chemicals

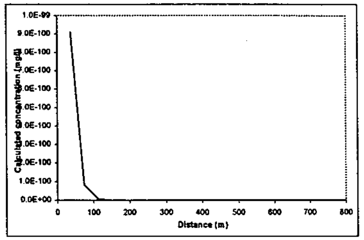
Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd	[redacted]	l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	1.00E+00	fraction
Organic carbon partition coefficient	Koc	4.64E+00	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$	[redacted]	l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Soil water partition coefficient	Kd	4.64E+00	l/kg

Dispersivity

Calculate dependant on distance to compliance point (0), specify dispersivity (1), or calc after Xu & Eckstein (2) ? 2

		Enter value	Calc value Xu & Eckstein	
Longitudinal dispersivity	ax	[redacted]	1.06E+01	m
Transverse dispersivity	az		1.06E+00	m
Vertical dispersivity	ay		1.06E-01	m

For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report ax = 0.83$(\log_{10}x)^{2.414}$; 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.

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration
	mg/l
37.5	9.1E-100
76.0	8.4E-101
112.5	7.7E-102
160.0	7.0E-103
117.6	6.3E-104
225.0	5.6E-105
262.5	5.1E-106
300.0	ICE-107
U7.6	4.1E-108
376.0	3.7E-109
412.5	3.3E-110
450.0	3.0E-111
487.6	2.7E-112
626.0	2.4E-113
562.5	2.2E-114
600.0	2.0E-115
637.5	1.8E-116
876.0	1.6E-117
712.6	1.5E-118
750.0	1.3E-119

This sheet calculates the Tier3 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

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 Tier 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.

Calculated Parameters	Variable		
Groundwater flow velocity	v	1.37E+00	m/d
Retardation factor	Rf	4.43E+01	fraction
Decay rate used	λ	3.30E-03	d^{-1}
Rate of contaminant flow due to retardation	u	3.10E-02	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	1.32E-119	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	1.28E-119	mg/l
Attenuation factor (one way vertical dispersion, C_O/C_{ED})	AF	7.53E+20	
Attenuation factor (two way vertical dispersion, C_O/C_{ED})	AF	7.73E+20	

Remedial Targets

Remedial Target LTC3 3.76E+18 mg/l — For comparison with measured groundwater concentration.
Ogata Banks

Distance to compliance point 750 m

Concentration of contaminant at compliance point $C_{ED}/C0$ 1.32E-119 mg/l Ogata Banks
after 9.9E+99 days

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.

Site being assessed	Bless 6 B Deerpark K20
Completed by	AJ
Date.	24 11 2005
Version:	12

R&D Publication 20 Remedial Targets Worksheet, Release 2.2a

ENVIRONMENT AGENCY

Tier 3 - Groundwater

Input Parameters (using pull down menu)	Variable	Value	Unit	Source
Contaminant		Sulphide		
Target Concentration	C_T	2.50E-04	mg/l	

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

Ogata Banks — Equations in R&D Pub. 20

Enter '1' to simulate vertical dispersion in one direction, '2' for two directions (pull down menu): 1

Enter '1' if biodegradation rate is for the substance in water,
'0' if rate is for decay in field conditions (i.e. field data from aquifer) (pull down menu): 0

				Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	6.20E-01	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	9.90E+99	days	
Calculated decay rate	λ	7.00E-101	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	8.00E+01	m	
Plume thickness at source	Sy	5.60E+01	m	
Saturated aquifer thickness	da	5.71E+01	m	
Bulk density of aquifer materials	ρ	1.70E+00	g/cm^3	
Effective porosity of aquifer	n	1.82E-01	fraction	
Hydraulic gradient	i	1.25E-02	fraction	
Hydraulic conductivity of aquifer	K	2.00E+01	m/d	
Distance to compliance point	x	7.50E+02	m	
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	0.00E+00	l/kg	*see options*
Longitudinal dispersivity	ax	10.623	m	*see options*
Transverse dispersivity	az	1.062	m	*see options*
Vertical dispersivity	ay	0.106	m	*see options*

Calculated Parameters	Variable		
Groundwater flow velocity	v	1.37E+00	m/d
Retardation factor	Rf	1.00E+00	fraction
Decay rate used	λ	7.00E-101	d^{-1}
Rate of contaminant flow due to retardation	u	1.37E+00	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	4.24E-01	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	4.13E-01	mg/l
Attenuation factor (one way vertical dispersion, C_O/C_{ED})	AF	1.46E+00	
Attenuation factor (two way vertical dispersion, C_O/C_{ED})	AF	1.50E+00	

Remedial Targets

Remedial Target	LTC3	3.66E-04	mg/l
Ogata Banks			

For comparison with measured groundwater concentration.

Distance to compliance point		760	m	
Concentration of contaminant at compliance point	$C_{ED}/C0$	4.24E-01	mg/l	Ogata Banks
after		9.9E+99	days	

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

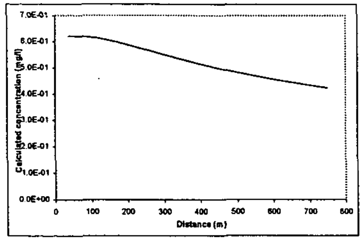
Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd	[redacted]	l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	1.00E+00	fraction
Organic carbon partition coefficient	Koc	0.00E+00	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$	[redacted]	l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Soil water partition coefficient	Kd	0.00E+00	l/kg

Dispersivity

Calculate dependant on distance to compliance point (0), specify dispersivity (1), or calc after Xu & Eckstein (2) ? 2

		Enter value	Calc value Xu & Eckstein	
Longitudinal dispersivity	ax	[redacted]	1.06E+01	m
Transverse dispersivity	az		1.06E+00	m
Vertical dispersivity	ay		1.06E-01	m

For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report ax = $0.83(\log_{10}x)^{2.414}$; 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.

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration
	mg/l
37.5	6.2E-01
76.0	6.2E-01
112.5	6.1E-01
150.0	6.0E-01
167.6	5.9E-01
2226.0	5.8E-01
2S2.6	5.6E-01
300.0	5.5E-01
337.5	5.4E-01
376.0	5.2E-01
412.6	5.1E-01
450.0	5.0E-01
487.6	4.9E-01
525.0	4.8E-01
69226	4.7E-01
8W.0	4.6E-01
837.6	4.5E-01
876.0	4.4E-01
71226	4.3E-01
760.0	4.2E-01

This sheet calculates the Tier3 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

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 Tier 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.

Site being assessed:	Area 6 Deerpark A K20
Completed by:	AJ
Date:	24 11 2005
Version:	12

ENVIRONMENT
AGENCY

R&D Publication20 Remedial Targets Worksheet, Release2.2a

Tier 3 • Groundwater

Input Parameters(using pulldown menu)	Variable	Value	Unit	Source
Contaminant		tert butylbenzne		
Target Concentration	C_T	1.00E-03	mg/l	

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

Ogata Banks — Equations in R&D Pub. 20

Enter '1' to simulate vertical dispersion in one direction, '2' for two directions (pull down menu) 1

Enter '1' if biodegradation rate is for the substance in water,
'0' if rate is for decay in field conditions (i.e. field data from aquifer) (pull down menu 0

	Variable	Value	Unit	Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	9.90E-99	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	9.99E+99	days	
Calculated decay rate	λ	6.94E-101	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	8.00E+01	m	
Plume thickness at source	Sy	5.60E+01	m	
Saturated aquifer thickness	da	5.71E+01	m	
Bulk density of aquifer materials	ρ	1.70E+00	g/cm^3	
Effective porosity of aquifer	n	1.82E-01	fraction	
Hydraulic gradient	i	1.25E-02	fraction	
Hydraulic conductivity of aquifer	K	2.00E+01	m/d	
Distance to compliance point	x	7.50E+02	m	
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	2.14E-01	l/kg	*see options*
Longitudinal dispersivity	ax	10.623	m	*see options*
Transverse dispersivity	az	1.062	m	*see options*
Vertical dispersivity	ay	0.106	m	*see options*

Calculated Parameters	Variable		
Groundwater flow velocity	v	1.37E+00	m/d
Retardation factor	Rf	3.00E+00	fraction
Decay rate used	λ	6.94E-101	d^{-1}
Rate of contaminant flow due to retardation	u	4.58E-01	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	6.77E-99	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	6.59E-99	mg/l
Attenuation factor (one way vertical dispersion, C_0/C_{ED})	AF	1.46E+00	
Attenuation factor (two way vertical dispersion, C_0/C_{ED})	AF	1.50E+00	

Remedial Targets

Remedial Target LTC3 1.46E-03 mg/l For comparison with measured groundwater concentration.
Ogata Banks

Distance to compliance point 750 m

Concentration of contaminant at compliance point $C_{ED}/C0$ 6.77E-99 mg/l Ogata Banks
after 9.9E+99 days

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 pulldown menu)

Calculate for non-polar organic chemicals

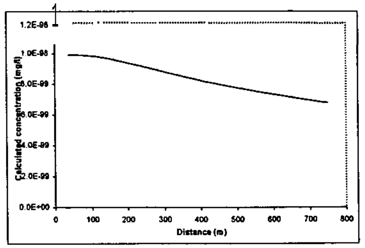
Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd	[redacted]	l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	1.00E+00	fraction
Organic carbon partition coefficient	Koc	2.14E-01	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$	[redacted]	l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Soil water partition coefficient	Kd	2.14E-01	l/kg

Dispersivity

Calculate dependant on distance to compliance point (0), specify dispersivity (1), or calc after Xu & Eckstein (2) ? 2

		Enter value	Calc value Xu & Eckstein	
Longitudinal dispersivity	ax	[redacted]	1.06E+01	m
Transverse dispersivity	az		1.06E+00	m
Vertical dispersivity	ay		1.06E-01	m

For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report ax = $0.83(\log_{10}x)^{2.414}$; 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.

This sheet calculates the Tier3 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

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 Tier 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.

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration
37.6	9.9E-99
76.0	9.9E-99
112.6	9.8E-99
160.0	9.7E-99
187.6	9.5E-99
225.0	9.2E-99
262.5	9.0E-99
300.0	8.8E-99
337.6	I.EE-99
376.0	8.4E-99
412.5	8.2E-99
450.0	8.0E-99
487.5	7.8E-99
525.0	7.6E-99
562.5	7.5E-99
600.0	7.3E-99
637.5	7.2E-99
576.0	7.0E-99
7126	6.9E-99
760.0	6.8E-99

Site being assessed	Bless 6 B Deerpark K20
Completed by	AJ
Date	24 11 2005
Version	12

R&D Publication 20 Remedial Targets Worksheet, Release 2.2a

Tier 3 -Groundwater

ENVIRONMENT AGENCY

Input Parameters (using pull down menu)	Variable	Value	Unit	Source
Contaminant		Total Cyanide		
Target Concentration	C_T	1.00E-02	mg/l	

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

Ogata Banks — Equations in R&D Pub. 20

Enter '1' to simulate vertical dispersion in one direction, '2' for two directions (pull down menu) — 1

Enter '1' if biodegradation rate is for the substance in water,
'0' if rate is for decay in field conditions (i.e. field data from aquifer) (pull down menu) — 0

	Variable	Value	Unit	Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	6.40E+01	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	2.92E+01	days	
Calculated decay rate	λ	2.38E-02	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	8.00E+01	m	
Plume thickness at source	Sy	5.60E+01	m	
Saturated aquifer thickness	da	5.71E+01	m	
Bulk density of aquifer materials	ρ	1.70E+00	g/cm^3	
Effective porosity of aquifer	n	1.82E-01	fraction	
Hydraulic gradient	i	1.25E-02	fraction	
Hydraulic conductivity of aquifer	K	2.00E+01	m/d	
Distance to compliance point	x	7.50E+02	m	
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	9.90E+00	l/kg	*see options*
Longitudinal dispersivity	ax	10.623	m	*see options*
Transverse dispersivity	az	1.062	m	*see options*
Vertical dispersivity	ay	0.106	m	*see options*

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

Calculate for non-polar organic chemicals

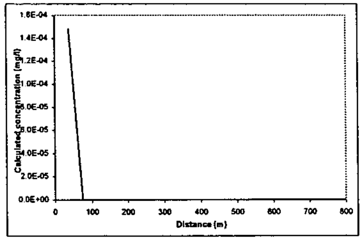
Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd	[redacted]	l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	1.00E+00	fraction
Organic carbon partition coefficient	Koc	9.90E+00	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$	[redacted]	l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Soil water partition coefficient	Kd	9.90E+00	l/kg

Dispersivity

Calculate dependant on distance to compliance point (0), specify dispersivity (1), or calc after Xu & Eckstein (2) ? — 2

		Enter value	Calc value Xu & Eckstein	
Longitudinal dispersivity	ax	[redacted]	1.06E+01	m
Transverse dispersivity	az		1.06E+00	m
Vertical dispersivity	ay		1.06E-01	m

For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report ax = 0.83$(\log_{10}x)^{2.414}$; az = ax/10, ay = ax/100 are assumed



Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration mg/l
17.6	1.5E-04
76.0	3.4E-10
112.6	7.9E-16
150.0	1.8E-21
187.5	4.1E-27
225.0	9.4E-33
262.5	2.1E-38
300.0	4.8E-44
337.5	1.1E-49
376.0	2.5E-55
412.6	5.6E-61
450.0	1.3E-66
467.6	2.9E-72
525.0	6.6E-78
562.5	1.5E-83
600.0	3.4E-89
037.6	7.7E-95
076.0	1.8E-100
712.6	4.0E-106
760.0	9.2E-112

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.

This sheet calculates the Tier3 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

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 Tier 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.

Calculated Parameters	Variable		
Groundwater flow velocity	v	1.37E+00	m/d
Retardation factor	Rf	9.35E+01	fraction
Decay rate used	λ	2.38E-02	d^{-1}
Rate of contaminant flow due to retardation	u	1.47E-02	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	9.17E-112	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	8.93E-112	mg/l
Attenuation factor (one way vertical dispersion, C_O/C_{ED})	AF	6.98E+112	
Attenuation factor (two way vertical dispersion, C_O/C_{ED})	AF	7.17E+112	

Site being assessed	Area 6 Deerpark A K20
Completed by.	AJ
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Remedial Targets

Remedial Target	**LTC3**	**6.98E+110**	**mg/l**	For comparison with measured groundwater concentration.
Ogata Banks				
Distance to compliance point		**760**	**m**	
Concentration of contaminant at compliance point	$C_{ED}/C0$	**9.17E-112**	**mg/l**	Ogata Banks
after		**9.9E+99**	**days**	

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.

R&D Publication20 Remedial Targets Worksheet, Release 2.2a

ENVIRONMENT AGENCY

Tier 3 -Groundwater

Input Parameter. (using pull down menu)	Variable	Value	Unit	Source
Contaminant		Zinc		
Target Concentration	C_T	1.00E-01	mg/l	

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

Ogata Banks — Equations in R&D Pub. 20

Enter '1' to simulate vertical dispersion in one direction, '2' for two directions (pull down menu) 1

Enter '1' if biodegradation rate is for the substance in water,
'0' if rate is for decay in field conditions (i.e. field data from aquifer) (pull down menu 0

	Variable	Value	Unit	Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	1.47E-01	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	9.90E+99	days	
Calculated decay rate	λ	7.00E-101	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	8.00E+01	m	
Plume thickness at source	Sy	5.60E+01	m	
Saturated aquifer thickness	da	5.71E+01	m	
Bulk density of aquifer materials	ρ	1.70E+00	g/cm^3	
Effective porosity of aquifer	n	1.82E-01	fraction	
Hydraulic gradient	i	1.25E-02	fraction	
Hydraulic conductivity of aquifer	K	2.00E+01	m/d	
Distance to compliance point	x	7.50E+02	m	
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	0.00E+00	l/kg	*see options*
Longitudinal dispersivity	ax	10.623	m	*see options*
Transverse dispersivity	az	1.062	m	*see options*
Vertical dispersivity	ay	0.106	m	*see options*

Calculated Parameters	Variable		
Groundwater flow velocity	v	1.37E+00	m/d
Retardation factor	Rf	1.00E+00	fraction
Decay rate used	λ	7.00E-101	d^{-1}
Rate of contaminant flow due to retardation	u	1.37E+00	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	1.00E-01	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	9.78E-02	mg/l
Attenuation factor (one way vertical dispersion, C_0/C_{ED})	AF	1.46E+00	
Attenuation factor (two way vertical dispersion, C_0/C_{ED})	AF	1.50E+00	

Remedial Targets

Remedial Target	LTC3	1.46E-01	mg/l	For comparison with measured groundwater concentration.
Ogata Banks				
Distance to compliance point		750	m	
Concentration of contaminant at compliance point	$C_{ED}/C0$	1.00E-01	mg/l	Ogata Banks
after		9.9E+99	days	

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

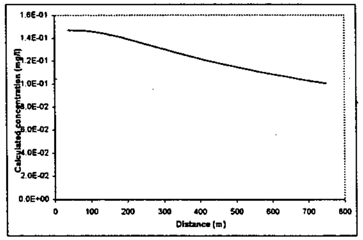
Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd	[redacted]	l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	1.00E+00	fraction
Organic carbon partition coefficient	Koc	0.00E+00	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$	[redacted]	l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Soil water partition coefficient	Kd	0.00E+00	l/kg

Dispersivity

Calculate dependant on distance to compliance point (0), specify dispersivity (1), or calc after Xu & Eckstein (2) ? 2

		Enter value	Calc value Xu & Eckstein	
Longitudinal dispersivity	ax	[redacted]	1.06E+01	m
Transverse dispersivity	az		1.06E+00	m
Vertical dispersivity	ay		1.06E-01	m

For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report ax = $0.83(\log_{10}x)^{2.414}$; 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.

This sheet calculates the Tier3 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

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 Tier 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.

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration mg/l
37.5	1.5E-01
76.0	1.5E-01
112.6	1.5E-01
160.0	1.4E-01
187.5	1.4E-01
225.0	1.4E-01
262.5	1.3E-01
300.0	1.3E-01
337.5	1.3E-01
176.0	1.2E-01
412.6	1.2E-01
450.0	1.2E-01
487.5	1.2E-01
626.0	1.1E-01
562.5	l.lE-M
600.0	1.1E-01
637.5	1.1E-01
876.0	1.0E-01
712.6	1.0E-01
760.0	1.0E-01

Site being assessed	Area 6 Deerpark A K20
Completed by	AJ
Date.	24 11 2005
Version	12

R&D Publication 20 Remedial Targets Worksheet, Release 2.2a

Tier 3 - Groundwater

ENVIRONMENT AGENCY

Input Parameters (using pull down menu)	Variable	Value	Unit	Source
Contaminant		1 2 4 trimethylbenzene		
Target Concentration	C_T	1.00E-02	mg/l	

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

Ogata Banks — Equations in R&D Pub. 20

Enter '1' to simulate vertical dispersion in one direction, '2' for two directions (pull down menu): 1

Enter '1' if biodegradation rate is for the substance in water,
'0' if rate is for decay in field conditions (i.e. field data from aquifer) (pull down menu): 0

	Variable	Value	Unit	Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	3.00E-03	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	3.60E+02	days	
Calculated decay rate	λ	1.93E-03	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	8.00E+01	m	
Plume thickness at source	Sy	5.60E+01	m	
Saturated aquifer thickness	da	5.71E+01	m	
Bulk density of aquifer materials	ρ	1.70E+00	g/cm^3	
Effective porosity of aquifer	n	1.82E-01	fraction	
Hydraulic gradient	i	1.25E-02	fraction	
Hydraulic conductivity of aquifer	K	2.00E+01	m/d	
Distance to compliance point	x	7.50E+02	m	
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	2.95E+01	l/kg	*see options*
Longitudinal dispersivity	ax	10.623	m	*see options*
Transverse dispersivity	az	1.062	m	*see options*
Vertical dispersivity	ay	0.106	m	*see options*

Calculated Parameters	Variable		
Groundwater flow velocity	v	1.37E+00	m/d
Retardation factor	Rf	2.77E+02	fraction
Decay rate used	λ	1.93E-03	d^{-1}
Rate of contaminant flow due to retardation	u	4.97E-03	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	3.58E-52	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	3.49E-52	mg/l
Attenuation factor (one way vertical dispersion, C_0/C_{ED})	AF	8.37E+48	
Attenuation factor (two way vertical dispersion, C_0/C_{ED})	AF	8.60E+48	

Remedial Targets

Remedial Target	LTC3	8.37E+48	mg/l	For comparison with measured groundwater concentration.

Ogata Banks

Distance to compliance point		750	m	
Concentration of contaminant at compliance point	$C_{ED}/C0$	3.58E-52	mg/l	Ogata Banks
after		9.9E+99	days	

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

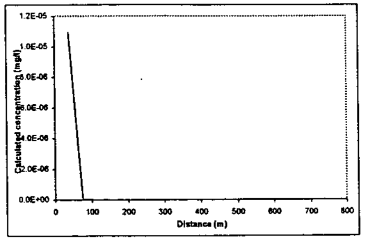
Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd		l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	1.00E+00	fraction
Organic carbon partition coefficient	Koc	2.95E+01	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$		l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Soil water partition coefficient	Kd	2.95E+01	l/kg

Dispersivity

Calculate dependant on distance to compliance point (0), specify dispersivity (1), or calc after Xu & Eckstein (2) ? 2

		Enter value	Calc value Xu & Eckstein	
Longitudinal dispersivity	ax		1.06E+01	m
Transverse dispersivity	az		1.06E+00	m
Vertical dispersivity	ay		1.06E-01	m

For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report ax = $0.83(\log_{10}x)^{2.414}$; 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.

This sheet calculates the Tier3 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

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 Tier 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.

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration
	mg/l
31.6	1.1E-05
75.0	4.0E-08
112.6	1.4E-10
150.0	5.9E-18
225.0	6.6E-18
262.5	2.3E-20
300.0	8.8E-28
316.0	1.1E-27
412.6	3.8E-30
450.0	1.3E-32
487.5	4.8E-35
626.0	1.7E-37
562.5	6.1E-40
600.0	2.2E-42
637.5	7.8E-45
016.0	2.8E-47
712.5	1.0E-49
750.0	3.6E-52

Site being assessed	Bless 6 B Deerpark K20
Completed by	AJ
Date.	24 11 2005
Version:	12

R&D Publication20 RemedialTargets Worksheet, Release 2.2a

ENVIRONMENT AGENCY

Tier 3 - Groundwater

Input Parameters(using pulldown menu)	Variable	Value	unit	Source
Contaminant		1 3 5 trimethylbenzene		
Target Concentration	C_T	1.00E-02	mg/l	

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

Ogata Banks — Equations in R&D Pub. 20

Enter '1' to simulate vertical dispersion in one direction, '2' for two directions (pull down menu) — 1

Enter '1' if biodegradation rate is for the substance in water,
'0' if rate is for decay in field conditions (i.e. field data from aquifer) (pull down menu) — 0

				Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	1.00E-03	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	3.60E+02	days	
Calculated decay rate	λ	1.93E-03	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	8.00E+01	m	
Plume thickness at source	Sy	5.60E+01	m	
Saturated aquifer thickness	da	5.71E+01	m	
Bulk density of aquifer materials	ρ	1.70E+00	g/cm^3	
Effective porosity of aquifer	n	1.82E-01	fraction	
Hydraulic gradient	i	1.25E-02	fraction	
Hydraulic conductivity of aquifer	K	2.00E+01	m/d	
Distance to compliance point	x	7.50E+02	m	
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	2.95E+01	l/kg	*see options*
Longitudinal dispersivity	ax	10.623	m	*see options*
Transverse dispersivity	az	1.062	m	*see options*
Vertical dispersivity	ay	0.106	m	*see options*

Calculated Parameters	Variable		
Groundwater flow velocity	v	1.37E+00	m/d
Retardation factor	Rf	2.77E+02	fraction
Decay rate used	λ	1.93E-03	d^{-1}
Rate of contaminant flow due to retardation	u	4.97E-03	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	1.19E-52	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	1.16E-52	mg/l
Attenuation factor (one way vertical dispersion, C_0/C_{ED})	AF	8.37E+48	
Attenuation factor (two way vertical dispersion, C_0/C_{ED})	AF	8.60E+48	

Remedial Targets

Remedial Target	LTC3	8.37E+48	mg/l	For comparison with measured groundwater concentration.
Ogata Banks				
Distance to compliance point		**750**	**m**	
Concentration of contaminant at compliance point	$C_{ED}/C0$	**1.19E-52**	**mg/l**	Ogata Banks
after		**9.9E+99**	**days**	

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

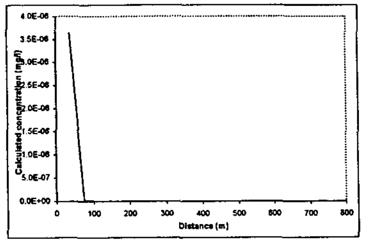
Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd		l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	1.00E+00	fraction
Organic carbon partition coefficient	Koc	2.95E+01	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$		l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Soil water partition coefficient	Kd	2.95E+01	l/kg

Dispersivity

Calculate dependant on distance to compliance point (0), specify dispersivity (1), or calc after Xu & Eckstein (2) ? — 2

		Enter value	Calc value Xu & Eckstein	
Longitudinal dispersivity	ax		1.06E+01	m
Transverse dispersivity	az		1.06E+00	m
Vertical dispersivity	ay		1.06E-01	m

For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report ax = $0.83(\log_{10}x)^{2.414}$; 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.

Calculated concentrations for *distance-concentration graph*

Ogata Banks
From calculation sheet

Distance	Concentration
	mg/l
11.6	3.6E-06
16.0	1.3E-08
112.6	4.8E-11
150.0	1.7E-13
187.5	6.2E-16
225.0	2.2E-18
262.5	7.8E-21
300.0	2.8E-23
337.5	9.9E-26
176.0	3.5E-28
412.6	1.3E-30
450.0	4.5E-33
481.6	1.6E-35
562.5	
	8.0E-38
600.0	7.3E-43
017.6	2.6E-45
675.0	9.3E-48
112.6	3.3E-50
160.0	1.2E-52

This sheet calculates the Tier3 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

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 Tier 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.

Site being assessed	Bless 6 B Deerpark K20
Completed by:	AJ
Date:	24 11 2005
Version:	12

R&D Publication20 Remedial Targets Worksheet, Release 2.2a

Tier 3 - Groundwater

ENVIRONMENT AGENCY

Input Parameters (using pull down menu)

Input Parameters (using pull down menu)	Variable	Value	Unit	Source
Contaminant		1 4 Dichlorobenzene		
Target Concentration	C_T	1.00E-02	mg/l	

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

Ogata Banks — Equations in R&D Pub. 20

Enter '1' to simulate vertical dispersion in one direction, '2' for two directions (pull down menu): 1

Enter '1' if biodegradation rate is for the substance in water,
'0' if rate is for decay in field conditions (i.e. field data from aquifer) (pull down menu): 0

	Variable	Value	Unit	Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	9.90E-99	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	3.60E+02	days	
Calculated decay rate	λ	1.93E-03	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	8.00E+01	m	
Plume thickness at source	Sy	5.60E+01	m	
Saturated aquifer thickness	da	5.71E+01	m	
Bulk density of aquifer materials	ρ	1.70E+00	g/cm^3	
Effective porosity of aquifer	n	1.82E-01	fraction	
Hydraulic gradient	i	1.25E-02	fraction	
Hydraulic conductivity of aquifer	K	2.00E+01	m/d	
Distance to compliance point	x	7.50E+02	m	
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	7.76E+00	l/kg	*see options*
Longitudinal dispersivity	*ax*	*10.623*	*m*	*see options*
Transverse dispersivity	az	1.062	m	*see options*
Vertical dispersivity	ay	0.106	m	*see options*

Calculated Parameters

Calculated Parameters	Variable		
Groundwater flow velocity	v	1.37E+00	m/d
Retardation factor	Rf	7.35E+01	fraction
Decay rate used	λ	1.93E-03	d^{-1}
Rate of contaminant flow due to retardation	u	1.87E-02	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	4.08E-119	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	3.97E-119	mg/l
Attenuation factor (one way vertical dispersion, C_0/C_{ED})	AF	2.43E+20	
Attenuation factor (two way vertical dispersion, C_0/C_{ED})	*AF*	*2.49E+20*	

Remedial Targets

Remedial Target	LTC3	2.43E+18	mg/l	For comparison with measured groundwater concentration.
Ogata Banks				
Distance to compliance point		**750**	**m**	
Concentration of contaminant at compliance point	$C_{ED}/C0$	**4.08E-119**	**mg/l**	Ogata Banks
after		**9.9E+99**	**days**	

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

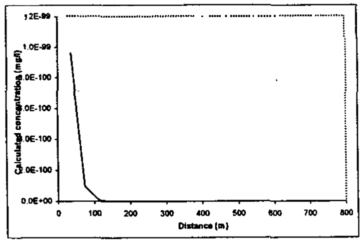
Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd		l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	1.00E+00	*fraction*
Organic carbon partition coefficient	Koc	7.76E+00	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$		l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Soil water partition coefficient	Kd	7.76E+00	l/kg

Dispersivity

Calculate dependant on distance to compliance point (0), specify dispersivity (1), or calc after Xu & Eckstein (2) ? 2

		Enter value	Calc value Xu & Eckstein	
Longitudinal dispersivity	ax		1.06E+01	m
Transverse dispersivity	az		1.06E+00	m
Vertical dispersivity	ay		1.06E-01	m

For calculated value, assumes ax = 0.1 * x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report ax = $0.83(\log_{10}x)^{2.414}$; 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.

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration mg/l
37.6	9.7E-100
76.0	9.4E-101
112.6	9.1E-102
150.0	8.7E-103
187.5	8.3E-104
225.0	7.9E-105
262.5	7.5E-106
300.0	7.2E-107
337.5	6.8E-108
376.0	6.5E-109
412.5	6.2E-110
450.0	5.9E-111
467.6	5.6E-112
525.0	5.3E-113
562.5	5.1E-114
600.0	4.9E-115
037.6	4.7E-116
076.0	4.4E-117
7126	4.3E-118
750.0	4.1E-119

This sheet calculates the Tier3 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

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 Tier 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

Site being assessed	Bless 6 S Deerpark K20
Completed by	AJ
Date.	24 11 2005
Version	12

R&D Publication 20 Remedial Targets Worksheet, Release 2.2a

Tier 3 - Groundwater

ENVIRONMENT
AGENCY

Input Parameters (using pull down menu)	Variable	Value	Unit	Source
Contaminant		Aliphatic C8-C10		
Target Concentration	C_T	7.14E-04	mg/l	

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

Ogata Banks — Equations in R&D Pub. 20

Enter '1' to simulate vertical dispersion in one direction, '2' for two directions (pull down menu): 1

Enter '1' if biodegradation rate is for the substance in water,
'0' if rate is for decay in field conditions (i.e. field data from aquifer) (pull down menu): 0

	Variable	Value	Unit	Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	2.12E-02	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	1.83E+03	days	
Calculated decay rate	λ	3.80E-04	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	8.00E+01	m	
Plume thickness at source	Sy	5.60E+01	m	
Saturated aquifer thickness	da	5.71E+01	m	
Bulk density of aquifer materials	ρ	1.70E+00	g/cm^3	
Effective porosity of aquifer	n	1.82E-01	fraction	
Hydraulic gradient	i	1.25E-02	fraction	
Hydraulic conductivity of aquifer	K	2.00E+01	m/d	
Distance to compliance point	x	7.50E+02	m	
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	1.15E+02	l/kg	*see options*
Longitudinal dispersivity	ax	10.623	m	*see options*
Transverse dispersivity	az	1.062	m	*see options*
Vertical dispersivity	ay	0.106	m	*see options*

Calculated Parameters	Variable		
Groundwater flow velocity	v	1.37E+00	m/d
Retardation factor	Rf	1.07E+03	fraction
Decay rate used	λ	3.80E-04	d^{-1}
Rate of contaminant flow due to retardation	u	1.28E-03	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	8.60E-44	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	8.37E-44	mg/l
Attenuation factor (one way vertical dispersion, C_0/C_{ED})	AF	2.47E+41	
Attenuation factor (two way vertical dispersion, C_0/C_{ED})	AF	2.53E+41	

Remedial Targets

Remedial Target	LTC3	1.76E+38	mg/l

For comparison with measured groundwater concentration.

Ogata Banks

Distance to compliance point 750 m

Concentration of contaminant at compliance point $C_{ED}/C0$ **8.60E-44** **mg/l** Ogata Banks
after **9.9E+99** **days**

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

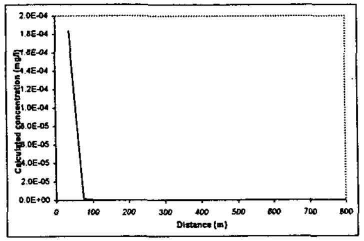
Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd		l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	1.00E+00	fraction
Organic carbon partition coefficient	Koc	1.15E+02	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$		l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Soil water partition coefficient	Kd	1.15E+02	l/kg

Dispersivity

Calculate dependant on distance to compliance point (0), specify dispersivity (1), or calc after Xu & Eckstein (2) ? 2

		Enter value	Calc value Xu & Eckstein	
Longitudinal dispersivity	**ax**		1.06E+01	m
Transverse dispersivity	**az**		1.06E+00	m
Vertical dispersivity	**ay**		1.06E-01	m

For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report ax = 0.83(log$_{10}$x)$^{2.414}$; 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.

This sheet calculates the Tier3 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

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 Tier 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.

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration
	mg/l
37.5	1.8E-04
75.0	1.6E-06
112.5	1.4E-08
150.0	1.2E-10
187.5	1.0E-12
225.0	8.5E-15
262.5	7.2E-17
300.0	6.1E-19
337.5	5.1E-21
176.0	4.4E-23
4126	3.7E-25
450.0	3.1E-27
487.5	2.7E-29
626.0	2.3E-31
562.5	1.9E-33
600.0	1.6E-35
637.5	1.4E-37
675.0	1.2E-39
712.6	1.0E-41
750.0	8.6E-44

Site being assessed	Area 6 Deerpark A K20
Completed by.	AJ
Date:	24 11 2005
Version	12

R&D Publication 20 Remedial Targets Worksheet, Release 2.2a

Tier 3 - Groundwater

ENVIRONMENT AGENCY

Input Parameters (using pull down manu)	**Variable**	**Value**	**Unit**	**Source**
Contaminant		Aliphatic C10-C12		
Target Concentration	C_T	7.14E-04	mg/l	

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

Ogata Banks — Equations in R&D Pub. 20

Enter '1 to simulate vertical dispersion in one direction, '2' for two directions (pull down menu): 1

Enter '1' if biodegradation rate is for the substance in water,
'0' if rate is for decay in field conditions (i.e. field data from aquifer) (pull down menu): 0

				Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	2.12E-02	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	1.83E+03	days	
Calculated decay rate	λ	3.80E-04	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	8.00E+01	m	
Plume thickness at source	Sy	5.60E+01	m	
Saturated aquifer thickness	da	5.71E+01	m	
Bulk density of aquifer materials	ρ	1.70E+00	g/cm^3	
Effective porosity of aquifer	n	1.82E-01	fraction	
Hydraulic gradient	i	1.25E-02	fraction	
Hydraulic conductivity of aquifer	K	2.00E+01	m/d	
Distance to compliance point	x	7.50E+02	m	
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	9.12E+02	l/kg	*see options*
Longitudinal dispersivity	ax	10.623	m	*see options*
Transverse dispersivity	az	1.062	m	*see options*
Vertical dispersivity	ay	0.106	m	*see options*

Calculated Parameters	**Variable**		
Groundwater flow velocity	v	1.37E+00	m/d
Retardation factor	Rf	8.52E+03	fraction
Decay rate used	λ	3.80E-04	d^{-1}
Rate of contaminant flow due to retardation	u	1.61E-04	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	2.27E-141	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	2.21E-141	mg/l
Attenuation factor (one way vertical dispersion, C_0/C_{ED})	AF	9.32E+138	
Attenuation factor (two way vertical dispersion, C_0/C_{ED})	AF	9.57E+138	

Remedial Targets

Remedial Target	LTCS	6.65E+135	mg/l	For comparison with measured groundwater concentration.
Ogata Banks				
Distance to compliance point		**750**	**m**	
Concentration of contaminant at compliance point	$C_{ED}/C0$	**2.27E-141**	**mg/l**	Ogata Banks
after		**9.9E+99**	**days**	

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

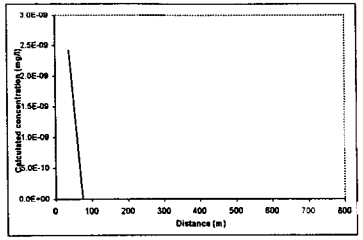
Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd	[redacted]	l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	1.00E+00	fraction
Organic carbon partition coefficient	Koc	9.12E+02	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$	[redacted]	l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Soil water partition coefficient	Kd	9.12E+02	l/kg

Dispersivity

Calculate dependant on distance to compliance point (0), specify dispersivity (1), or calc after Xu & Eckstein (2) ? 2

		Enter value	Calc value Xu & Eckstein	
Longitudinal dispersivity	ax	[redacted]	1.06E+01	m
Transverse dispersivity	az		1.06E+00	m
Vertical dispersivity	ay		1.06E-01	m

For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report ax = $0.83(\log_{10}x)^{2.414}$; 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.

This sheet calculates the Tier3 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

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 Tier 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.

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	**Concentration**
	mg/l
17.6	2.4E-09
76.0	2.8E-16
112.5	3.2E-23
150.0	3.6E-30
187.5	4.0E-37
225.0	4.5E-44
262.5	5.1E-51
300.0	5.7E-58
337.5	6.3E-65
375.0	7.1E-72
412.6	7.9E-79
450.0	8.9E-86
487.6	1.0E-92
626.0	1.1E-99
562.5	1.3E-106
600.0	1.4E-113
637.5	1.6E-120
675.0	1.8E-127
712.5	2.0E-134
750.0	2.3E-141

Site being assessed.	Area 6 Deerpark A K20
Completed by:	AJ
Date.	24 11 2005
Version	12

R&D Publication20 Remedial Targets Worksheet, Release 2.2a

Tier 3 -Groundwater

ENVIRONMENT AGENCY

Input Parameters (using pull down menu)	Variable	Value	Unit	Source
Contaminant		Aliphatic C12-C16		
Target Concentration	C_T	7.14E-04	mg/l	

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

Ogata Banks — Equations in R&D Pub. 20

Enter I to simulate vertical dispersion in one direction, '2' for two directions (pull down menu): 1

Enter '1' if biodegradation rate is for the substance in water,
'0' if rate is for decay in field conditions (i.e. field data from aquifer) (pull down menu: 0

	Variable	Value	Unit	Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	2.12E-02	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	1.83E+03	days	
Calculated decay rate	λ	3.80E-04	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	8.00E+01	m	
Plume thickness at source	Sy	5.60E+01	m	
Saturated aquifer thickness	da	5.71E+01	m	
Bulk density of aquifer materials	ρ	1.70E+00	g/cm^3	
Effective porosity of aquifer	n	1.82E-01	fraction	
Hydraulic gradient	i	1.25E-02	fraction	
Hydraulic conductivity of aquifer	K	2.00E+01	m/d	
Distance to compliance point	x	7.50E+02	m	
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	1.82E+04	l/kg	*see options*
Longitudinal dispersivity	ax	10.623	m	*see options*
Transverse dispersivity	az	1.062	m	*see options*
Vertical dispersivity	ay	0.106	m	*see options*

Calculated Parameters	Variable		
Groundwater flow velocity	v	1.37E+00	m/d
Retardation factor	Rf	1.70E+05	fraction
Decay rate used	λ	3.80E-04	d^{-1}
Rate of contaminant flow due to retardation	u	8.08E-06	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	#NUM!	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	#NUM!	mg/l
Attenuation factor (one way vertical dispersion, C_O/C_{ED})	AF	#NUM!	
Attenuation factor (two way vertical dispersion, C_O/C_{ED})	AF	#NUM!	

Remedial Targets

Remedial Target LTC3 #NUM! mg/l For comparison with measured groundwater concentration.

Ogata Banks

Distance to compliance point 750 m

Concentration of contaminant at compliance point $C_{ED}/C0$ #NUM! mg/l Ogata Banks
after 9.9E+99 days

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

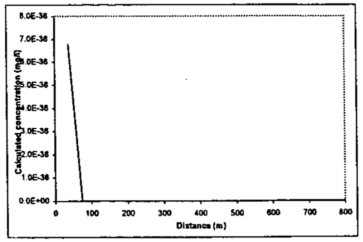
Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd	[redacted]	l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	1.00E+00	fraction
Organic carbon partition coefficient	Koc	1.82E+04	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$	[redacted]	l/kg
Sorption coefficient for ionised species	$K_{oc,i}$	[redacted]	l/kg
pH value	pH	[redacted]	
acid dissociation constant	pKa	[redacted]	
Soil water partition coefficient	Kd	1.82E+04	l/kg

Dispersivity

Calculate dependant on distance to compliance point (0), specify dispersivity (1), or calc after Xu & Eckstein (2) ? 2

		Enter value	Calc value Xu & Eckstein	
Longitudinal dispersivity	ax	[redacted]	1.06E+01	m
Transverse dispersivity	az	[redacted]	1.06E+00	m
Vertical dispersivity	ay	[redacted]	1.06E-01	m

For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report $ax = 0.83(\log_{10}x)^{2.414}$; 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.

Calculated concentrations for distance-concentration graph

Ogata Banks

Distance	Concentration mg/l
17.6	6.8E-36
76.0	2.2E-69
112.5	6.9E-103
150.0	2.2E-136
225.0	2.1E-203
262.5	6.7E-237
300.0	2.1E-270
337.5	#NUM!
375.0	#NUM!
412.5	#NUM!
450.0	#NUM!
487.6	#NUM!
525.0	#NUM!
562.5	#NUM!
600.0	#NUM!
637.5	#NUM!
712.5	#NUM!
750.0	#NUM!

This sheet calculates the Tier3 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 Tier 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.

Site being assessed.	Area 6 Deerpark A K20
Completed by	AJ
Date:	24 11 2005
Version	12

R&D Publication 20 Remedial Targets Worksheet, Release 2.2a

Tier 3 - Groundwater

ENVIRONMENT AGENCY

Input Parameters (using pull down menu)	Variable	Value	Unit	Source
Contaminant		Aliphatic C16-C21		
Target Concentration	C_T	7.14E-04	mg/l	

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

Ogata Banks | Equations in R&D Pub. 20

Enter '1' to simulate vertical dispersion in one direction, '2' for two directions (pull down menu) 1

Enter '1' if biodegradation rate is for the substance in water,
'0' if rate is for decay in field conditions (i.e. field data from aquifer) (pull down menu 0

	Variable	Value	Unit	Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	2.12E-02	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	3.65E+03	days	
Calculated decay rate	λ	1.90E-04	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	8.00E+01	m	
Plume thickness at source	Sy	5.60E+01	m	
Saturated aquifer thickness	da	5.71E+01	m	
Bulk density of aquifer materials	ρ	1.70E+00	g/cm^3	
Effective porosity of aquifer	n	1.82E-01	fraction	
Hydraulic gradient	i	1.25E-02	fraction	
Hydraulic conductivity of aquifer	K	2.00E+01	m/d	
Distance to compliance point	x	7.50E+02	m	
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	2.29E+06	l/kg	*see options*
Longitudinal dispersivity	ax	10.623	m	*see options*
Transverse dispersivity	az	1.062	m	*see options*
Vertical dispersivity	ay	0.106	m	*see options*

Calculated Parameters	Variable		
Groundwater flow velocity	v	1.37E+00	m/d
Retardation factor	Rf	2.14E+07	fraction
Decay rate used	λ	1.90E-04	d^{-1}
Rate of contaminant flow due to retardation	u	6.42E-08	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	#NUM!	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	#NUM!	mg/l
Attenuation factor (one way vertical dispersion, C_0/C_{ED})	AF	#NUM!	
Attenuation factor (two way vertical dispersion, C_0/C_{ED})	AF	#NUM!	

Remedial Targets

Remedial Target LTC3 #NUM! mg/l For comparison with measured groundwater concentration.
Ogata Banks

Distance to compliance point		**750**	**m**	
Concentration of contaminant at compliance point	**$C_{ED}/C0$**	**#NUM!**	**mg/l**	Ogata Banks
after		**9.9E+99**	**days**	

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

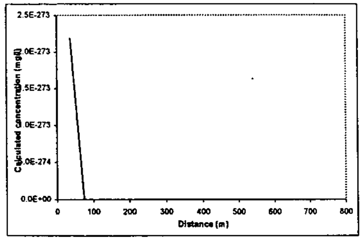
Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd		l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	1.00E+00	fraction
Organic carbon partition coefficient	Koc	2.29E+06	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$		l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Soil water partition coefficient	Kd	2.29E+06	l/kg

Dispersivity

Calculate dependant on distance to compliance point (0), 2
specify dispersivity (1), or calc after Xu & Eckstein (2) ?

		Enter value	Calc value Xu & Eckstein	
Longitudinal dispersivity	ax		1.06E+01	m
Transverse dispersivity	az		1.06E+00	m
Vertical dispersivity	ay		1.06E-01	m

For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report ax = $0.83(\log_{10}x)^{2.414}$; 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.

This sheet calculates the Tier3 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

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 Tier 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.

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration
	mg/l
37.6	2.2E-273
76.0	XNUMI
112.5	XNUMI
150.0	XNUHI
117.6	XNUHI
225.0	XNUMI
262.5	#NUM!
3W.0	#NUMI
337.5	#NUM!
176.0	#NUM!
4126	XNUMI
450.0	XNUMI
487.6	XNUHI
525.0	#NUMI
562.5	#NUMI
600.0	#NUM!
017.6	XNUMI
176.0	#NUM!
7126	#NUM!
750.0	XNUMI

Site being assessed:	Area 6 Deerpark A K20
Completed by	AJ
Date:	24 11 2005
Version:	12

R&D Publication20 Remedial Targets Worksheet, Release2.2a

Tier 3 - Groundwater

ENVIRONMENT AGENCY

Input Parameters (using pull down menu) Variable vatu Unit Source

	Variable	Value	Unit
Contaminant		Aliphatics C6-C8	
Target Concentration	C_T	7.14E-04	mg/l

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

Ogata Banks — Equations in R&D Pub. 20

Enter '1' to simulate vertical dispersion in one direction, '2' for two directions (pull down menu): 1

Enter '1' if biodegradation rate is for the substance in water,
'0' if rate is for decay in field conditions (i.e. field data from aquifer) (pull down menu: 0

	Variable	Value	Unit	Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	2.12E-02	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	7.30E+02	days	
Calculated decay rate	λ	9.50E-04	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	8.00E+01	m	
Plume thickness at source	Sy	5.60E+01	m	
Saturated aquifer thickness	da	5.71E+01	m	
Bulk density of aquifer materials	ρ	1.70E+00	g/cm^3	
Effective porosity of aquifer	n	1.82E-01	fraction	
Hydraulic gradient	i	1.25E-02	fraction	
Hydraulic conductivity of aquifer	K	2.00E+01	m/d	
Distance to compliance point	x	7.50E+02	m	
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	1.45E+01	l/kg	***see options***
Longitudinal dispersivity	ax	10.623	m	***see options***
Transverse dispersivity	az	1.062	m	***see options***
Vertical dispersivity	ay	0.106	m	***see options***

Calculated Parameters Variable

	Variable	Value	Unit
Groundwater flow velocity	v	1.37E+00	m/d
Retardation factor	Rf	1.36E+02	fraction
Decay rate used	λ	9.50E-04	d^{-1}
Rate of contaminant flow due to retardation	u	1.01E-02	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	1.70E-21	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	1.66E-21	mg/l
Attenuation factor (one way vertical dispersion, C_0/C_{ED})	AF	1.25E+19	
Attenuation factor (two way vertical dispersion, C_0/C_{ED})	AF	1.28E+19	

Remedial Targets

Remedial Target	LTC3	8.90E+15	mg/l	For comparison with measured groundwater concentration.

Ogata Banks

Distance to compliance point		**760**	**m**	
Concentration of contaminant at compliance point	**$C_{ED}/C0$**	**1.70E-21**	**mg/l**	Ogata Banks
after		**9.9E+99**	**days**	

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 pulldown menu)

Calculate for non-polar organic chemicals

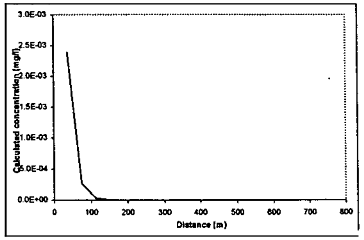
Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd	[redacted]	l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	1.00E+00	fraction
Organic carbon partition coefficient	Koc	1.45E+01	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$	[redacted]	l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Soil water partition coefficient	Kd	1.45E+01	l/kg

Dispersivity

Calculate dependant on distance to compliance point (0), specify dispersivity (1), or calc after Xu & Eckstein (2) ? 2

		Enter value	Calc value Xu & Eckstein	
Longitudinal dispersivity	**ax**	[redacted]	1.06E+01	m
Transverse dispersivity	**az**		1.06E+00	m
Vertical dispersivity	**ay**		1.06E-01	m

For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report ax = 0.83(log₁₀x)^2.414 ; 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.

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration mg/l
76.6	2.7E-04
112.6	3.0E-05
160.0	3.4E-06
187.5	3.7E-07
225.0	4.1E-08
262.5	4.6E-09
300.0	5.0E-10
317.6	5.6E-11
176.0	6.1E-12
412.5	6.8E-13
450.0	7.5E-14
487.5	8.3E-15
626.0	9.1E-16
562.5	1.0E-16
600.0	1.1E-17
817.6	1.2E-18
876.0	1.4E-19
712.6	1.5E-20
750.0	1.7E-21

This sheet calculates the Tier3 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

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 Tier 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.

Site being assessed	Area 6 Deerpark A K20
Completed by	AJ
Date	24 11 2005
Version	12

ENVIRONMENT AGENCY

R&D Publication 20 Remedial Targets Worksheet, Release 2.2a

Tier 3 - Groundwater

Input Parameters (using pull dorm manu)	Variable	Value	Unit	Source
Contaminant		Aliphatic C16-C21		
Target Concentration	C_T	7.14E-04	*mg/l*	

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

Ogata Banks — Equations in R&D Pub. 20

Enter '1' to simulate vertical dispersion in one direction, '2' for two directions (pull down menu) 1

Enter '1' if biodegradation rate is for the substance in water,
'0' if rate is for decay in field conditions (i.e. field data from aquifer) (pull down menu 0

				Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	2.12E-02	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	3.65E+03	days	
Calculated decay rate	λ	1.90E-04	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	8.00E+01	m	
Plume thickness at source	Sy	5.60E+01	m	
Saturated aquifer thickness	da	5.71E+01	m	
Bulk density of aquifer materials	ρ	1.70E+00	g/cm^3	
Effective porosity of aquifer	n	1.82E-01	fraction	
Hydraulic gradient	i	7.00E-03	fraction	
Hydraulic conductivity of aquifer	K	2.00E+01	m/d	
Distance to compliance point	x	8.50E+02	m	
Distance (lateral) to compliance point *perpendicular to flow direction*	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	2.29E+06	l/kg	*see options*
Longitudinal dispersivity	ax	11.114	m	*see options*
Transverse dispersivity	az	1.111	m	*see options*
Vertical dispersivity	ay	0.111	m	*see options*

Calculated Parameters	Variable		
Groundwater flow velocity	v	7.69E-01	m/d
Retardation factor	Rf	2.14E+07	fraction
Decay rate used	λ	1.90E-04	d^{-1}
Rate of contaminant flow due to retardation	u	3.60E-08	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	#NUM!	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	#NUM!	mg/l
Attenuation factor (one way vertical dispersion, C_0/C_{ED})	AF	#NUM!	
Attenuation factor (two way vertical dispersion, C_0/C_{ED})	AF	#NUM!	

Remedial Targets

Remedial Target	LTC3	#NUM!	mg/l

For comparison with measured groundwater concentration.

Ogata Banks

Distance to compliance point		850	m	
Concentration of contaminant at compliance point	$C_{ED}/C0$	#NUM!	mg/l	Ogata Banks
after		9.9E+99	days	

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

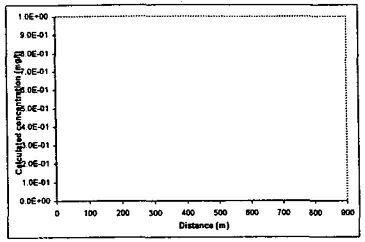
Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd		l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	1.00E+00	fraction
Organic carbon partition coefficient	Koc	2.29E+06	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$		l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Soil water partition coefficient	Kd	2.29E+06	l/kg

Dispersivity

Calculate dependant on distance to compliance point (0), specify dispersivity (1), or calc after Xu & Eckstein (2) ? 2

		Enter value	Calc value Xu & Eckstein	
Longitudinal dispersivity	ax		1.11E+01	m
Transverse dispersivity	az		1.11E+00	m
Vertical dispersivity	ay		1.11E-01	m

For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report ax = 0.83$(\log_{10}x)^{2.414}$; 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.

This sheet calculates the Tier3 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

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 Tier 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.

Calculated concentrations for distance-concentration graph

Ogata Banks
Bietaicalc Glatioersheetn

	mg/l
42.5	#NUM!
85.0	#NUM!
127.6	#NUM!
170.0	#NUM!
212.6	#NUM!
255.0	#NUM!
287.6	#NUM!
340.0	#NUM!
382.5	#NUM!
425.0	#NUM!
467.5	#NUM!
610.0	#NUM!
552.5	#NUM!
696.0	#NUM!
637.5	#NUM!
680.0	#NUM!
722.5	#NUM!
765.0	#NUM!
807.5	#NUM!
850.0	#NUM!

Site being assessed.	Bless 6 Res K20
Completed by	AJ
Date:	24 11 2005
Version	12

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R&D Publication 20 Remedial Targets Worksheet, Release 2.2a

Tier 3 - Groundwater

ENVIRONMENT AGENCY

Input Parameters (using pull down menu)	Variable	Value	Unit	Source
Contaminant		Aliphatics C6-C8		
Target Concentration	C_T	7.14E-04	mg/l	

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

Ogata Banks — Equations in R&D Pub. 20

Enter '1' to simulate vertical dispersion in one direction, '2' for two directions (pull down menu): 1

Enter '1' if biodegradation rate is for the substance in water,
'0' if rate is for decay in field conditions (i.e. field data from aquifer) (pull down menu): 0

	Variable	Value	Unit	Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	2.12E-02	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	7.30E+02	days	
Calculated decay rate	λ	9.50E-04	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	8.00E+01	m	
Plume thickness at source	Sy	5.60E+01	m	
Saturated aquifer thickness	da	5.71E+01	m	
Bulk density of aquifer materials	ρ	1.70E+00	g/cm^3	
Effective porosity of aquifer	n	1.82E-01	fraction	
Hydraulic gradient	i	7.00E-03	fraction	
Hydraulic conductivity of aquifer	K	2.00E+01	m/d	
Distance to compliance point	x	8.50E+02	m	
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	1.45E+01	l/kg	*see options*
Longitudinal dispersivity	ax	11.114	m	*see options*
Transverse dispersivity	az	1.111	m	*see options*
Vertical dispersivity	ay	0.111	m	*see options*

Calculated Parameters	Variable		
Groundwater flow velocity	v	7.69E-01	m/d
Retardation factor	Rf	1.36E+02	fraction
Decay rate used	λ	9.50E-04	d^{-1}
Rate of contaminant flow due to retardation	u	5.66E-03	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	2.69E-34	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	2.58E-34	mg/l
Attenuation factor (one way vertical dispersion, C_0/C_{ED})	AF	7.87E+31	
Attenuation factor (two way vertical dispersion, C_0/C_{ED})	AF	8.21E+31	

Remedial Targets

Remedial Target LTC3 6.62E+28 mg/l — For comparison with measured groundwater concentration.
Ogata Banks

Distance to compliance point		**850**	**m**	
Concentration of contaminant at compliance point	$C_{ED}/C0$	**2.69E-34**	**mg/l**	Ogata Banks
after		**9.9E+99**	**days**	

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

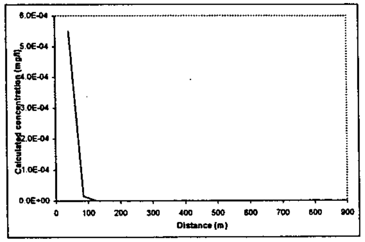
Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd	[redacted]	l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	1.00E+00	fraction
Organic carbon partition coefficient	Koc	1.45E+01	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$	[redacted]	l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Soil water partition coefficient	Kd	1.45E+01	l/kg

Dispersivity

Calculate dependant on distance to compliance point (0), specify dispersivity (1), or calc after Xu & Eckstein (2) ? 2

		Enter value	Calc value Xu & Eckstein	
Longitudinal dispersivity	ax	[redacted]	1.11E+01	m
Transverse dispersivity	az		1.11E+00	m
Vertical dispersivity	ay		1.11E-01	m

For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report $ax = 0.83(\log_{10}x)^{2.414}$; 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.

This sheet calculates the Tier3 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

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 Tier 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.

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration
	mg/l
42.5	5.5E-04
85.0	1.4E-05
127.5	3.7E-07
170.0	9.3E-09
212.6	2.3E-10
255.0	5.9E-12
297.6	1.5E-13
340.0	3.8E-15
382.5	9.5E-17
425.0	2.4E-18
[illegible]	6.5E-20
552.5	3.9E-23
595.0	9.9E-25
917.6	2.5E-26
680.0	6.4E-28
722.5	1.6E-29
765.0	4.1E-31
807.5	1.1E-32
850.0	2.7E-34

Site being assessed	Bless 6 Res K20
Completed by	AJ
Date:	24 11 2005
Version	12

R&D Publication 20 Remedial Targets Worksheet, Release 2.2a

ENVIRONMENT AGENCY

Tier 3 - Groundwater

Input Parameters (using pull down menu)	Variable	Value	Unit	Source
Contaminant		mmoniacal Nitrogen as		
Target Concentration	C_T	1.20E-01	mg/l	

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

Ogata Banks — Equations in R&D Pub. 20

Enter '1' to simulate vertical dispersion in one direction, '2' for two directions (pull down menu): 1

Enter '1' if biodegradation rate is for the substance in water,
'0' if rate is for decay in field conditions (i.e. field data from aquifer) (pull down menu): 0

	Variable	Value	Unit	Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	4.40E+00	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	2.19E+03	days	
Calculated decay rate	λ	3.17E-04	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	8.00E+01	m	
Plume thickness at source	Sy	5.60E+01	m	
Saturated aquifer thickness	da	5.71E+01	m	
Bulk density of aquifer materials	ρ	1.70E+00	g/cm^3	
Effective porosity of aquifer	n	1.82E-01	fraction	
Hydraulic gradient	i	7.00E-03	fraction	
Hydraulic conductivity of aquifer	K	2.00E+01	m/d	
Distance to compliance point	x	8.50E+02	m	
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	5.00E-01	l/kg	*see options*
Longitudinal dispersivity	ax	11.114	m	*see options*
Transverse dispersivity	az	1.111	m	*see options*
Vertical dispersivity	ay	0.111	m	*see options*

Calculated Parameters	Variable		
Groundwater flow velocity	v	7.69E-01	m/d
Retardation factor	Rf	5.67E+00	fraction
Decay rate used	λ	3.17E-04	d^{-1}
Rate of contaminant flow due to retardation	u	1.36E-01	m/d
Contaminant concentration at distance x, *assuming one-way vertical dispersion*	C_{ED}	4.09E-01	*mg/l*
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	3.92E-01	mg/l
Attenuation factor (one way vertical dispersion, C_0/C_{ED})	AF	1.08E+01	
Attenuation factor (two way vertical dispersion, C_0/C_{ED})	AF	1.12E+01	

Remedial Targets

Remedial Target LTC3 1.29E+00 mg/l For comparison with measured groundwater concentration.
Ogata Banks

Distance to compliance point		850	m	
Concentration of contaminant at compliance point	$C_{ED}/C0$	4.09E-01	mg/l	Ogata Banks
after		9.9E+99	days	

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

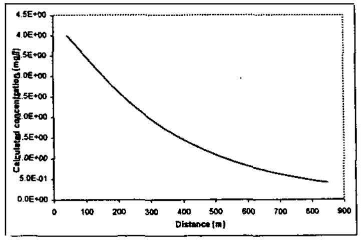
Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd		l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	1.00E+00	fraction
Organic carbon partition coefficient	Koc	5.00E-01	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$		l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Soil water partition coefficient	Kd	5.00E-01	l/kg

Dispersivity

Calculate dependant on distance to compliance point (0), specify dispersivity (1), or calc after Xu & Eckstein (2) ? 2

		Enter value	Calc value Xu & Eckstein	
Longitudinal dispersivity	ax		1.11E+01	m
Transverse dispersivity	az		1.11E+00	m
Vertical dispersivity	ay		1.11E-01	m

For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report ax = 0.83$(log_{10}x)^{2.414}$; 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.

This sheet calculates the Tier3 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

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 Tier 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.

Calculated concentrations for distance-concentration graph

Ogata Banks

Distance	Concentration mg/l
42.5	4.0E+00
€5.0	3.6E+00
170.0	2.9E+00
212.5	2.6E+00
266.0	2.2E+00
W7.6	2.0E+00
340.0	1.7E+00
382.5	1.5E+00
426.0	1.3E+00
467.5	1.2E+00
610.0	1.1E+00
6626	9.3E-01
696.0	8.3E-01
U1.6	7.3E-01
680.0	6.5E-01
722.5	5.8E-01
765.0	5.2E-01
807.5	4.6E-01
850.0	4.1E-01

Site being assessed:	Bless 6 Res K20
Completed by:	AJ
Date:	24 11 2005
Version	12

R&D Publication20 Remedial Targets Worksheet, Release 2.2a

Tier 3 - Groundwater

ENVIRONMENT AGENCY

Input Parameters (using pull down menu)	Variable	Value	Unit	Source
Contaminant		Aromatic C7-C8		
Target Concentration	C_T	7.14E-04	mg/l	

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

Ogata Banks — Equations in R&D Pub. 20

Enter '1' to simulate vertical dispersion in one direction, '2' for two directions (pull down menu): 1

Enter '1' if biodegradation rate is for the substance in water, '0' if rate is for decay in field conditions (i.e. field data from aquifer) (pull down menu): 0

	Variable	Value	Unit	Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	7.70E-02	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	7.30E+02	days	
Calculated decay rate	λ	9.50E-04	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	8.00E+01	m	
Plume thickness at source	Sy	5.60E+01	m	
Saturated aquifer thickness	da	5.71E+01	m	
Bulk density of aquifer materials	ρ	1.70E+00	g/cm^3	
Effective porosity of aquifer	n	1.82E-01	fraction	
Hydraulic gradient	i	7.00E-03	fraction	
Hydraulic conductivity of aquifer	K	2.00E+01	m/d	
Distance to compliance point	x	8.50E+02	m	
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	9.12E-01	l/kg	*see options*
Longitudinal dispersivity	ax	11.114	m	*see options*
Transverse dispersivity	az	1.111	m	*see options*
Vertical dispersivity	ay	0.111	m	*see options*

Calculated Parameters	Variable		
Groundwater flow velocity	v	*7.69E-01*	*m/d*
Retardation factor	Rf	9.52E+00	fraction
Decay rate used	λ	9.50E-04	d^{-1}
Rate of contaminant flow due to retardation	u	8.08E-02	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	6.48E-06	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	6.21E-06	mg/l
Attenuation factor (one way vertical dispersion, C_O/C_{ED})	AF	1.19E+04	
Attenuation factor (two way vertical dispersion, C_O/C_{ED})	AF	1.24E+04	

Remedial Targets

Remedial Target	**LTC3**	**8.49E+00**	**mg/l**	For comparison with measured groundwater concentration.
Ogata Banks				
Distance to compliance point		**850**	**m**	
Concentration of contaminant at compliance point	**$C_{ED}/C0$**	**6.48E-06**	**mg/l**	Ogata Banks
after		**9.9E+99**	**days**	

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

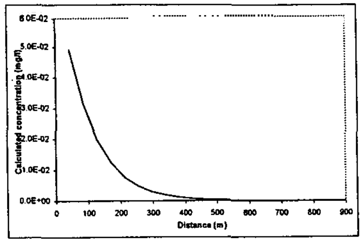
Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd		l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	1.00E+00	fraction
Organic carbon partition coefficient	Koc	9.12E-01	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$		l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Soil water partition coefficient	Kd	9.12E-01	l/kg

Dispersivity

Calculate dependant on distance to compliance point (0), specify dispersivity (1), or calc after Xu & Eckstein (2) ? 2

		Enter value	Calc value Xu & Eckstein	
Longitudinal dispersivity	ax		1.11E+01	m
Transverse dispersivity	az		1.11E+00	m
Vertical dispersivity	ay		1.11E-01	m

For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report ax = 0.83$(\log_{10}x)^{2.414}$; 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.

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration
	mg/l
42.5	4.9E-02
85.0	3.1E-02
127.5	2.0E-02
170.0	1.2E-02
212.5	7.7E-03
255.0	4.8E-03
297.5	3.0E-03
340.0	1.8E-03
382.5	1.1E-03
425.0	7.1E-04
467.5	4.4E-04
510.0	2.8E-04
552.5	1.7E-04
595.0	1.1E-04
637.5	6.7E-05
680.0	4.2E-05
722.5	2.6E-05
765.0	1.6E-05
807.5	1.0E-05
850.0	6.5E-06

This sheet calculates the Tier3 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

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 Tier 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.

Site being assessed	Bless 5 Res K20
Completed by	AJ
Date:	24 11 2005
Version:	12

R&D Publication20 Remedial Targets Worksheet, Release 2.2a

Tier 3 -Groundwater

ENVIRONMENT AGENCY

Input Parameters (using pull down menu)

Input Parameters	Variable	Value	Unit	Source
Contaminant		Aromatic C8-C10		
Target Concentration	C_T	*7.14E-04*	*mg/l*	

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

Ogata Banks — Equations in R&D Pub. 20

Enter '1' to simulate vertical dispersion in one direction, '2' for two directions (pull down menu): 1

Enter '1' if biodegradation rate is for the substance in water,
'0' if rate is for decay in field conditions (i.e. field data from aquifer) (pull down menu: 0

	Variable	Value	Unit	Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	2.12E-02	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	1.83E+03	days	
Calculated decay rate	λ	3.80E-04	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	8.00E+01	m	
Plume thickness at source	Sy	5.60E+01	m	
Saturated aquifer thickness	da	5.71E+01	m	
Bulk density of aquifer materials	ρ	1.70E+00	g/cm^3	
Effective porosity of aquifer	n	1.82E-01	fraction	
Hydraulic gradient	i	7.00E-03	fraction	
Hydraulic conductivity of aquifer	K	2.00E+01	m/d	
Distance to compliance point	x	8.50E+02	m	
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	5.75E+00	l/kg	*see options*
Longitudinal dispersivity	ax	11.114	m	*see options*
Transverse dispersivity	az	1.111	m	*see options*
Vertical dispersivity	ay	0.111	m	*see options*

Calculated Parameters

Calculated Parameters	Variable		
Groundwater flow velocity	v	7.69E-01	m/d
Retardation factor	Rf	5.47E+01	fraction
Decay rate used	λ	3.80E-04	d^{-1}
Rate of contaminant flow due to retardation	u	1.41E-02	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	1.26E-10	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	1.21E-10	mg/l
Attenuation factor (one way vertical dispersion, C_0/C_{ED})	AF	1.68E+08	
Attenuation factor (two way vertical dispersion, C_0/C_{ED})	AF	1.76E+08	

Remedial Targets

Remedial Target	LTCS	1.20E+05	mg/l	For comparison with measured groundwater concentration.
Ogata Banks				
Distance to compliance point		850	m	
Concentration of contaminant at compliance point	$C_{ED}/C0$	1.26E-10	mg/l	Ogata Banks
after		9.9E+99	days	

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

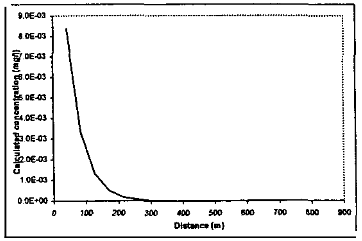
Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd		l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	1.00E+00	fraction
Organic carbon partition coefficient	Koc	5.75E+00	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$		l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Soil water partition coefficient	*Kd*	*5.75E+00*	*l/kg*

Dispersivity

Calculate dependant on distance to compliance point (0), specify dispersivity (1), or calc after Xu & Eckstein (2) ? 2

		Enter value	Calc value Xu & Eckstein	
Longitudinal dispersivity	ax		1.11E+01	m
Transverse dispersivity	az		1.11E+00	m
Vertical dispersivity	ay		1.11E-01	m

For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report $ax = 0.83(\log_{10}x)^{2.414}$; 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.

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration
	mg/l
42.5	8.4E-03
85.0	3.3E-03
127.5	1.3E-03
170.0	5.0E-04
255.0	7.8E-05
297.5	2.9E-05
340.0	1.1E-05
382.5	4.3E-06
426.0	1.6E-06
467.5	6.3E-07
510.0	2.6E-07
552.5	9.5E-08
595.0	3.7E-08
637.5	1.4E-08
722.5	8.5E-09
765.0	8.3E-10
807.6	3.2E-10
850.0	1.3E-10

This sheet calculates the Tier3 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

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 Tier 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.

Site being assessed	Bless 6 Res K20
Completed by	AJ
Date:	24 11 2005
Version:	12

R&D Publication20 Remedial Targets Worksheet, Release 2.2a

ENVIRONMENT AGENCY

Tier 3 -Groundwater

Input Parameters (using pull down menu)	Variable	Value	Unit	Source
Contaminant		Styrene		
Target Concentration	C_T	5.00E-02	mg/l	

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

Ogata Banks — Equations in R&D Pub. 20

Enter '1' to simulate vertical dispersion in one direction, '2' for two directions (pull down menu) 1

Enter '1' if biodegradation rate is for the substance in water,
'0' if rate is for decay in field conditions (i.e. field data from aquifer) (pull down menu 0

	Variable	Value	Unit	Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	9.90E-99	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	2.10E+02	days	
Calculated decay rate	λ	3.30E-03	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	8.00E+01	m	
Plume thickness at source	Sy	5.60E+01	m	
Saturated aquifer thickness	da	5.71E+01	m	
Bulk density of aquifer materials	ρ	1.70E+00	g/cm^3	
Effective porosity of aquifer	n	1.82E-01	fraction	
Hydraulic gradient	i	7.00E-03	fraction	
Hydraulic conductivity of aquifer	K	2.00E+01	m/d	
Distance to compliance point	x	8.50E+02	m	
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	4.64E+00	l/kg	*see options*
Longitudinal dispersivity	ax	11.114	m	*see options*
Transverse dispersivity	az	1.111	m	*see options*
Vertical dispersivity	ay	0.111	m	*see options*

Calculated Parameters	Variable		
Groundwater flow velocity	v	7.69E-01	m/d
Retardation factor	Rf	4.43E+01	fraction
Decay rate used	λ	3.30E-03	d^{-1}
Rate of contaminant flow due to retardation	u	1.74E-02	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	2.18E-133	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	2.09E-133	mg/l
Attenuation factor (one way vertical dispersion, C_0/C_{ED})	AF	4.54E+34	
Attenuation factor (two way vertical dispersion, C_0/C_{ED})	AF	4.74E+34	

Remedial Targets

Remedial Target	LTC3	2.27E+33	mg/l	For comparison with measured groundwater concentration.
Ogata Banks				
Distance to compliance point		850	m	
Concentration of contaminant at compliance point	$C_{ED}/C0$	2.18E-133	mg/l	Ogata Banks
after		9.9E+99	days	

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

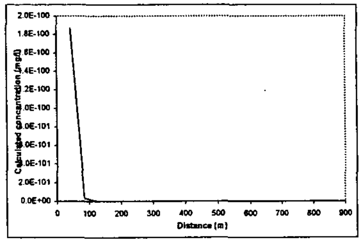
Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd		l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	1.00E+00	fraction
Organic carbon partition coefficient	Koc	4.64E+00	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$		l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	*pH*		
acid dissociation constant	pKa		
Soil water partition coefficient	Kd	4.64E+00	l/kg

Dispersivity

Calculate dependant on distance to compliance point (0), specify dispersivity (1), or calc after Xu & Eckstein (2) ? 2

		Enter value	Calc value Xu & Eckstein	
Longitudinal dispersivity	ax		1.11E+01	m
Transverse dispersivity	az		1.11E+00	m
Vertical dispersivity	ay		1.11E-01	m

For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report $ax = 0.83(log_{10}x)^{2.414}$; 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.

This sheet calculates the Tier3 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

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 Tier 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.

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration
	mg/l
42.5	1.9E-100
85.0	3.5E-102
127.5	6.6E-104
170.0	1.2E-105
212.5	2.2E-107
255.0	4.1E-109
[illegible]	7.6E-112
382.5	2.5E-114
[illegible]	[illegible]
510.0	1.6E-119
[illegible]	5.4E-123
637.5	1.0E-124
680.0	1.8E-126
722.6	3.4E-128
765.0	6.3E-130
807.5	1.2E-131
850.0	2.2E-133

Site being assessed	Bless 6 Res K20
Completed by	AJ
Date:	24 11 2005
Version	12

R&D Publication 20 Remedial Targets Worksheet, **Release 2.2a**

Tier 3 • Groundwater

ENVIRONMENT AGENCY

Input Parameters (using pull down menu)	Variable	Value	Unit	Source
Contaminant Target Concentration	C_T	7.14E-04	mg/l	

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

Ogata Banks — Equations in R&D Pub. 20

Enter '1 to simulate vertical dispersion in one direction, '2' for two directions (pull down menu): 1

Enter '1' if biodegradation rate is for the substance in water, '0' if rate is for decay in field conditions (i.e. field data from aquifer) (pull down menu): 0

	Variable	Value	Unit	Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	2.12E-02	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	1.83E+03	days	
Calculated decay rate	λ	3.80E-04	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	8.00E+01	m	
Plume thickness at source	Sy	5.60E+01	m	
Saturated aquifer thickness	da	5.71E+01	m	
Bulk density of aquifer materials	ρ	1.70E+00	g/cm^3	
Effective porosity of aquifer	n	1.82E-01	fraction	
Hydraulic gradient	i	7.00E-03	fraction	
Hydraulic conductivity of aquifer	K	2.00E+01	m/d	
Distance to compliance point	x	8.50E+02	m	
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	9.12E+00	l/kg	*see options*
Longitudinal dispersivity	ax	11.114	m	*see options*
Transverse dispersivity	az	1.111	m	*see options*
Vertical dispersivity	ay	0.111	m	*see options*

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	1.00E+00	fraction
Organic carbon partition coefficient	Koc	9.12E+00	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$		l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Soil water partition coefficient	Kd	9.12E+00	l/kg

Dispersivity

Calculate dependant on distance to compliance point (0), specify dispersivity (1), or calc after Xu & Eckstein (2) ? 2

		Enter value	Calc value Xu & Eckstein	
Longitudinal dispersivity	ax		1.11E+01	m
Transverse dispersivity	az		1.11E+00	m
Vertical dispersivity	ay		1.11E-01	m

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

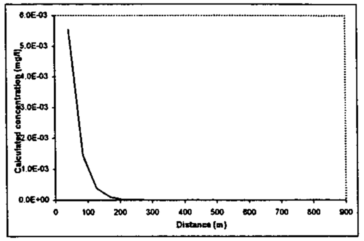
Xu & Eckstein (1995) report ax = $0.83(\log_{10}x)^{2.414}$; az = ax/10, ay = ax/100 are assumed

Calculated Parameters	Variable		
Groundwater flow velocity	v	7.69E-01	m/d
Retardation factor	Rf	8.62E+01	fraction
Decay rate used	λ	3.80E-04	d^{-1}
Rate of contaminant flow due to retardation	u	8.93E-03	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	3.18E-14	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	3.04E-14	mg/l
Attenuation factor (one way vertical dispersion, C_O/C_{ED})	AF	6.68E+11	
Attenuation factor (two way vertical dispersion, C_O/C_{ED})	AF	6.97E+11	

Remedial Targets

Remedial Target	LTC3	4.77E+08	mg/l	For comparison with measured groundwater concentration.
Ogata Banks				
Distance to compliance point		850	m	
Concentration of contaminant at compliance point	$C_{ED}/C0$	3.18E-14	mg/l	Ogata Banks
after		9.9E+99	days	

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.



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.

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration
	mg/l
42.6	5.6E-03
[illegible]	[illegible]
[illegible]	[illegible]
266.0	6.2E-06
297.5	1.6E-06
340.0	4.0E-07
382.5	1.0E-07
426.0	2.6E-08
467.6	6.7E-09
610.0	1.7E-09
552.6	4.3E-10
637.5	2.8E-11
680.0	7.3E-12
722.5	1.9E-12
765.0	4.8E-13
807.6	1.2E-13
850.0	3.2E-14

This sheet calculates the Tier3 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

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 Tier 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.

Site being assessed:	Bless 6 Res K20
Completed by:	AJ
Date.	24 11 2005
Version.	12

R&D Publication 20 Remedial Targets Worksheet, Release 2.2a

ENVIRONMENT AGENCY

Tier 3 - Groundwater

Input Parameters (using pull down menu)	Variable	Value	Unit	Source
Contaminant Target Concentration	C_T	7.14E-04	mg/l	

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

Ogata Banks — Equations in R&D Pub. 20

Enter '1' to simulate vertical dispersion in one direction, '2' for two directions (pull down menu): 1

Enter '1' if biodegradation rate is for the substance in water,
'0' if rate is for decay in field conditions (i.e. field data from aquifer) (pull down menu): 0

	Variable	Value	Unit	Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	2.12E-02	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	1.83E+03	days	
Calculated decay rate	λ	3.80E-04	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	8.00E+01	m	
Plume thickness at source	Sy	5.60E+01	m	
Saturated aquifer thickness	da	5.71E+01	m	
Bulk density of aquifer materials	ρ	1.70E+00	g/cm^3	
Effective porosity of aquifer	n	1.82E-01	fraction	
Hydraulic gradient	i	7.00E-03	fraction	
Hydraulic conductivity of aquifer	K	2.00E+01	m/d	
Distance to compliance point	x	8.50E+02	m	
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	1.82E+01	l/kg	*see options*
Longitudinal dispersivity	ax	11.114	m	*see options*
Transverse dispersivity	az	1.111	m	*see options*
Vertical dispersivity	ay	0.111	m	*see options*

Calculated Parameters

	Variable		
Groundwater flow velocity	v	7.69E-01	m/d
Retardation factor	Rf	1.71E+02	fraction
Decay rate used	λ	3.80E-04	d^{-1}
Rate of contaminant flow due to retardation	u	4.50E-03	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	3.45E-22	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	3.31E-22	mg/l
Attenuation factor (one way vertical dispersion, C_O/C_{ED})	AF	6.14E+19	
Attenuation factor (two way vertical dispersion, C_O/C_{ED})	AF	6.40E+19	

Remedial Targets

Remedial Target	LTC3	4.38E+16	mg/l	For comparison with measured groundwater concentration.

Ogata Banks

Distance to compliance point		850	m	
Concentration of contaminant at compliance point	$C_{ED}/C0$	3.45E-22	mg/l	Ogata Banks
after		9.9E+99	days	

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

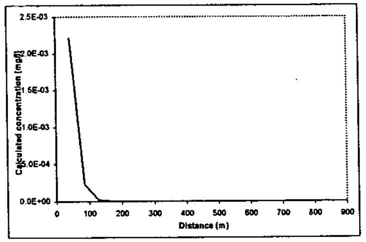
Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd	[redacted]	l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	1.00E+00	fraction
Organic carbon partition coefficient	Koc	1.82E+01	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$	[redacted]	l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Soil water partition coefficient	Kd	1.82E+01	l/kg

Dispersivity

Calculate dependant on distance to compliance point (0), specify dispersivity (1), or calc after Xu & Eckstein (2) ? 2

		Enter value	Calc value Xu & Eckstein	
Longitudinal dispersivity	ax	[redacted]	1.11E+01	m
Transverse dispersivity	az		1.11E+00	m
Vertical dispersivity	ay		1.11E-01	m

For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report $ax = 0.83(\log_{10}x)^{2.414}$; 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.

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration
	mg/l
42.5	2.2E-03
85.0	2.3E-04
127.5	2.4E-05
170.0	2.5E-06
212.5	2.5E-07
266.0	2.5E-08
297.5	2.6E-09
340.0	2.6E-10
382.5	2.7E-11
425.0	2.7E-12
[illegible]	2.8E-14
662.6	2.9E-15
595.0	3.0E-16
637.5	3.0E-17
[illegible]	3.2E-19
796.0	3.3E-20
807.5	3.4E-21
960.0	3.5E-22

This sheet calculates the Tier3 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 Tier 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.

Site being assessed:	Bless 6 Res K20
Completed by	AJ
Date:	24 11 2005
Version	12

R&D Publication 20 Remedial Targets Worksheet, Release 2.2a

Tier 3 - Groundwater

ENVIRONMENT AGENCY

Input Parameters (using pull down menu)

Input Parameters (using pull down menu)	Variable	Value	Unit	Source
Contaminant		Aromatic C16-C21		
Target Concentration	C_T	7.14E-04	mg/l	

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

Ogata Banks — Equations in R&D Pub. 20

Enter '1' to simulate vertical dispersion in one direction, '2' for two directions (pull down menu): 1

Enter '1' if biodegradation rate is for the substance in water,
'0' if rate is for decay in field conditions (i.e. field data from aquifer) (pull down menu): 0

	Variable	Value	Unit	Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	2.12E-02	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	3.65E+03	days	
Calculated decay rate	λ	1.90E-04	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	8.00E+01	m	
Plume thickness at source	Sy	5.60E+01	m	
Saturated aquifer thickness	da	5.71E+01	m	
Bulk density of aquifer materials	ρ	1.70E+00	g/cm^3	
Effective porosity of aquifer	n	1.82E-01	fraction	
Hydraulic gradient	i	7.00E-03	fraction	
Hydraulic conductivity of aquifer	K	2.00E+01	m/d	
Distance to compliance point	x	8.50E+02	m	
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	5.75E+01	l/kg	*see options*
Longitudinal dispersivity	ax	11.114	m	*see options*
Transverse dispersivity	az	1.111	m	*see options*
Vertical dispersivity	ay	0.111	m	*see options*

Calculated Parameters

Calculated Parameters	Variable	Value	Unit
Groundwater flow velocity	v	7.69E-01	m/d
Retardation factor	Rf	5.38E+02	fraction
Decay rate used	λ	1.90E-04	d^{-1}
Rate of contaminant flow due to retardation	u	1.43E-03	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	1.23E-29	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	1.18E-29	mg/l
Attenuation factor (one way vertical dispersion, C_0/C_{ED})	AF	1.73E+27	
Attenuation factor (two way vertical dispersion, C_0/C_{ED})	AF	1.80E+27	

Remedial Targets

Remedial Target Ogata Banks	LTC3	1.23E+24	mg/l

For comparison with measured groundwater concentration.

Distance to compliance point		850	m	
Concentration of contaminant at compliance point	$C_{ED}/C0$	1.23E-29	mg/l	Ogata Banks
after		9.9E+99	days	

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

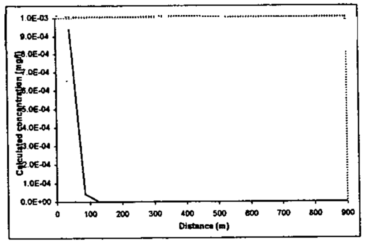
Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd	[redacted]	l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	1.00E+00	fraction
Organic carbon partition coefficient	Koc	5.75E+01	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$	[redacted]	l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Soil water partition coefficient	Kd	5.75E+01	l/kg

Dispersivity

Calculate dependant on distance to compliance point (0), specify dispersivity (1), or calc after Xu & Eckstein (2) ? 2

		Enter value	Calc value Xu & Eckstein	
Longitudinal dispersivity	ax	[redacted]	1.11E+01	m
Transverse dispersivity	az		1.11E+00	m
Vertical dispersivity	ay		1.11E-01	m

For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report ax = $0.83(\log_{10}x)^{2.414}$; 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.

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration
	mg/l
42.5	9.4E-04
85.0	4.2E-05
127.5	1.8E-06
170.0	7.9E-08
212.5	3.4E-09
255.0	1.5E-10
297.5	6.4E-12
340.0	2.8E-13
382.5	1.2E-14
425.0	5.1E-16
467.5	2.2E-17
510.0	9.6E-19
552.5	4.2E-20
595.0	1.8E-21
637.5	7.9E-23
680.0	3.4E-24
722.5	1.5E-25
765.0	6.5E-27
807.5	2.8E-28
850.0	1.2E-29

This sheet calculates the Tier3 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

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 Tier 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.

Site being assessed. Bless 6 Res K20
Completed by: AJ
Date: 24 11 2005
Version 12

R&D Publication20 Remedial Targets Worksheet, Release 2.2a

Tier 3 -Groundwater

ENVIRONMENT
AGENCY

Input Parameters (using pull down menu)

	Variable	Value	Unit	Source
Contaminant		Aromatic C21-C35		
Target Concentration	C_T	7.14E-04	mg/l	

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

Ogata Banks — Equations in R&D Pub. 20

Enter '1' to simulate vertical dispersion in one direction, '2' for two directions (pull down menu): 1

Enter '1' if biodegradation rate is for the substance in water,
'0' if rate is for decay in field conditions (i.e. field data from aquifer) (pull down menu: 0

	Variable	Value	Unit	Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	2.12E-02	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	3.65E+03	days	
Calculated decay rate	λ	1.90E-04	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	8.00E+01	m	
Plume thickness at source	Sy	5.60E+01	m	
Saturated aquifer thickness	da	5.71E+01	m	
Bulk density of aquifer materials	ρ	1.70E+00	g/cm^3	
Effective porosity of aquifer	n	1.82E-01	fraction	
Hydraulic gradient	i	7.00E-03	fraction	
Hydraulic conductivity of aquifer	K	2.00E+01	m/d	
Distance to compliance point	x	8.50E+02	m	
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	4.57E+02	l/kg	*see options*
Longitudinal dispersivity	ax	11.114	m	*see options*
Transverse dispersivity	az	1.111	m	*see options*
Vertical dispersivity	ay	0.111	m	*see options*

Calculated Parameters

	Variable		
Groundwater flow velocity	v	7.69E-01	m/d
Retardation factor	Rf	4.27E+03	fraction
Decay rate used	λ	1.90E-04	d^{-1}
Rate of contaminant flow due to retardation	u	1.80E-04	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	7.09E-101	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	6.80E-101	mg/l
Attenuation factor (one way vertical dispersion, C_0/C_{ED})	AF	2.99E+98	
Attenuation factor (two way vertical dispersion, C_0/C_{ED})	AF	3.12E+98	

Remedial Targets

Remedial Target	LTC3	2.13E+95	mg/l

For comparison with measured groundwater concentration.

Ogata Banks

Distance to compliance point		850	m	
Concentration of contaminant at compliance point	$C_{ED}/C0$	7.09E-101	mg/l	Ogata Banks
after		9.9E+99	days	

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

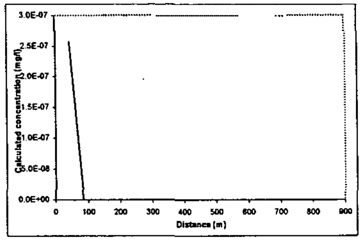
Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd	[redacted]	l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	1.00E+00	fraction
Organic carbon partition coefficient	Koc	4.57E+02	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$	[redacted]	l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Soil water partition coefficient	Kd	4.57E+02	l/kg

Dispersivity

Calculate dependant on distance to compliance point (0), specify dispersivity (1), or calc after Xu & Eckstein (2) ? 2

		Enter value	Calc value Xu & Eckstein	
Longitudinal dispersivity	ax	[redacted]	1.11E+01	m
Transverse dispersivity	az		1.11E+00	m
Vertical dispersivity	ay		1.11E-01	m

For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report $ax = 0.83(\log_{10}x)^{2.414}$; 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.

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration
	mg/l
42.5	2.6E-07
85.0	3.1E-12
127.5	3.8E-17
170.0	4.5E-22
212.6	5.3E-27
266.0	6.3E-32
W7.6	7.4E-37
382.6	5.6E-46
426.0	1.2E-51
610.0	1.5E-56
552.5	2.1E-66
695.0	2.5E-71
917.6	2.9E-76
680.0	3.5E-81
722.6	4.9E-86
807.6	5.9E-96
850.0	7.1E-101

This sheet calculates the Tier3 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

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 Tier 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.

Site being assessed	Bless 6 Res K20
Completed by	AJ
Date	24 11 2005
Version	12

R&D Publication 20 Remedial Targets Worksheet, Release 2.2a

ENVIRONMENT AGENCY

Tier 3 -Groundwater

Input Parameters (using pull down menu) **Variable** **Value** **Unit** **Source**

	Variable	Value	Unit
Contaminant		Arsenic	
Target Concentration	C_T	1.00E-02	mg/l

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

Ogata Banks — Equations in R&D Pub. 20

Enter '1' to simulate vertical dispersion in one direction, '2' for two directions (pull down menu): 1

Enter '1' if biodegradation rate is for the substance in water,
'0' if rate is for decay in field conditions (i.e. field data from aquifer) (pull down menu): 0

	Variable	Value	Unit	Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	9.90E-99	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	9.90E+99	days	
Calculated decay rate	λ	7.00E-101	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	8.00E+01	m	
Plume thickness at source	Sy	5.60E+01	m	
Saturated aquifer thickness	da	5.71E+01	m	
Bulk density of aquifer materials	ρ	1.70E+00	g/cm^3	
Effective porosity of aquifer	n	1.82E-01	fraction	
Hydraulic gradient	i	7.00E-03	fraction	
Hydraulic conductivity of aquifer	K	2.00E+01	m/d	
Distance to compliance point	x	8.50E+02	m	
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	1.17E+02	l/kg	*see options*
Longitudinal dispersivity	ax	11.114	m	*see options*
Transverse dispersivity	az	1.111	m	*see options*
Vertical dispersivity	ay	0.111	m	*see options*

Calculated Parameters

	Variable		
Groundwater flow velocity	v	7.69E-01	m/d
Retardation factor	Rf	1.10E+03	fraction
Decay rate used	λ	7.00E-101	d^{-1}
Rate of contaminant flow due to retardation	u	7.00E-04	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	6.36E-99	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	6.10E-99	mg/l
Attenuation factor (one way vertical dispersion, C_0/C_{ED})	AF	1.56E+00	
Attenuation factor (two way vertical dispersion, C_0/C_{ED})	AF	1.62E+00	

Remedial Targets

Remedial Target LTC3 1.56E-02 mg/l For comparison with measured groundwater concentration.
Ogata Banks

Distance to compliance point		850	m	
Concentration of contaminant at compliance point	$C_{ED}/C0$	6.36E-99	mg/l	Ogata Banks
after		9.9E+99	days	

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

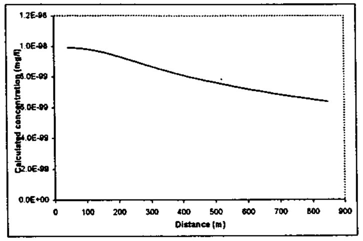
Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd	[redacted]	l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	1.00E+00	fraction
Organic carbon partition coefficient	Koc	1.17E+02	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$	[redacted]	l/kg
Sorption coefficient for ionised species	$K_{oc,i}$	[redacted]	l/kg
pH value	pH	[redacted]	
acid dissociation constant	pKa	[redacted]	
Soil water partition coefficient	Kd	1.17E+02	l/kg

Dispersivity

Calculate dependant on distance to compliance point (0), specify dispersivity (1), or calc after Xu & Eckstein (2) ? 2

		Enter value	Calc value Xu & Eckstein	
Longitudinal dispersivity	ax	[redacted]	1.11E+01	m
Transverse dispersivity	az	[redacted]	1.11E+00	m
Vertical dispersivity	ay	[redacted]	1.11E-01	m

For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report ax = 0.83$(\log_{10}x)^{2.414}$; 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.

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration
	mg/l
42.5	9.9E-99
85.0	9.9E-99
127.5	9.7E-99
170.0	9.5E-99
255.0	9.2E-99
297.5	8.7E-99
340.0	8.6E-S
382.5	8.2E-99
425.0	8.0E-99
467.5	7.8E-99
610.0	7.6E-99
662.6	7.4E-99
595.0	7.2E-99
637.5	7.0E-99
680.0	6.9E-99
722.5	6.7E-99
768.0	6.6E-99
807.5	6.5E-99
850.0	6.4E-99

This sheet calculates the Tier3 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

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 Tier 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.

Site being assessed	Bless 6 Res K20
Completed by:	AJ
Date:	24 11 2005
Version	12

R&D Publication 20 Remedial Targets Worksheet, Release 2.2a

ENVIRONMENT AGENCY

Tier 3 - Groundwater

Input Parameters (using pull down menu)	Variable	Value	Unit	Source
Contaminant		Benzene		
Target Concentration	C_T	1.00E-03	mg/l	

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

Ogata Banks — Equations in R&D Pub. 20

Enter '1' to simulate vertical dispersion in one direction, '2' for two directions (pull down menu): 1

Enter '1' if biodegradation rate is for the substance in water,
'0' if rate is for decay in field conditions (i.e. field data from aquifer) (pull down menu: 0

	Variable	Value	Unit	Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	9.90E-89	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	7.20E+02	days	
Calculated decay rate	λ	9.63E-04	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	8.00E+01	m	
Plume thickness at source	Sy	5.60E+01	m	
Saturated aquifer thickness	da	5.71E+01	m	
Bulk density of aquifer materials	ρ	1.70E+00	g/cm^3	
Effective porosity of aquifer	n	1.82E-01	fraction	
Hydraulic gradient	i	7.00E-03	fraction	
Hydraulic conductivity of aquifer	K	2.00E+01	m/d	
Distance to compliance point	x	8.50E+02	m	
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	2.14E-01	l/kg	*see options*
Longitudinal dispersivity	ax	11.114	m	*see options*
Transverse dispersivity	az	1.111	m	*see options*
Vertical dispersivity	ay	0.111	m	*see options*

Calculated Parameters	Variable		
Groundwater flow velocity	v	7.69E-01	m/d
Retardation factor	Rf	3.00E+00	fraction
Decay rate used	λ	9.63E-04	d^{-1}
Rate of contaminant flow due to retardation	u	2.57E-01	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	2.97E-100	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	2.84E-100	mg/l
Attenuation factor (one way vertical dispersion, C_0/C_{ED})	AF	3.34E+01	
Attenuation factor (two way vertical dispersion, C_0/C_{ED})	AF	3.48E+01	

Remedial Targets

Remedial Target LTC3 3.34E-02 mg/l — For comparison with measured groundwater concentration.
Ogata Banks

Distance to compliance point		850	m	
Concentration of contaminant at compliance point	$C_{ED}/C0$	2.97E-100	mg/l	Ogata Banks
after		9.9E+99	days	

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

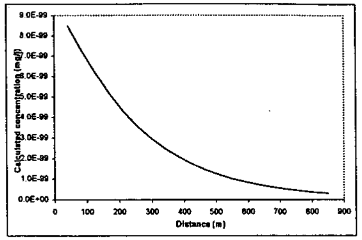
Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd		l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	1.00E+00	fraction
Organic carbon partition coefficient	Koc	2.14E-01	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$		l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Soil water partition coefficient	Kd	2.14E-01	l/kg

Dispersivity

Calculate dependant on distance to compliance point (0), specify dispersivity (1), or calc after Xu & Eckstein (2) ? 2

		Enter value	Calc value Xu & Eckstein	
Longitudinal dispersivity	ax		1.11E+01	m
Transverse dispersivity	az		1.11E+00	m
Vertical dispersivity	ay		1.11E-01	m

For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report ax = $0.83(\log_{10}x)^{2.414}$; 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.

This sheet calculates the Tier3 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

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 Tier 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.

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration mg/l
42.5	8.5E-99
85.0	7.3E-99
127.5	6.1E-99
170.0	6.ZE-M
212.5	4.3E-99
255.0	3.6E-99
297.5	3.0E-99
340.0	2.5E-99
382.5	2.1E-99
425.0	1.7E-M
467.5	1.4E-99
610.0	1.2E-M
662.6	1.0E-99
595.0	8.4E-100
637.5	7.1E-100
680.0	5.9E-100
722.5	5.0E-100
765.0	4.2E-100
807.5	3.5E-100
850.0	3.0E-100

Site being assessed	Bless 6 Res K20
Completed by	AJ
Date:	24 11 2005
Version	12

R&D Publication20 Remedial Targets Worksheet, Release 2.2a

ENVIRONMENT AGENCY

Tier 3 - Groundwater

Input Parameters (using pull down menu)	Variable	Value	Unit	Source
Contaminant		Boron		
Target Concentration	C_T	1.00E+00	mg/l	

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

Ogata Banks — Equations in R&D Pub. 20

Enter '1' to simulate vertical dispersion in one direction, '2' for two directions (pull down menu): 1

Enter '1' if biodegradation rate is for the substance in water,
'0' if rate is for decay in field conditions (i.e. field data from aquifer) (pull down menu): 0

	Variable	Value	Unit	Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	1.00E-01	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	9.90E+99	days	
Calculated decay rate	λ	7.00E-101	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	8.00E+01	m	
Plume thickness at source	Sy	5.60E+01	m	
Saturated aquifer thickness	da	5.71E+01	m	
Bulk density of aquifer materials	ρ	1.70E+00	g/cm^3	
Effective porosity of aquifer	n	1.82E-01	fraction	
Hydraulic gradient	i	7.00E-03	fraction	
Hydraulic conductivity of aquifer	K	2.00E+01	m/d	
Distance to compliance point	x	8.50E+02	m	
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	0.00E+00	l/kg	*see options*
Longitudinal dispersivity	ax	11.114	m	*see options*
Transverse dispersivity	az	1.111	m	*see options*
Vertical dispersivity	*ay*	*0.111*	*m*	*see options*

Calculated Parameters	Variable		
Groundwater flow velocity	v	7.69E-01	m/d
Retardation factor	Rf	1.00E+00	fraction
Decay rate used	λ	7.00E-101	d^{-1}
Rate of contaminant flow due to retardation	u	7.69E-01	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	6.43E-02	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	6.16E-02	mg/l
Attenuation factor (one way vertical dispersion, C_0/C_{ED})	AF	1.56E+00	
Attenuation factor (two way vertical dispersion, C_0/C_{ED})	AF	1.62E+00	

Remedial Targets

Remedial Target	**LTC3**	**1.56E+00**	**mg/l**

For comparison with measured groundwater concentration.

Ogata Banks

Distance to compliance point		**850**	**m**	
Concentration of contaminant at compliance point	$C_{ED}/C0$	**6.43E-02**	**mg/l**	Ogata Banks
after		**9.9E+99**	**days**	

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

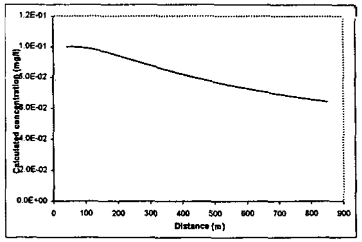
Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd	[redacted]	l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	1.00E+00	fraction
Organic carbon partition coefficient	Koc	0.00E+00	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$	[redacted]	l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Soil water partition coefficient	Kd	0.00E+00	l/kg

Dispersivity

Calculate dependant on distance to compliance point (0), specify dispersivity (1), or calc after Xu & Eckstein (2) ? 2

		Enter value	Calc value Xu & Eckstein	
Longitudinal dispersivity	ax	[redacted]	1.11E+01	m
Transverse dispersivity	az		1.11E+00	m
Vertical dispersivity	ay		1.11E-01	m

*For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x*
Xu & Eckstein (1995) report ax = $0.83(\log_{10}x)^{2.414}$; 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.

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	**Concentration**
	mg/l
42.5	**1.0E-01**
85.0	**1.0E-01**
127.6	**9.8E-02**
170.0	9.6E-02
212.5	**9.3E-02**
266.0	9.1E-02
297.5	8.8E-02
340.0	**8.5E-02**
382.5	8.3E-02
425.0	**8.1E-02**
467.5	**7.9E-02**
610.0	7.7E-02
662.6	7.5E-02
696.0	7.3E-02
637.5	7.1E-02
680.0	7.0E-02
722.5	**6.8E-02**
766.0	6.7E-02
860.0	
	6.4E-02

This sheet calculates the Tier3 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

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 Tier 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.

Site being assessed	Bless 6 Res K20
Completed by	AJ
Date	24 11 2005
Version	12

R&D Publication 20 Remedial Targets Worksheet, Release 2.2a

Tier 3 - Groundwater

Input Parameters (using pull down menu)	Variable	Value	Unit	Source
Contaminant		Chlorobenzene		
Target Concentration	C_T	1.00E-03	mg/l	

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

Ogata Banks — Equations in R&D Pub. 20

ter '1' to simulate vertical dispersion in one direction, '2' for two directions (pull down menu) 1

Enter '1' if biodegradation rate is for the substance in water,
'0' if rate is for decay in field conditions (i.e. field data from aquifer) (pull down menu 0

				Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	9.90E-99	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	3.00E+02	days	
Calculated decay rate	λ	2.31E-03	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	8.00E+01	m	
Plume thickness at source	Sy	5.60E+01	m	
Saturated aquifer thickness	da	5.71E+01	m	
Bulk density of aquifer materials	ρ	1.70E+00	g/cm^3	
Effective porosity of aquifer	n	1.82E-01	fraction	
Hydraulic gradient	i	7.00E-03	fraction	
Hydraulic conductivity of aquifer	K	2.00E+01	m/d	
Distance to compliance point	x	8.50E+02	m	
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	7.94E-01	l/kg	*see options*
Longitudinal dispersivity	ax	11.114	m	*see options*
Transverse dispersivity	az	1.111	m	*see options*
Vertical dispersivity	av	0.111	m	*see options*

Calculated Parameters	Variable		
Groundwater flow velocity	v	7.69E-01	m/d
Retardation factor	Rf	8.42E+00	fraction
Decay rate used	λ	2.31E-03	d^{-1}
Rate of contaminant flow due to retardation	u	9.14E-02	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	1.61E-106	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	1.54E-106	mg/l
Attenuation factor (one way vertical dispersion, C_O/C_{ED})	AF	6.15E+07	
Attenuation factor (two way vertical dispersion, C_O/C_{ED})	AF	8.42E+07	

Remedial Targets

Remedial Target	LTC3	6.15E+04	mg/l	*For comparison with measured groundwater concentration.*
Ogata Banks				
Distance to compliance point		850	m	
Concentration of contaminant at compliance point	$C_{ED}/C0$	1.61E-106	mg/l	Ogata Banks
after		9.9E+99	days	

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	1.00E+00	fraction
Organic carbon partition coefficient	Koc	7.94E-01	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$		l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Soil water partition coefficient	Kd	7.94E-01	l/kg

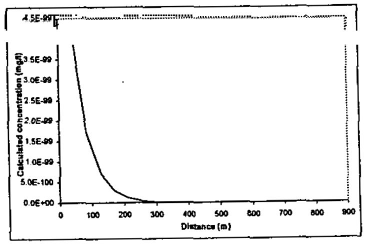
Dispersivity

Calculate dependant on distance to compliance point (0), specify dispersivity (1), or calc after Xu & Eckstein (2) ? 2

		Enter value	Calc value Xu & Eckstein	
Longitudinal dispersivity	ax		1.11E+01	m
Transverse dispersivity	az		1.11E+00	m
Vertical dispersivity	ay		1.11E-01	m

For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report ax = $0.83(\log_{10}x)^{2.414}$; az = ax/10, ay = ax/100 are assumed

ENVIRONMENT AGENCY



Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration
	mg/l
42.5	4.1E-99
85.0	1.7E-99
127.5	7.1E-100
170.0	2.9E-100
212.5	1.2E-100
255.0	4.7E-101
297.5	1.9E-101
340.0	7.7E-102
382.5	3.1E-102
425.0	1.3E-102
467.5	5.2E-103
510.0	2.1E-103
552.5	8.5E-104
595.0	3.5E-104
637.5	1.4E-104
680.0	5.8E-105
722.5	2.4E-105
765.0	9.6E-106
807.5	3.9E-106
850.0	1.6E-106

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.

This sheet calculates the Tier3 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

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 Tier 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.

Site being assessed	Bless 6 Res K20
Completed by	AJ
Date	24 11 2005
Version	12

R&D Publication20 Remedial Targets Worksheet, Release 2.2a

ENVIRONMENT AGENCY

Tier 3 -Groundwater

Input Parameters (using pull down menu)	Variable	Value	Unit	Source
Contaminant		Chloroethane		
Target Concentration	C_T	1.00E-03	mg/l	

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

Ogata Banks — Equations in R&D Pub. 20

Enter '1' to simulate vertical dispersion in one direction, '2' for two directions (pull down menu) 1

Enter '1' if biodegradation rate is for the substance in water,
'0' if rate is for decay in field conditions (i.e. field data from aquifer) (pull down menu 0

				Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	4.00E-02	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	5.60E+01	days	
Calculated decay rate	λ	1.24E-02	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	8.00E+01	m	
Plume thickness at source	Sy	5.60E+01	m	
Saturated aquifer thickness	da	5.71E+01	m	
Bulk density of aquifer materials	ρ	1.70E+00	g/cm^3	
Effective porosity of aquifer	n	1.82E-01	fraction	
Hydraulic gradient	i	7.00E-03	fraction	
Hydraulic conductivity of aquifer	K	2.00E+01	m/d	
Distance to compliance point	x	8.50E+02	m	
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	6.46E-02	l/kg	*see options*
Longitudinal dispersivity	ax	11.114	m	*see options*
Transverse dispersivity	az	1.111	m	*see options*
Vertical dispersivity	ay	0.111	m	*see options*

Calculated Parameters	Variable		
Groundwater flow velocity	v	7.69E-01	m/d
Retardation factor	Rf	1.60E+00	fraction
Decay rate used	λ	1.24E-02	d^{-1}
Rate of contaminant flow due to retardation	u	4.80E-01	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	4.81E-10	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	4.61E-10	mg/l
Attenuation factor (one way vertical dispersion, C_0/C_{ED})	AF	8.31E+07	
Attenuation factor (two way vertical dispersion, C_0/C_{ED})	AF	8.67E+07	

Remedial Targets

Remedial Target LTC3 8.31E+04 mg/l For comparison with measured groundwater concentration.

Ogata Banks

Distance to compliance point		850	m	
Concentration of contaminant at compliance point	$C_{ED}/C0$	4.81E-10	mg/l	Ogata Banks
after		9.9E+99	days	

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

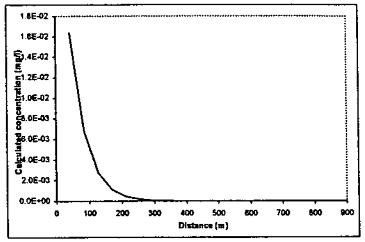
Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd	[redacted]	l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	1.00E+00	fraction
Organic carbon partition coefficient	Koc	6.46E-02	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$	[redacted]	l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Soil water partition coefficient	Kd	6.46E-02	l/kg

Dispersivity

Calculate dependant on distance to compliance point (0), 2
specify dispersivity (1), or calc after Xu & Eckstein (2) ?

		Enter value	Calc value Xu & Eckstein	
Longitudinal dispersivity	ax	[redacted]	1.11E+01	m
Transverse dispersivity	az		1.11E+00	m
Vertical dispersivity	ay		1.11E-01	m

For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report ax = $0.83(\log_{10}x)^{2.414}$; 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.

Calculated concentrations for distance-concentration graph

FromBankation sheet

Distance	Concentration
	mg/l
42.5	1.6E-02
86.0	6.7E-03
170.0	2.7E-03
212.5	4.4E-04
255.5	1.8E-04
340.0	2.8E-05
382.5	1.1E-05
425.0	4.4E-06
467.5	1.8E-06
510.0	7.1E-07
552.5	2.8E-07
637.5	4.6E-08
682.5	1.8E-08
766.0	3.0E-09
807.5	1.2E-09
850.0	4.8E-10

This sheet calculates the Tier3 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

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 Tier 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.

Site being assessed	Blessington Appeal
Completed by	Anna Jeffcoat
Date	########
Version	11

R&D Publication 20 Remedial Targets Worksheet, Release 2.2a

Tier 3 - Groundwater

ENVIRONMENT AGENCY

Input Parameters (using pull down menu) Variable Value Unit Source

Contaminant		Ethylbenzene	
Target Concentration	C_T	- 1.00E-02	mg/l

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

Ogata Banks — Equations in R&D Pub. 20

Enter '1' to simulate vertical dispersion in one direction, '2' for two directions (pull down menu) 1

Enter '1' if biodegradation rate is for the substance in water,
'0' if rate is for decay in field conditions (i.e. field data from aquifer) (pull down menu) 0

Parameter	Variable	Value	Unit	Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	9.90E-99	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	2.28E+02	days	
Calculated decay rate	λ	3.04E-03	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	8.00E+01	m	
Plume thickness at source	Sy	5.60E+01	m	
Saturated aquifer thickness	da	5.71E+01	m	
Bulk density of aquifer materials	ρ	1.70E+00	g/cm^3	
Effective porosity of aquifer	n	1.82E-01	fraction	
Hydraulic gradient	i	7.00E-03	fraction	
Hydraulic conductivity of aquifer	K	2.00E+01	m/d	
Distance to compliance point	x	8.50E+02	m	
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	1.32E+00	l/kg	*see options*
Longitudinal dispersivity	ax	11.114	m	*see options*
Transverse dispersivity	az	1.111	m	*see options*
Vertical dispersivity	ay	0.111	m	*see options*

Calculated Parameters Variable

Groundwater flow velocity	v	7.69E-01	m/d
Retardation factor	Rf	1.33E+01	fraction
Decay rate used	λ	3.04E-03	d^{-1}
Rate of contaminant flow due to retardation	u	5.78E-02	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	1.16E-112	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	1.11E-112	mg/l
Attenuation factor (one way vertical dispersion, C_0/C_{ED})	AF	8.51E+13	
Attenuation factor (two way vertical dispersion, C_0/C_{ED})	AF	8.88E+13	

Remedial Targets

Remedial Target LTC3 8.51E+11 mg/l For comparison with measured groundwater concentration.
Ogata Banks

Distance to compliance point 850 m

Concentration of contaminant at compliance point $C_{ED}/C0$ 1.16E-112 mg/l Ogata Banks
after 9.9E+99 days

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

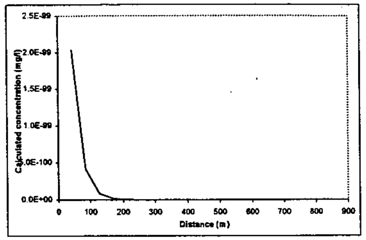
Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd		l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	1.00E+00	fraction
Organic carbon partition coefficient	Koc	1.32E+00	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$		l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Soil water partition coefficient	Kd	1.32E+00	l/kg

Dispersivity

Calculate dependant on distance to compliance point (0), specify dispersivity (1), or calc after Xu & Eckstein (2) ? 2

		Enter value	Calc value Xu & Eckstein	
Longitudinal dispersivity	ax		1.11E+01	m
Transverse dispersivity	az		1.11E+00	m
Vertical dispersivity	ay		1.11E-01	m

For calculated value, assumes ax = 0.1 * x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report ax = $0.83(\log_{10}x)^{2.414}$; 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.

This sheet calculates the Tier3 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

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 Tier 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.

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration
	mg/l
42.5	2.0E-99
85.0	4.2E-100
127.5	8.5E-101
170.0	1.7E-101
212.5	3.4E-102
255.0	6.8E-103
297.5	1.4E-103
340.0	2.7E-104
382.5	5.4E-105
425.0	1.1E-105
467.5	2.2E-106
510.0	4.3E-107
552.5	8.7E-108
595.0	1.7E-108
637.5	3.5E-109
680.0	7.0E-110
722.5	1.4E-110
765.0	2.8E-111
807.5	5.6E-112
850.0	1.2E-112

Site being assessed:	Bless 6 Res K20
Completed by	AJ
Date.	24 11 2005
Version	12

R&D Publication 20 Remedial Targets Worksheet, Release 2.2a

ENVIRONMENT AGENCY

Tier 3 - Groundwater

Input Parameters (using pull down menu)	Variable	Value	Unit	Source
Contaminant		Isopropylbenzene		
Target Concentration	C_T	1.00E-02	mg/l	

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

Ogata Banks — Equations in R&D Pub. 20

Enter '1' to simulate vertical dispersion in one direction, '2' for two directions (pull down menu): 1

Enter '1' if biodegradation rate is for the substance in water,
'0' if rate is for decay in field conditions (i.e. field data from aquifer) (pull down menu): 0

				Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	9.90E-99	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	7.20E+02	days	
Calculated decay rate	λ	9.63E-04	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	8.00E+01	m	
Plume thickness at source	Sy	5.60E+01	m	
Saturated aquifer thickness	da	5.71E+01	m	
Bulk density of aquifer materials	ρ	1.70E+00	g/cm^3	
Effective porosity of aquifer	n	1.82E-01	fraction	
Hydraulic gradient	i	7.00E-03	fraction	
Hydraulic conductivity of aquifer	K	2.00E+01	m/d	
Distance to compliance point	x	8.50E+02	m	
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	2.14E-01	l/kg	***see options***
Longitudinal dispersivity	ax	11.114	m	***see options***
Transverse dispersivity	az	1.111	m	***see options***
Vertical dispersivity	ay	0.111	m	***see options***

Calculated Parameters

Calculated Parameters	Variable		
Groundwater flow velocity	v	7.69E-01	m/d
Retardation factor	Rf	3.00E+00	fraction
Decay rate used	λ	9.63E-04	d^{-1}
Rate of contaminant flow due to retardation	u	2.57E-01	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	2.97E-100	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	2.84E-100	mg/l
Attenuation factor (one way vertical dispersion, C_0/C_{ED})	AF	3.34E+01	
Attenuation factor (two way vertical dispersion, C_0/C_{ED})	AF	3.48E+01	

Remedial Targets

Remedial Target	LTC3	3.34E-01	mg/l	For comparison with measured groundwater concentration.
Ogata Banks				
Distance to compliance point		850	m	
Concentration of contaminant at compliance point	$C_{ED}/C0$	2.97E-100	mg/l	Ogata Banks
after		9.9E+99	days	

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

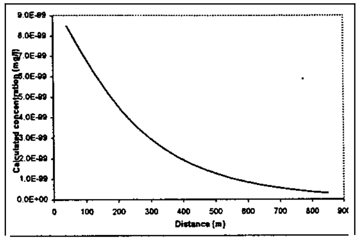
Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd	[redacted]	l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	1.00E+00	fraction
Organic carbon partition coefficient	Koc	2.14E-01	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$	[redacted]	l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Soil water partition coefficient	Kd	2.14E-01	l/kg

Dispersivity

Calculate dependant on distance to compliance point (0), specify dispersivity (1), or calc after Xu & Eckstein (2) ? 2

		Enter value	Calc value Xu & Eckstein	
Longitudinal dispersivity	ax	[redacted]	1.11E+01	m
Transverse dispersivity	az		1.11E+00	m
Vertical dispersivity	ay		1.11E-01	m

For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report ax = $0.83(\log_{10}x)^{2.414}$; 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.

Calculated concentrations for distance-concentration graph

Ogata Banks

DistancalcConcentration	mg/l
42.6	8.6E-99
85.0	7.3E-99
127.6	6.1E-99
170.0	5.2E-99
212.6	4.3E-99
255.0	3.6E-99
297.5	3.0E-99
	2.5E-99
380.6	
425.0	1.7E-99
197.6	1.4E-99
610.0	1.2E-99
662.6	1.0E-99
686.0	8.4E-100
U7.6	7.1E-100
582.6	5.9E-100
786.0	4.2E-100
807.5	3.5E-100
860.0	3.0E-100

This sheet calculates the Tier3 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

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 Tier 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.

Site being assessed.	Bless 6 Res K20
Completed by	AJ
Date.	24 11 2005
Version	12

R&D Publication 20 Remedial Targets Worksheet, Release 2.2a

Tier 3 -Groundwater

ENVIRONMENT AGENCY

Input Parameters (using pull down menu)	Variable	Value	Unit	Source
Contaminant		n- butylbenzene		
Target Concentration	C_T	1.00E-03	mg/l	

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

Ogata Banks — Equations in R&D Pub. 20

Enter '1' to simulate vertical dispersion in one direction, '2' for two directions (pull down menu) — 1

Enter '1' if biodegradation rate is for the substance in water,
'0' if rate is for decay in field conditions (i.e. field data from aquifer) (pull down menu — 0

				Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	9.90E-99	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	9.99E+99	days	
Calculated decay rate	λ	6.94E-101	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	8.00E+01	m	
Plume thickness at source	Sy	5.60E+01	m	
Saturated aquifer thickness	da	5.71E+01	m	
Bulk density of aquifer materials	ρ	1.70E+00	g/cm^3	
Effective porosity of aquifer	n	1.82E-01	fraction	
Hydraulic gradient	i	7.00E-03	fraction	
Hydraulic conductivity of aquifer	K	2.00E+01	m/d	
Distance to compliance point	x	8.50E+02	m	
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	8.91E+00	l/kg	*see options*
Longitudinal dispersivity	ax	11.114	m	*see options*
Transverse dispersivity	az	1.111	m	*see options*
Vertical dispersivity	ay	0.111	m	*see options*

Calculated Parameters	Variable		
Groundwater flow velocity	v	7.69E-01	m/d
Retardation factor	Rf	8.42E+01	fraction
Decay rate used	λ	6.94E-101	d^{-1}
Rate of contaminant flow due to retardation	u	9.13E-03	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	6.36E-99	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	6.10E-99	mg/l
Attenuation factor (one way vertical dispersion, C_0/C_{ED})	AF	1.56E+00	
Attenuation factor (two way vertical dispersion, C_0/C_{ED})	AF	1.62E+00	

Remedial Targets

Remedial Target	LTC3	1.56E-03	mg/l	For comparison with measured groundwater concentration.
Ogata Banks				
Distance to compliance point		850	m	
Concentration of contaminant at compliance point	$C_{ED}/C0$	6.36E-99	mg/l	Ogata Banks
after		9.9E+99	days	

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

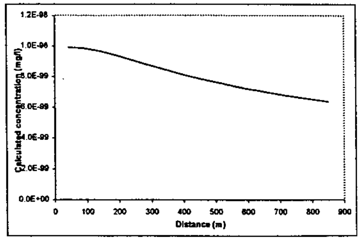
Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd		l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	1.00E+00	fraction
Organic carbon partition coefficient	Koc	8.91E+00	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$		l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Soil water partition coefficient	Kd	8.91E+00	l/kg

Dispersivity

Calculate dependant on distance to compliance point (0), specify dispersivity (1), or calc after Xu & Eckstein (2) ? — 2

		Enter value	Calc value Xu & Eckstein	
Longitudinal dispersivity	ax		1.11E+01	m
Transverse dispersivity	az		1.11E+00	m
Vertical dispersivity	ay		1.11E-01	m

For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x.
Xu & Eckstein (1995) report ax = $0.83(\log_{10}x)^{2.414}$; 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.

Calculated concentrations for distance-concentration graph

Ogata Banks Calculation sheet

Distance	Concentration
	mg/l
42.5	S.SE-59
85.0	9.9E-99
127.6	9.7E-99
170.0	I.SE-59
212.6	9.2E-99
255.0	9.0E-99
217.6	8.7E-59
340.0	8.5E-99
382.5	8.2E-99
426.0	8.0E-99
487.6	7.8E-59
510.0	7.6E-99
662.6	7.4E-99
696.0	7.2E-99
U7.6	7.0E-59
680.0	6.9E-99
722.5	6.7E-99
765.0	6.6E-99
607.6	6.5E-99
850.0	6.4E-99

This sheet calculates the Tier3 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

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 Tier 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.

Site being assessed:	Bloss 6 Res K20
Completed by:	AJ
Date:	24 11 2005
Version	12

ENVIRON
AGENCY

R&D Publication20 Remedial Targets Worksheet, Release 2.2a

Tier 3 - Groundwater

Input Parameters (using pull down menu)	Variable	Value	Unit	Source
Contaminant		Napthalene		
Target Concentration	C_T	1.00E-03	mg/l	

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

Ogata Banks — Equations in R&D Pub. 20

Enter '1' to simulate vertical dispersion in one direction, '2' for two directions (pull down menu): 1

Enter '1' if biodegradation rate is for the substance in water,
'0' if rate is for decay in field conditions (i.e. field data from aquifer) (pull down menu): 0

	Variable	Value	Unit	Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	9.90E-99	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	2.58E+02	days	
Calculated decay rate	λ	2.69E-03	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	8.00E+01	m	
Plume thickness at source	Sy	5.60E+01	m	
Saturated aquifer thickness	da	5.71E+01	m	
Bulk density of aquifer materials	ρ	1.70E+00	g/cm^3	
Effective porosity of aquifer	n	1.82E-01	fraction	
Hydraulic gradient	i	7.00E-03	fraction	
Hydraulic conductivity of aquifer	K	2.00E+01	m/d	
Distance to compliance point	x	8.50E+02	m	
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	7.24E+00	l/kg	*see options*
Longitudinal dispersivity	ax	11.114	m	*see options*
Transverse dispersivity	az	1.111	m	*see options*
Vertical dispersivity	av	0.111	m	*see options*

Calculated Parameters	Variable		
Groundwater flow velocity	v	7.69E-01	m/d
Retardation factor	Rf	6.87E+01	fraction
Decay rate used	λ	2.69E-03	d^{-1}
Rate of contaminant flow due to retardation	u	1.12E-02	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	5.04E-139	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	4.83E-139	mg/l
Attenuation factor (one way vertical dispersion, C_0/C_{ED})	AF	1.96E+40	
Attenuation factor (two way vertical dispersion, C_0/C_{ED})	AF	2.05E+40	

Remedial Targets

Remedial Target	LTCS	1.96E+37	mg/l
Ogata Banks			

For comparison with measured groundwater concentration.

Distance to compliance point		850	m	
Concentration of contaminant at compliance point	$C_{ED}/C0$	5.04E-139	mg/l	Ogata Banks
after		9.9E+99	days	

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

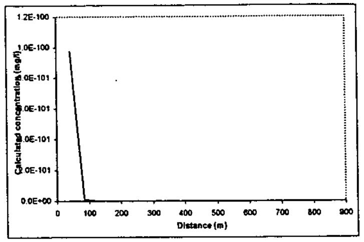
Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd		l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	1.00E+00	fraction
Organic carbon partition coefficient	Koc	7.24E+00	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$		l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Soil water partition coefficient	Kd	7.24E+00	l/kg

Dispersivity

Calculate dependant on distance to compliance point (0), specify dispersivity (1), or calc after Xu & Eckstein (2) ? 2

		Enter value	Calc value Xu & Eckstein	
Longitudinal dispersivity	ax		1.11E+01	m
Transverse dispersivity	az		1.11E+00	m
Vertical dispersivity	ay		1.11E-01	m

For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report ax = 0.83$(\log_{10}x)^{2.414}$; 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.

This sheet calculates the Tier3 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
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 Tier 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.

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration
	mg/l
42.5	9.8E-101
85.0	9.6E-103
127.6	9.4E-105
170.0	9.1E-107
212.5	8.7E-109
266.0	8.4E-111
297.5	8.0E-113
340.0	7.7E-115
382.5	7.4E-117
425.0	7.1E-119
467.5	6.8E-121
610.0	6.6E-123
552.5	6.4E-125
696.0	6.1E-127
680.6	5.9E-129
722.5	5.5E-133
7E6.0	5.4E-135
M7.6	5.2E-137
850.0	5.0E-139

Site being assessed	Bless 6 Res K20
Completed by	AJ
Date	24 11 2005
Version	12

R&D Publication 20 Remedial Targets Worksheet, Release 2.2a

Tier 3 -Groundwater

ENVIRONMENT AGENCY

Input Parameters (using pull down menu)

Input Parameters (using pull down menu)	Variable	Value	Unit	Source
Contaminant		Phenol		
Target Concentration	C_T	5.00E-04	mg/l	

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

Ogata Banks — Equations in R&D Pub. 20

Enter '1' to simulate vertical dispersion in one direction, '2' for two directions (pull down menu): 1

Enter '1' if biodegradation rate is for the substance in water,
'0' if rate is for decay in field conditions (i.e. field data from aquifer) (pull down menu: 0

	Variable	Value	Unit	Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	9.90E-99	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	1.00E+01	days	
Calculated decay rate	λ	6.93E-02	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	8.00E+01	m	
Plume thickness at source	Sy	5.60E+01	m	
Saturated aquifer thickness	da	5.71E+01	m	
Bulk density of aquifer materials	ρ	1.70E+00	g/cm^3	
Effective porosity of aquifer	n	1.82E-01	fraction	
Hydraulic gradient	i	7.00E-03	fraction	
Hydraulic conductivity of aquifer	K	2.00E+01	m/d	
Distance to compliance point	x	8.50E+02	m	
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	1.05E-01	l/kg	*see options*
Longitudinal dispersivity	ax	11.114	m	*see options*
Transverse dispersivity	az	1.111	m	*see options*
Vertical dispersivity	ay	0.111	m	*see options*

Calculated Parameters

Calculated Parameters	Variable		
Groundwater flow velocity	v	7.69E-01	m/d
Retardation factor	Rf	1.98E+00	fraction
Decay rate used	λ	6.93E-02	d^{-1}
Rate of contaminant flow due to retardation	u	3.89E-01	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	6.33E-132	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	6.07E-132	mg/l
Attenuation factor (one way vertical dispersion, C_0/C_{ED})	AF	1.56E+33	
Attenuation factor (two way vertical dispersion, C_0/C_{ED})	AF	1.63E+33	

Remedial Targets

Remedial Target Ogata Banks	LTC3	7.92E+29	mg/l	For comparison with measured groundwater concentration.
Distance to compliance point		850	m	
Concentration of contaminant at compliance point	$C_{ED}/C0$	6.33E-132	mg/l	Ogata Banks
after		9.9E+99	days	

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

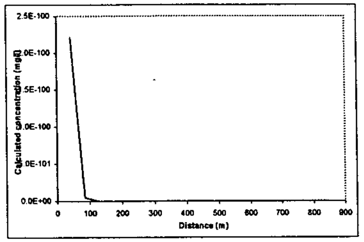
Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd	[redacted]	l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	1.00E+00	fraction
Organic carbon partition coefficient	Koc	1.05E-01	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$	[redacted]	l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Soil water partition coefficient	Kd	1.05E-01	l/kg

Dispersivity

Calculate dependant on distance to compliance point (0), specify dispersivity (1), or calc after Xu & Eckstein (2) ? 2

		Enter value	Calc value Xu & Eckstein	
Longitudinal dispersivity	ax	[redacted]	1.11E+01	m
Transverse dispersivity	az		1.11E+00	m
Vertical dispersivity	ay		1.11E-01	m

For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report $ax = 0.83(\log_{10}x)^{2.414}$; 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.

This sheet calculates the Tier3 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

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 Tier 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.

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration mg/l
42.5	2.2E-100
85.0	4.9E-102
127.5	1.1E-103
170.0	LIE-IO6
212.6	6.2E-107
255.0	1.1E-108
297.5	2.6E-110
340.0	6.3E-112
[illegible]	2.5E-115
467.5	6.5E-117
	[illegible]
[illegible]	
696.0	6.7E-122
637.5	1.2E-123
680.0	2.7E-125
722.5	6.0E-127
786.0	1.3E-128
807.6	2.9E-130
850.0	6.3E-132

Site being assessed:	Bloss 6 Res K20
Completed by:	AJ
Date	24 11 2005
Version	12

R&D Publication 20 Remedial Targets Worksheet, Release 2.2a

Tier 3 - Groundwater

ENVIRONMENT AGENCY

Input Parameters (using pull down menu)	Variable	Value	Unit	Source
Contaminant		Propylbenzene		
Target Concentration	C_T	1.00E-03	mg/l	

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

Ogata Banks — Equations in R&D Pub. 20

Enter '1' to simulate vertical dispersion in one direction, '2' for two directions (pull down menu) — 1

Enter '1' if biodegradation rate is for the substance in water,
'0' if rate is for decay in field conditions (i.e. field data from aquifer) (pull down menu — 0

	Variable	Value	Unit	Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	9.90E-99	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	7.20E+02	days	
Calculated decay rate	λ	9.63E-04	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	8.00E+01	m	
Plume thickness at source	Sy	5.60E+01	m	
Saturated aquifer thickness	da	5.71E+01	m	
Bulk density of aquifer materials	ρ	1.70E+00	g/cm^3	
Effective porosity of aquifer	n	1.82E-01	fraction	
Hydraulic gradient	i	7.00E-03	fraction	
Hydraulic conductivity of aquifer	K	2.00E+01	m/d	
Distance to compliance point	x	8.50E+02	m	
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	2.14E-01	l/kg	*see options*
Longitudinal dispersivity	ax	11.114	m	*see options*
Transverse dispersivity	az	1.111	m	*see options*
Vertical dispersivity	ay	0.111	m	*see options*

Calculated Parameters	Variable		
Groundwater flow velocity	v	7.69E-01	m/d
Retardation factor	Rf	3.00E+00	fraction
Decay rate used	λ	9.63E-04	d^{-1}
Rate of contaminant flow due to retardation	u	2.57E-01	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	2.97E-100	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	2.84E-100	mg/l
Attenuation factor (one way vertical dispersion, C_O/C_{ED})	AF	3.34E+01	
Attenuation factor (two way vertical dispersion, C_O/C_{ED})	AF	3.48E+01	

Remedial Targets

Remedial Target	LTCS	3.34E-02	mg/l	For comparison with measured groundwater concentration.
Ogata Banks				

Distance to compliance point		850	m	
Concentration of contaminant at compliance point	$C_{ED}/C0$	2.97E-100	mg/l	Ogata Banks
after		9.9E+99	days	

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

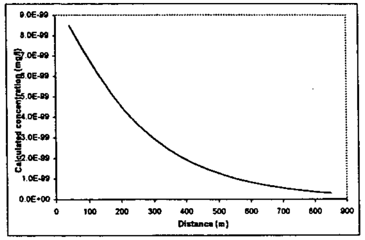
Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd	[redacted]	l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	1.00E+00	fraction
Organic carbon partition coefficient	Koc	2.14E-01	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$	[redacted]	l/kg
Sorption coefficient for ionised species	$K_{oc,i}$	[redacted]	l/kg
pH value	pH	[redacted]	
acid dissociation constant	pKa	[redacted]	
Soil water partition coefficient	Kd	2.14E-01	l/kg

Dispersivity

Calculate dependant on distance to compliance point (0), specify dispersivity (1), or calc after Xu & Eckstein (2) ? — 2

		Enter value	Calc value Xu & Eckstein	
Longitudinal dispersivity	ax	[redacted]	1.11E+01	m
Transverse dispersivity	az	[redacted]	1.11E+00	m
Vertical dispersivity	ay	[redacted]	1.11E-01	m

For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report ax = $0.83(\log_{10}x)^{2.414}$; 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.

This sheet calculates the Tier3 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

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 Tier 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

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration mg/l
42.5	8.5E-99
85.0	7.3E-99
127.5	6.1E-99
170.0	5.2E-99
212.5	4.3E-99
255.0	3.6E-99
297.5	3.0E-99
340.0	2.5E-99
382.5	2.1E-99
425.0	1.7E-99
467.5	1.4E-99
610.0	1.2E-M
552.5	1.0E-99
595.0	8.4E-100
637.5	7.1E-100
680.0	5.9E-100
722.5	5.0E-100
765.0	4.2E-100
807.5	3.5E-100
850.0	3.0E-100

Site being assessed	Bless 6 Res K20
Completed by	AJ
Date	24 11 2005
Version	12

ENVIRONMENT AGENCY

R&D Publication 20 Remedial Targets Worksheet, Release 2.2a

Tier 3 - Groundwater

Input Parameters (using pull down menu)

Input Parameters (using pull down menu)	Variable	Value	Unit	Source
Contaminant		sec butylbenzene		
Target Concentration	C_T	1.00E-03	mg/l	

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

Ogata Banks — Equations in R&D Pub. 20

Enter '1' to simulate vertical dispersion in one direction, '2' for two directions (pull down menu): 1

Enter '1' if biodegradation rate is for the substance in water,
'0' if rate is for decay in field conditions (i.e. field data from aquifer) (pull down menu): 0

	Variable	Value	Unit	Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	9.90E-99	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	7.20E+02	days	
Calculated decay rate	λ	9.63E-04	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	8.00E+01	m	
Plume thickness at source	Sy	5.60E+01	m	
Saturated aquifer thickness	da	5.71E+01	m	
Bulk density of aquifer materials	ρ	1.70E+00	g/cm^3	
Effective porosity of aquifer	n	1.82E-01	fraction	
Hydraulic gradient	i	7.00E-03	fraction	
Hydraulic conductivity of aquifer	K	2.00E+01	m/d	
Distance to compliance point	x	8.50E+02	m	
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	2.14E-01	l/kg	*see options*
Longitudinal dispersivity	ax	11.114	m	*see options*
Transverse dispersivity	az	1.111	m	*see options*
Vertical dispersivity	ay	0.111	m	*see options*

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

Calculate for non-polar organic chemicals

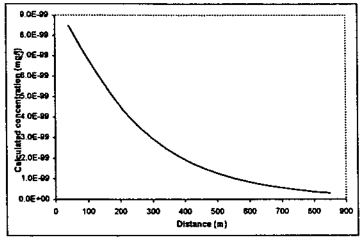
Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd		l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	1.00E+00	fraction
Organic carbon partition coefficient	Koc	2.14E-01	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$		l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Soil water partition coefficient	Kd	2.14E-01	l/kg

Dispersivity

Calculate dependant on distance to compliance point (0), specify dispersivity (1), or calc after Xu & Eckstein (2) ? 2

		Enter value	Calc value Xu & Eckstein	
Longitudinal dispersivity	ax		1.11E+01	m
Transverse dispersivity	az		1.11E+00	m
Vertical dispersivity	ay		1.11E-01	m

For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report ax = 0.83$(\log_{10}x)^{2.414}$; 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.

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration mg/l
42.5	8.5E-99
85.0	7.3E-99
127.5	6.1E-99
170.0	5.2E-99
212.5	4.3E-99
255.0	3.6E-99
297.5	3.0E-99
340.0	2.5E-99
382.5	2.1E-99
425.0	1.7E-99
467.5	1.4E-99
510.0	1.2E-99
552.5	1.0E-99
595.0	8.4E-100
637.5	7.1E-100
680.0	5.9E-100
722.5	5.0E-100
765.0	4.2E-100
807.5	3.5E-100
850.0	3.0E-100

This sheet calculates the Tier3 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

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 Tier 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.

Calculated Parameters

Calculated Parameters	Variable		
Groundwater flow velocity	v	7.69E-01	m/d
Retardation factor	Rf	3.00E+00	fraction
Decay rate used	λ	9.63E-04	d^{-1}
Rate of contaminant flow due to retardation	u	2.57E-01	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	2.97E-100	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	2.85E-100	mg/l
Attenuation factor (one way vertical dispersion, C_0/C_{ED})	AF	3.33E+01	
Attenuation factor (two way vertical dispersion, C_0/C_{ED})	AF	3.48E+01	

Site being assessed:	Biess 6 Res K20
Completed by:	AJ
Date.	24 11 2005
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Remedial Targets

Remedial Target	LTCS	3.33E-02	mg/l	For comparison with measured groundwater concentration.
Ogata Banks				

Distance to compliance point		850	m	
Concentration of contaminant at compliance point	$C_{ED}/C0$	2.97E-100	mg/l	Ogata Banks
after		9.9E+99	days	

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.

R&D Publication 20 Remedial Targets Worksheet, Release 2.2a

ENVIRONMENT AGENCY

Tier 3 - Groundwater

Input Parameters (using pull down menu)	Variable	Value	Unit	Source
Contaminant		Selenium		
Target Concentration	C_T	1.00E-02	mg/l	

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

Ogata Banks — Equations in R&D Pub. 20

Enter '1' to simulate vertical dispersion in one direction, '2' for two directions (pull down menu) 1

Enter '1' if biodegradation rate is for the substance in water,
'0' if rate is for decay in field conditions (i.e. field data from aquifer) (pull down menu 0

				Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	3.00E+00	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	9.90E+99	days	
Calculated decay rate	λ	7.00E-101	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	8.00E+01	m	
Plume thickness at source	Sy	5.60E+01	m	
Saturated aquifer thickness	da	5.71E+01	m	
Bulk density of aquifer materials	ρ	1.70E+00	g/cm^3	
Effective porosity of aquifer	n	1.82E-01	fraction	
Hydraulic gradient	i	7.00E-03	fraction	
Hydraulic conductivity of aquifer	K	2.00E+01	m/d	
Distance to compliance point	x	8.50E+02	m	
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	9.55E+00	l/kg	*see options*
Longitudinal dispersivity	ax	11.114	m	*see options*
Transverse dispersivity	az	1.111	m	*see options*
Vertical dispersivity	ay	0.111	m	*see options*

Calculated Parameters	Variable		
Groundwater flow velocity	v	7.69E-01	m/d
Retardation factor	Rf	9.02E+01	fraction
Decay rate used	λ	7.00E-101	d^{-1}
Rate of contaminant flow due to retardation	u	8.53E-03	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	1.93E+00	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	1.85E+00	mg/l
Attenuation factor (one way vertical dispersion, C_0/C_{ED})	AF	1.56E+00	
Attenuation factor (two way vertical dispersion, C_0/C_{ED})	AF	1.62E+00	

Remedial Targets

Remedial Target LTC3 1.56E-02 mg/l For comparison with measured groundwater concentration.
Ogata Banks

Distance to compliance point		850	m	
Concentration of contaminant at compliance point	$C_{ED}/C0$	1.93E+00	mg/l	Ogata Banks
after		9.9E+99	days	

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

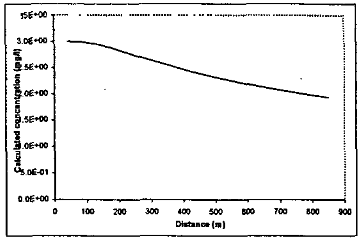
Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd	[redacted]	l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	1.00E+00	fraction
Organic carbon partition coefficient	Koc	9.55E+00	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$	[redacted]	l/kg
Sorption coefficient for ionised species	$K_{oc,i}$	[redacted]	l/kg
pH value	pH	[redacted]	
acid dissociation constant	pKa	[redacted]	
Soil water partition coefficient	Kd	9.55E+00	l/kg

Dispersivity

Calculate dependant on distance to compliance point (0), specify dispersivity (1), or calc after Xu & Eckstein (2) ? 2

		Enter value	Calc value Xu & Eckstein	
Longitudinal dispersivity	ax	[redacted]	1.11E+01	m
Transverse dispersivity	az	[redacted]	1.11E+00	m
Vertical dispersivity	ay	[redacted]	1.11E-01	m

For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report ax = $0.83(\log_{10}x)^{2.414}$; 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.

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration
	mg/l
42.5	3.0E+00
16.0	3.0E+00
127.5	2.9E+00
170.0	2.9E+00
212.5	2.8E+00
255.0	2.7E+00
297.5	2.6E+00
340.0	2.6E+00
[illegible]	2.4E+00
467.5	2.4E+00
610.0	2.3E+00
552.5	2.2E+00
595.0	2.2E+00
637.5	2.1E+00
680.0	2.1E+00
722.6	2.0E+00
765.0	2.0E+00
807.6	2.0E+00
850.0	1.9E+00

This sheet calculates the Tier3 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

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 Tier 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.

Site being assessed	Bless 6 Res K20
Completed by	AJ
Date	24 11 2005
Version	12

R&D Publication 20 Remedial Targets Worksheet, Release 2.2a

ENVIRONMENT AGENCY

Tier 3 - Groundwater

Input Parameters (using pull down menu)	Variable	Value	Unit	Source
Contaminant		Strontium		
Target Concentration	C_T	1.00E+00	mg/l	

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

Ogata Banks Equations in R&D Pub. 20

Enter '1' to simulate vertical dispersion in one direction, '2' for two directions (pull down menu) 1

Enter '1' if biodegradation rate is for the substance in water,
'0' if rate is for decay in field conditions (i.e. field data from aquifer) (pull down menu 0

	Variable	Value	Unit	Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	2.30E+01	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	9.90E+99	days	
Calculated decay rate	λ	7.00E-101	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	8.00E+01	m	
Plume thickness at source	Sy	5.60E+01	m	
Saturated aquifer thickness	da	5.71E+01	m	
Bulk density of aquifer materials	ρ	1.70E+00	g/cm^3	
Effective porosity of aquifer	n	1.82E-01	mdbn	
Hydraulic gradient	i	7.00E-03	fraction	
Hydraulic conductivity of aquifer	K	2.00E+01	m/d	
Distance to compliance point	x	8.50E+02	m	
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater		9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	M	0.00E+00	l/kg	*see options*
Longitudinal dispersivity	a	11 114	m	*see options*
Transverse dispersivity	az		m	*see options*
Vertical dispersivity	ay	0.111	m	*see options*

Calculated Parameters	Variable		
Groundwater flow velocity	v	7.69E-01	m/d
Retardation factor	Rf	1.00E+00	fraction
Decay rate used	λ	7.00E-101	d^{-1}
Rate of contaminant flow due to retardation	u	7.69E-01	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	1.48E+01	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	1.42E+01	mg/l
Attenuation factor (one way vertical dispersion, C_O/C_{ED})	AF	1.56E+00	
Attenuation factor (two way vertical dispersion, C_O/C_{ED})	AF	1.62E+00	

Remedial Targets

Remedial Target LTC3 1.56E+00 mg/l For comparison with measured groundwater concentration.
Ogata Banks

Distance to compliance point		850	m	
Concentration of contaminant at compliance point	$C_{ED}/C0$	1.48E+01	mg/l	Ogata Banks
after		9.9E+99	days	

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

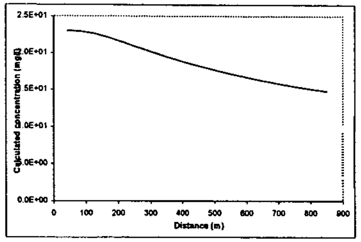
Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd		l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	1.00E+00	fraction
Organic carbon partition coefficient	Koc	0.00E+00	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$		l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Soil water partition coefficient	Kd	0.00E+00	l/kg

Dispersivity

Calculate dependant on distance to compliance point (0), specify dispersivity (1), or calc after Xu & Eckstein (2) ? 2

		Enter value	Calc value Xu & Eckstein	
Longitudinal dispersivity	ax		1.11E+01	m
Transverse dispersivity	az		1.11E+00	m
Vertical dispersivity	ay		1.11E-01	m

For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report $ax = 0.83(\log_{10}x)^{2.414}$; 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.

This sheet calculates the Tier3 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

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 Tier 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.

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration
	mg/l
42.6	2.3E+01
85.0	2.3E+01
127.6	2.3E+01
170.0	2.2E+01
212.6	2.1E+01
255.0	2.1E+01
297.5	2.0E+01
340.0	2.0E+01
382.5	1.9E+01
425.0	1.9E+01
467.5	1.8E+01
510.0	1.8E+01
552.5	1.7E+01
595.0	1.7E+01
637.5	1.6E+01
680.0	1.6E+01
722.5	1.6E+01
765.0	1.5E+01
807.5	1.5E+01
850.0	1.5E+01

Site being assessed	Sless 6 Res K20
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R&D Publication 20 Remedial Targets Worksheet, Release 2.2a

Tier 3 -Groundwater

ENVIRONMENT
AGENCY

Input Parameters (using pull down menu)	Variable	Value	Unit	Source
Contaminant		Sulphide		
Target Concentration	C_T	2.50E-04	mg/l	

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

Ogata Banks — Equations in R&D Pub. 20

Enter '1' to simulate vertical dispersion in one direction, '2' for two directions (pull down menu) 1

Enter '1' if biodegradation rate is for the substance in water,
'0' if rate is for decay in field conditions (i.e. field data from aquifer) (pull down menu) 0

	Variable	Value	Unit	Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	6.20E-01	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	9.90E+99	days	
Calculated decay rate	λ	7.00E-101	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	8.00E+01	m	
Plume thickness at source	Sy	5.60E+01	m	
Saturated aquifer thickness	da	5.71E+01	m	
Bulk density of aquifer materials	ρ	1.70E+00	g/cm^3	
Effective porosity of aquifer	n	1.82E-01	fraction	
Hydraulic gradient	i	7.00E-03	fraction	
Hydraulic conductivity of aquifer	K	2.00E+01	m/d	
Distance to compliance point	x	8.50E+02	m	
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	0.00E+00	l/kg	*see options*
Longitudinal dispersivity	ax	11.114	m	*see options*
Transverse dispersivity	az	1.111	m	*see options*
Vertical dispersivity	ay	0.111	m	*see options*

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

Calculate for non-polar organic chemicals

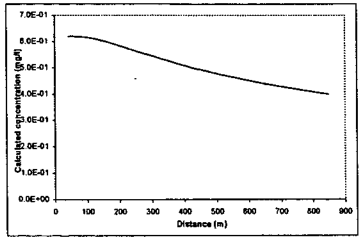
Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd	[redacted]	l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	1.00E+00	fraction
Organic carbon partition coefficient	Koc	0.00E+00	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$	[redacted]	l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Soil water partition coefficient	Kd	0.00E+00	l/kg

Dispersivity

Calculate dependant on distance to compliance point (0), specify dispersivity (1), or calc after Xu & Eckstein (2) ? 2

		Enter value	Calc value Xu & Eckstein	
Longitudinal dispersivity	ax	[redacted]	1.11E+01	m
Transverse dispersivity	az		1.11E+00	m
Vertical dispersivity	ay		1.11E-01	m

For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report ax = $0.83(\log_{10}x)^{2.414}$; 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.

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration
	mg/l
42.5	6.2E-01
85.0	6.2E-01
127.5	6.1E-01
170.0	6.0E-01
212.6	5.8E-01
255.0	5.6E-01
297.6	8.KE-M
340.0	5.3E-01
[illegible]	5.0E-01
467.5	4.9E-01
510.0	4.7E-01
552.5	4.6E-01
595.0	4.5E-01
087.6	4.4E-01
680.0	4.3E-01
722.5	4.2E-01
706.0	4.1E-M
807.5	4.1E-01
850.0	4.0E-M

This sheet calculates the Tier3 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

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 Tier 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.

Calculated Parameters	Variable		
Groundwater flow velocity	v	7.69E-01	m/d
Retardation factor	Rf	1.00E+00	fraction
Decay rate used	λ	7.00E-101	d^{-1}
Rate of contaminant flow due to retardation	u	7.69E-01	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	3.98E-01	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	3.82E-01	mg/l
Attenuation factor (one way vertical dispersion, C_0/C_{ED})	AF	1.56E+00	
Attenuation factor (two way vertical dispersion, C_0/C_{ED})	AF	1.62E+00	

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Remedial Targets

Remedial Target	LTC3	3.99E-04	mg/l	For comparison with measured groundwater concentration.
Ogata Banks				

Distance to compliance point		**850**	**m**	
Concentration of contaminant at compliance point	$C_{ED}/C0$	**3.98E-01**	**mg/l**	Ogata Banks
after		**9.9E+99**	**days**	

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.

R&D Publication20 Remedial Targets Worksheet, Release2.2a

Tier 3 -Groundwater

ENVIRONMENT AGENCY

Input Parameters (using pull dorm manu)	Variable	Value	Unit	Source
Contaminant		tert butylbenzne		
Target Concentration	C_T	1.00E-03	mg/l	

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

Ogata Banks — Equations in R&D Pub. 20

Enter '1' to simulate vertical dispersion in one direction, '2' for two directions (pull down menu) 1

Enter '1' if biodegradation rate is for the substance in water,
'0' if rate is for decay in field conditions (i.e. field data from aquifer) (pull down menu 0

	Variable	Value	Unit	Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	9.90E-99	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	9.99E+99	days	
Calculated decay rate	λ	6.94E-101	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	8.00E+01	m	
Plume thickness at source	Sy	5.60E+01	m	
Saturated aquifer thickness	da	5.71E+01	m	
Bulk density of aquifer materials	ρ	1.70E+00	g/cm^3	
Effective porosity of aquifer	n	1.82E-01	fraction	
Hydraulic gradient	i	7.00E-03	fraction	
Hydraulic conductivity of aquifer	K	2.00E+01	m/d	
Distance to compliance point	x	8.50E+02	m	
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	2.14E-01	l/kg	*see options*
Longitudinal dispersivity	ax	11.114	m	*see options*
Transverse dispersivity	az	1.111	m	*see options*
Vertical dispersivity	ay	0.111	m	*see options*

Calculated Parameters	Variable		
Groundwater flow velocity	v	7.69E-01	m/d
Retardation factor	Rf	3.00E+00	fraction
Decay rate used	λ	6.94E-101	d^{-1}
Rate of contaminant flow due to retardation	u	2.57E-01	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	6.36E-99	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	6.10E-99	mg/l
Attenuation factor (one way vertical dispersion, C_O/C_{ED})	AF	1.56E+00	
Attenuation factor (two way vertical dispersion, C_O/C_{ED})	AF	1.62E+00	

Remedial Targets

Remedial Target	**LTC3**	**1.56E-03**	**mg/l**
Ogata Banks			

For comparison with measured groundwater concentration.

Distance to compliance point		**850**	**m**	
Concentration of contaminant at compliance point	$C_{ED}/C0$	**6.36E-99**	**mg/l**	Ogata Banks
after		**9.9E+99**	**days**	

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

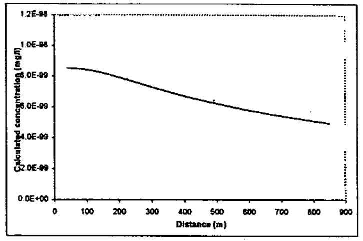
Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd	[redacted]	l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	1.00E+00	fraction
Organic carbon partition coefficient	Koc	2.14E-01	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$	[redacted]	l/kg
Sorption coefficient for ionised species	$K_{oc,i}$	[redacted]	l/kg
pH value	pH	[redacted]	
acid dissociation constant	pKa	[redacted]	
Soil water partition coefficient	Kd	2.14E-01	l/kg

Dispersivity

Calculate dependant on distance to compliance point (0), 2
specify dispersivity (1), or calc after Xu & Eckstein (2) ?

		Enter value	Calc value Xu & Eckstein	
Longitudinal dispersivity	**ax**	[redacted]	1.11E+01	m
Transverse dispersivity	**az**	[redacted]	1.11E+00	m
Vertical dispersivity	**ay**	[redacted]	1.11E-01	m

For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report $ax = 0.83(\log_{10}x)^{2.414}$; 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.

This sheet calculates the Tier3 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

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 Tier 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.

Calculated concentrations for distance-concentration graph

Ogata Banks

Distance	calc Concentration mg/l
426	9.9E-99
85.0	9.9E-99
127.6	9.7E-99
170.0	9.5E-99
212.5	9.2E-99
255.0	9.0E-99
297.5	8.7E-99
340.0	8.5E-99
382.5	8.2E-99
425.0	8.0E-99
467.5	7.8E-99
510.0	7.6E-99
552.5	7.4E-99
595.0	7.2E-99
637.5	7.0E-99
680.0	6.9E-99
722.5	6.7E-99
765.0	6.6E-99
807.5	6.5E-99
850.0	6.4E-99

Site being assessed	Bless 6 Res K20
Completed by	AJ
Date:	24 11 2005
Version	12

R&D Publication 20 Remedial Targets Worksheet, Release 2.2a

ENVIRONMENT AGENCY

Tier 3 - Groundwater

Input Parameters (using pull down menu)	Variable	Value	Unit	Source
Contaminant		Total Cyanide		
Target Concentration	C_T	1.00E-02	mg/l	

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

Ogata Banks — Equations in R&D Pub. 20

Enter '1' to simulate vertical dispersion in one direction, '2' for two directions (pull down menu): 1

Enter '1' if biodegradation rate is for the substance in water,
'0' if rate is for decay in field conditions (i.e. field data from aquifer) (pull down menu): 0

	Variable	Value	Unit	Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	6.40E+01	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	2.92E+01	days	
Calculated decay rate	λ	2.38E-02	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	8.00E+01	m	
Plume thickness at source	Sy	5.60E+01	m	
Saturated aquifer thickness	da	5.71E+01	m	
Bulk density of aquifer materials	ρ	1.70E+00	g/cm^3	
Effective porosity of aquifer	n	1.82E-01	fraction	
Hydraulic gradient	i	7.00E-03	fraction	
Hydraulic conductivity of aquifer	K	2.00E+01	m/d	
Distance to compliance point	x	8.50E+02	m	
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	9.90E+00	l/kg	*see options*
Longitudinal dispersivity	ax	11.114	m	*see options*
Transverse dispersivity	az	1.111	m	*see options*
Vertical dispersivity	ay	0.111	m	*see options*

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	1.00E+00	fraction
Organic carbon partition coefficient	Koc	9.90E+00	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$		l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Soil water partition coefficient	Kd	9.90E+00	l/kg

Dispersivity

Calculate dependant on distance to compliance point (0), specify dispersivity (1), or calc after Xu & Eckstein (2) ? 2

		Enter value	Calc value Xu & Eckstein	
Longitudinal dispersivity	ax		1.11E+01	m
Transverse dispersivity	az		1.11E+00	m
Vertical dispersivity	ay		1.11E-01	m

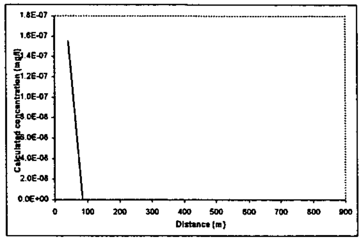
For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report ax = $0.83(\log_{10}x)^{2.414}$; az = ax/10, ay = ax/100 are assumed

Calculated Parameters	Variable		
Groundwater flow velocity	v	7.69E-01	m/d
Retardation factor	Rf	9.35E+01	fraction
Decay rate used	λ	2.38E-02	d^{-1}
Rate of contaminant flow due to retardation	u	8.23E-03	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	2.09E-171	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	2.00E-171	mg/l
Attenuation factor (one way vertical dispersion, C_0/C_{ED})	AF	3.07E+172	
Attenuation factor (two way vertical dispersion, C_0/C_{ED})	AF	3.20E+172	

Remedial Targets

Remedial Target Ogata Banks	LTC3	3.07E+170	mg/l	For comparison with measured groundwater concentration.
Distance to compliance point		850	m	
Concentration of contaminant at compliance point	$C_{ED}/C0$	2.09E-171	mg/l	Ogata Banks
after		9.9E+99	days	

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.



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.

This sheet calculates the Tier3 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 Tier 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.

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration mg/l
42.5	1.6E-07
85.0	3.5E-16
127.5	9.0E-25
170.0	2.1E-33
212.5	5.0E-42
255.0	1.2E-50
297.5	2.8E-59
340.0	6.6E-68
382.5	1.6E-76
425.0	3.7E-85
467.5	8.7E-94
510.0	2.1E-102
552.5	4.9E-111
595.0	1.2E-119
637.5	2.7E-128
680.0	6.5E-137
722.5	1.5E-145
765.0	3.7E-154
807.5	8.8E-163
850.0	2.1E-171

Site being assessed:	Bless 6 Res K20
Completed by	AJ
Date:	24 11 2005
Version	12

R&D Publication20 RemedialTargets Worksheet, Release2.2a

Tier 3 • Groundwater

ENVIRONMENT AGENCY

Input Parameters (using cull **down** menu)

	Variable	Value	unit	Source
Contaminant		Zinc		
Target Concentration	C_T	1.00E-01	mg/l	

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

Ogata Banks — Equations in R&D Pub. 20

Enter '1' to simulate vertical dispersion in one direction, '2' for two directions (pull down menu): 1

Enter '1' if biodegradation rate is for the substance in water,
'0' if rate is for decay in field conditions (i.e. field data from aquifer) (pull down menu): 0

				Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	1.47E-01	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	9.90E+99	days	
Calculated decay rate	λ	7.00E-101	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	8.00E+01	m	
Plume thickness at source	Sy	5.60E+01	m	
Saturated aquifer thickness	da	5.71E+01	m	
Bulk density of aquifer materials	P	1.70E+00	g/cm^3	
Effective porosity of aquifer		1.82E-01	fraction	
Hydraulic gradient		7.00E-03	fraction	
Hydraulic conductivity of aquifer	K	2.00E+01	m/d	
Distance to compliance point		8.50E+02	m	
Distance (lateral) to compliance point perpendicular to flow direction		0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction		0.00E+00	m	
Time since pollutant entered groundwater	I	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	0.00E+00	l/kg	*see options*
Longitudinal dispersivity	ax	11.114	m	*see options*
Transverse dispersivity	az	1.111	m	*see options*
Vertical dispersivity	y	0.111	m	*see options*

Calculated Parameters

	Variable		
Groundwater flow velocity	v	7.69E-01	m/d
Retardation factor	Rf	1.00E+00	fraction
Decay rate used	λ	7.00E-101	d^{-1}
Rate of contaminant flow due to retardation	u	7.69E-01	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	9.44E-02	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	9.05E-02	mg/l
Attenuation factor (one way vertical dispersion, C_0/C_{ED})	AF	1.56E+00	
Attenuation factor (two way vertical dispersion, C_0/C_{ED})	AF	1.62E+00	

Remedial Targets

Remedial Target	**LTC3**	**1.56E-01**	**mg/l**

For comparison with measured groundwater concentration.

Ogata Banks

Distance to compliance point		**850**	**m**	
Concentration of contaminant at compliance point	$C_{ED}/C0$	**9.44E-02**	**mg/l**	Ogata Banks
after		**9.9E+99**	**days**	

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

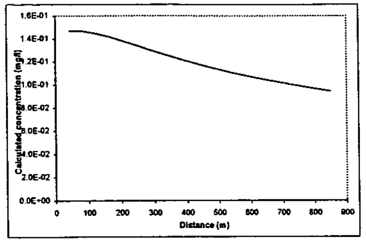
Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd		l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	1.00E+00	fraction
Organic carbon partition coefficient	Koc	0.00E+00	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$		l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Soil water partition coefficient	Kd	0.00E+00	l/kg

Dispersivity

Calculate dependant on distance to compliance point (0), specify dispersivity (1), or calc after Xu & Eckstein (2) ? 2

		Enter value	Calc value Xu & Eckstein	
Longitudinal dispersivity	**ax**		1.11E+01	m
Transverse dispersivity	**az**		1.11E+00	m
Vertical dispersivity	**ay**		1.11E-01	m

For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report ax = $0.83(\log_{10}x)^{2.414}$; 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.

This sheet calculates the Tier3 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

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 Tier 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.

Calculated concentrations for distance-concentration graph

Ogata Banks

Distance	Concentration mg/l
42.5	1.5E-01
86.0	1.5E-01
127.6	1.4E-01
170.0	1.4E-01
212.5	1.4E-01
255.0	1.3E-01
297.5	1.3E-01
340.0	1.3E-01
382.5	1.2E-01
425.0	1.2E-01
467.5	1.2E-01
510.0	1.1E-01
552.5	1.1E-01
696.0	1.1E-01
637.5	1.0E-01
680.0	1.0E-01
765.0	9.8E-02
807.5	9.6E-02
850.0	9.4E-02

Site being assessed	Bless 6 Res K20
Completed by.	AJ
Date	24 11 2005
Version	12

R&D Publication 20 Remedial Targets Worksheet, Release 2.2a

Tier 3 - Groundwater

ENVIRONMENT AGENCY

Input Parameters (using pull down menu)	Variable	Value	Unit	Source
Contaminant		1 2 4 trimethylbenzene		
Target Concentration	C_T	1.00E-02	mg/l	

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

Ogata Banks — Equations in R&D Pub. 20

Enter '1' to simulate vertical dispersion in one direction, '2' for two directions (pull down menu): 1

Enter '1' if biodegradation rate is for the substance in water,
'0' if rate is for decay in field conditions (i.e. field data from aquifer) (pull down menu: 0

	Variable	Value	Unit	Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	3.00E-03	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	3.60E+02	days	
Calculated decay rate	λ	1.93E-03	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	8.00E+01	m	
Plume thickness at source	Sy	5.60E+01	m	
Saturated aquifer thickness	da	5.71E+01	m	
Bulk density of aquifer materials	ρ	1.70E+00	g/cm^3	
Effective porosity of aquifer	n	1.82E-01	fraction	
Hydraulic gradient	i	7.00E-03	fraction	
Hydraulic conductivity of aquifer	K	2.00E+01	m/d	
Distance to compliance point	x	8.50E+02	m	
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	2.95E+01	l/kg	*see options*
Longitudinal dispersivity	ax	11.114	m	*see options*
Transverse dispersivity	az	1.111	m	*see options*
Vertical dispersivity	ay	0.111	m	*see options*

Calculated Parameters	Variable		
Groundwater flow velocity	v	7.69E-01	m/d
Retardation factor	Rf	2.77E+02	fraction
Decay rate used	λ	1.93E-03	d^{-1}
Rate of contaminant flow due to retardation	u	2.78E-03	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	1.87E-80	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	1.79E-80	mg/l
Attenuation factor (one way vertical dispersion, C_O/C_{ED})	AF	1.61E+77	
Attenuation factor (two way vertical dispersion, C_O/C_{ED})	AF	1.68E+77	

Remedial Targets

Remedial Target	LTC3	1.61E+75	mg/l	For comparison with measured groundwater concentration.
Ogata Banks				
Distance to compliance point		850	m	
Concentration of contaminant at compliance point	$C_{ED}/C0$	1.87E-80	mg/l	Ogata Banks
after		9.9E+99	days	

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

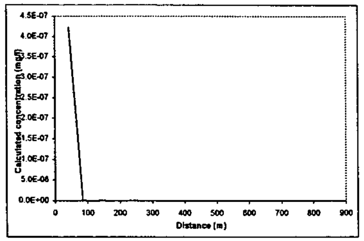
Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd		l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	1.00E+00	fraction
Organic carbon partition coefficient	Koc	2.95E+01	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$		l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Soil water partition coefficient	Kd	2.95E+01	l/kg

Dispersivity

Calculate dependant on distance to compliance point (0), specify dispersivity (1), or calc after Xu & Eckstein (2) ? 2

		Enter value	Calc value Xu & Eckstein	
Longitudinal dispersivity	ax		1.11E+01	m
Transverse dispersivity	az		1.11E+00	m
Vertical dispersivity	ay		1.11E-01	m

For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report ax = $0.83(\log_{10}x)^{2.414}$; 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.

This sheet calculates the Tier3 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

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 Tier 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.

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration
	mg/l
42.5	4.2E-07
85.0	5.9E-11
127.5	8.3E-15
170.0	1.1E-18
212.5	1.6E-22
255.0	2.1E-26
297.5	2.9E-30
340.0	4.0E-34
382.5	5.5E-38
425.0	7.5E-42
467.5	1.0E-45
510.0	1.4E-49
552.5	2.0E-53
595.0	2.7E-57
637.5	3.7E-61
680.0	5.1E-65
722.5	7.1E-69
796.0	9.8E-73
807.5	1.3E-76
850.0	1.9E-80

Site being assessed	Bless 6 Res K20
Completed by	AJ
Date:	24 11 2005
Version	12

R&D Publication 20 Remedial Targets Worksheet, Release 2.2a

Tier 3 - Groundwater

ENVIRONMENT AGENCY

Input Parameters (using pull down menu)	Variable	Value	Unit	Source
Contaminant		1 3 5 trimethylbenzene		
Target Concentration	C_T	1.00E-02	mg/l	

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

Ogata Banks — Equations in R&D Pub. 20

Enter '1 to simulate vertical dispersion in one direction, '2' for two directions (pull down menu) — 1

Enter '1' if biodegradation rate is for the substance in water,
'0' if rate is for decay in field conditions (i.e. field data from aquifer) (pull down menu) — 0

	Variable	Value	Unit	Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	1.00E-03	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	3.60E+02	days	
Calculated decay rate	λ	1.93E-03	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	8.00E+01	m	
Plume thickness at source	Sy	5.60E+01	m	
Saturated aquifer thickness	da	5.71E+01	m	
Bulk density of aquifer materials	ρ	1.70E+00	g/cm^3	
Effective porosity of aquifer	n	1.82E-01	fraction	
Hydraulic gradient	i	7.00E-03	fraction	
Hydraulic conductivity of aquifer	K	2.00E+01	m/d	
Distance to compliance point	x	8.50E+02	m	
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	2.95E+01	l/kg	*see options*
Longitudinal dispersivity	ax	11.114	m	*see options*
Transverse dispersivity	az	1.111	m	*see options*
Vertical dispersivity	ay	0.111	m	*see options*

Calculated Parameters	Variable		
Groundwater flow velocity	v	7.69E-01	m/d
Retardation factor	Rf	2.77E+02	fraction
Decay rate used	λ	1.93E-03	d^{-1}
Rate of contaminant flow due to retardation	u	2.78E-03	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	6.22E-81	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	5.96E-81	mg/l
Attenuation factor (one way vertical dispersion, C_0/C_{ED})	AF	1.61E+77	
Attenuation factor (two way vertical dispersion, C_0/C_{ED})	AF	1.68E+77	

Remedial Targets

Remedial Target Ogata Banks	LTC3	1.61E+75	mg/l	For comparison with measured groundwater concentration.
Distance to compliance point		850	m	
Concentration of contaminant at compliance point	$C_{ED}/C0$	6.22E-81	mg/l	Ogata Banks
after		9.9E+99	days	

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

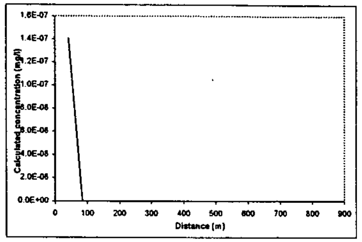
Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd		l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	1.00E+00	fraction
Organic carbon partition coefficient	Koc	2.95E+01	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$		l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Soil water partition coefficient	Kd	2.95E+01	l/kg

Dispersivity

Calculate dependant on distance to compliance point (0), specify dispersivity (1), or calc after Xu & Eckstein (2) ? — 2

		Enter value	Calc value Xu & Eckstein	
Longitudinal dispersivity	ax		1.11E+01	m
Transverse dispersivity	az		1.11E+00	m
Vertical dispersivity	ay		1.11E-01	m

For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report ax = $0.83(\log_{10}x)^{2.414}$; 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.

This sheet calculates the Tier3 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

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 Tier 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.

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration mg/l
42.5	1.4E-07
[illegible]	2.6E-15
170.0	3.8E-19
212.5	5.2E-23
255.0	7.1E-27
297.5	9.8E-31
340.0	1.3E-34
382.5	1.8E-38
425.0	2.5E-42
467.6	3.4E-46
610.0	4.7E-50
662.6	6.5E-54
595.0	9.0E-58
037.6	1.2E-61
680.0	1.7E-65
722.6	2.4E-69
766.0	3.3E-73
850.0	6.8E-87

Site being assessed.	Bless 6 Res K20
Completed by	AJ
Date	24 11 2005
Version	12

R&D Publication 20 Remedial Targets Worksheet, Release 2.2a

Tier 3 - Groundwater

ENVIRONMENT
AGENCY

Input Parameters (using pull down menu)

	Variable	Value	Unit	Source
Contaminant		1 4 Dichlorobenzene		
Target Concentration	C_T	1.00E-02	mg/l	

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

Ogata Banks — Equations in R&D Pub. 20

Enter '1' to simulate vertical dispersion in one direction, '2' for two directions (pull down menu): 1

Enter '1' if biodegradation rate is for the substance in water,
'0' if rate is for decay in field conditions (i.e. field data from aquifer) (pull down menu): 0

				Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	9.90E-99	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	3.60E+02	days	
Calculated decay rate	λ	1.93E-03	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	8.00E+01	m	
Plume thickness at source	Sy	5.60E+01	m	
Saturated aquifer thickness	da	5.71E+01	m	
Bulk density of aquifer materials	ρ	1.70E+00	g/cm^3	
Effective porosity of aquifer	n	1.82E-01	fraction	
Hydraulic gradient	i	7.00E-03	fraction	
Hydraulic conductivity of aquifer	K	2.00E+01	m/d	
Distance to compliance point	x	8.50E+02	m	
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	7.76E+00	l/kg	*see options*
Longitudinal dispersivity	ax	11.114	m	*see options*
Transverse dispersivity	az	1.111	m	*see options*
Vertical dispersivity	ay	0.111	m	*see options*

Calculated Parameters

	Variable		
Groundwater flow velocity	v	7.69E-01	m/d
Retardation factor	Rf	7.35E+01	fraction
Decay rate used	λ	1.93E-03	d^{-1}
Rate of contaminant flow due to retardation	u	1.05E-02	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	1.26E-132	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	1.20E-132	mg/l
Attenuation factor (one way vertical dispersion, C_0/C_{ED})	AF	7.89E+33	
Attenuation factor (two way vertical dispersion, C_0/C_{ED})	AF	8.23E+33	

Remedial Targets

Remedial Target	LTC3	7.89E+31	mg/l	For comparison with measured groundwater concentration.
Ogata Banks				
Distance to compliance point		**850**	**m**	
Concentration of contaminant at compliance point	**$C_{ED}/C0$**	**1.26E-132**	**mg/l**	Ogata Banks
after		**9.9E+99**	**days**	

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

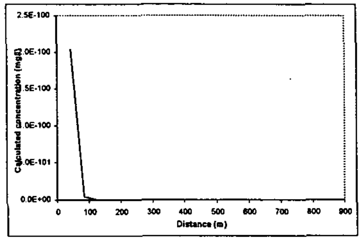
Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd		l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	1.00E+00	fraction
Organic carbon partition coefficient	Koc	7.76E+00	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$		l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Soil water partition coefficient	Kd	7.76E+00	l/kg

Dispersivity

Calculate dependant on distance to compliance point (0), specify dispersivity (1), or calc after Xu & Eckstein (2) ? 2

		Enter value	Calc value Xu & Eckstein	
Longitudinal dispersivity	**ax**		1.11E+01	m
Transverse dispersivity	**az**		1.11E+00	m
Vertical dispersivity	**ay**		1.11E-01	m

For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report ax = $0.83(\log_{10}x)^{2.414}$; 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.

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration
	mg/l
85.0	8.2E-102
127.6	8.6E-104
170.0	1.7E-105
212.6	3.5E-107
295.6	6.8E-109
340.0	2.8E-112
382.5	5.6E-114
465.6	2.3E-115
610.0	4.5E-119
662.6	9.1E-121
595.0	1.8E-122
917.6	3.7E-124
680.0	7.5E-126
722.5	1.5E-127
765.0	3.1E-129
807.5	6.2E-131
850.0	1.3E-132

This sheet calculates the Tier3 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

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 Tier 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.

Site being assessed:	Bless 6 Res K20
Completed by	AJ
Date.	24 11 2005
Version	12

R&D Publication 20 Remedial Targets Worksheet, Release 2.2a

Tier 3 - Groundwater

ENVIRONMENT AGENCY

Input Parameters (using pull down menu)	Variable	Value	Unit	Source
Contaminant		Aliphatic C8-C10		
Target Concentration	C_T	7.14E-04	mg/l	

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

Ogata Banks | Equations in R&D Pub. 20

Enter '1' to simulate vertical dispersion in one direction, '2' for two directions (pull down menu) | 1

Enter '1' if biodegradation rate is for the subetance in water,
'0' if rate is for decay in field conditions (i.e. field data from aquifer) (pull down menu | 0

				Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	2.12E-02	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	1.83E+03	days	
Calculated decay rate	λ	3.80E-04	days^{-1}	
Width of plume in aquifer at source (perpendicular to flow)	Sz	8.00E+01	m	
Plume thickness at source	Sy	5.60E+01	m	
Saturated aquifer thickness	da	5.71E+01	m	
Bulk density of aquifer materials	ρ	1.70E+00	g/cm^3	
Effective porosity of aquifer	n	1.82E-01	fraction	
Hydraulic gradient	i	7.00E-03	fraction	
Hydraulic conductivity of aquifer	K	2.00E+01	m/d	
Distance to compliance point	x	8.50E+02	m	
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	1.15E+02	l/kg	***see options***
Longitudinal dispersivity	ax	11.114	m	***see options***
Transverse dispersivity	az	1.111	m	***see options***
Vertical dispersivity	ay	0.111	m	***see options***

Calculated Parameters	Variable		
Groundwater flow velocity	v	7.69E-01	m/d
Retardation factor	Rf	1.07E+03	fraction
Decay rate used	λ	3.80E-04	d^{-1}
Rate of contaminant flow due to retardation	u	7.17E-04	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	2.77E-68	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	2.65E-68	mg/l
Attenuation factor (one way vertical dispersion, C_O/C_{ED})	AF	7.65E+65	
Attenuation factor (two way vertical dispersion, C_O/C_{ED})	AF	7.99E+65	

Remedial Targets

Remedial Target	LTC3	5.46E+02	mg/l	For comparison with measured groundwater concentration.
Ogata Banks				
Distance to compliance point		**850**	**m**	
Concentration of contaminant at compliance point	$C_{ED}/C0$	**2.77E-68**	**mg/l**	Ogata Banks
after		**9.9E+99**	**days**	

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

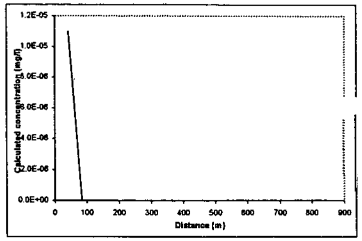
Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd		l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	1.00E+00	fraction
Organic carbon partition coefficient	Koc	1.15E+02	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$		l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Soil water partition coefficient	Kd	1.15E+02	l/kg

Dispersivity

Calculate dependant on distance to compliance point (0), specify dispersivity (1), or calc after Xu & Eckstein (2) ? | 2

		Enter value	Calc value Xu & Eckstein	
Longitudinal dispersivity	**ax**		1.11E+01	m
Transverse dispersivity	**az**		1.11E+00	m
Vertical dispersivity	**ay**		1.11E-01	m

For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report $ax = 0.83(\log_{10}x)^{2.414}$; 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.

This sheet calculates the Tier3 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
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 Tier 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.

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

men

Distance	Concentration
	1.1E-05
85.0 42.5	5.7E-09
127.5	2.9E-12
170.0	1.5E-15
212.5	7.5E-19
255.0	3.8E-22
297.5	1.9E-25
340.0	9.6E-29
382.5	4.8E-32
425.0	2.4E-35
467.5	1.2E-38
510.0	6.2E-42
552.5	3.2E-45
595.0	1.6E-48
637.5	8.1E-52
680.0	4.1E-55
722.5	2.1E-58
765.0	1.1E-61
807.5	5.4E-65
850.0	2.8E-68

Site being assessed	Bless 6 Res K20
Completed by	AJ
Date:	24 11 2005
Version	12

R&D Publication20 Remedial Targets Worksheet, Release 2.2a

ENVIRONMENT AGENCY

Tier 3 - Groundwater

Input Parameters (using pull down menu)	Variable	Value	Unit	Source
Contaminant		Aliphatic C10-C12		
Target Concentration	C_T	7.14E-04	mg/l	

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

Ogata Banks — Equations in R&D Pub. 20

Enter '1' to simulate vertical dispersion in one direction, '2' for two directions (pull down menu): 1

Enter '1' if biodegradation rate is for the substance in water,
'0' if rate is for decay in field conditions (i.e. field data from aquifer) (pull down menu): 0

	Variable	Value	Unit	Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	2.12E-02	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	1.83E+03	days	
Calculated decay rate	λ	3.80E-04	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	8.00E+01	m	
Plume thickness at source	Sy	5.60E+01	m	
Saturated aquifer thickness	da	5.71E+01	m	
Bulk density of aquifer materials	ρ	1.70E+00	g/cm^3	
Effective porosity of aquifer	n	1.82E-01	fraction	
Hydraulic gradient	i	7.00E-03	fraction	
Hydraulic conductivity of aquifer	K	2.00E+01	m/d	
Distance to compliance point	x	8.50E+02	m	
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	9.12E+02	l/kg	*see options*
Longitudinal dispersivity	ax	11.114	m	*see options*
Transverse dispersivity	az	1.111	m	*see options*
Vertical dispersivity	ay	0.111	m	*see options*

Calculated Parameters	Variable		
Groundwater flow velocity	v	7.69E-01	m/d
Retardation factor	Rf	8.52E+03	fraction
Decay rate used	λ	3.80E-04	d^{-1}
Rate of contaminant flow due to retardation	u	9.03E-05	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	1.12E-213	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	1.07E-213	mg/l
Attenuation factor (one way vertical dispersion, C_0/C_{ED})	AF	1.89E+211	
Attenuation factor (two way vertical dispersion, C_0/C_{ED})	AF	1.97E+211	

Remedial Targets

Remedial Target	LTC3	1.35E+208	mg/l	For comparison with measured groundwater concentration.
Ogata Banks				
Distance to compliance point		**850**	**m**	
Concentration of contaminant at compliance point	$C_{ED}/C0$	**1.12E-213**	**mg/l**	Ogata Banks
after		**9.9E+99**	**days**	

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

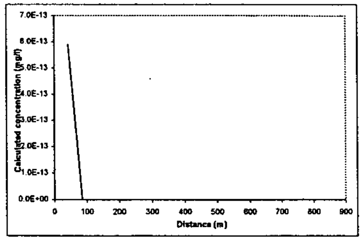
Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd	[redacted]	l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	1.00E+00	fraction
Organic carbon partition coefficient	Koc	9.12E+02	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$	[redacted]	l/kg
Sorption coefficient for ionised species	$K_{oc,i}$	[redacted]	l/kg
pH value	pH	[redacted]	
acid dissociation constant	pKa	[redacted]	
Soil water partition coefficient	Kd	9.12E+02	l/kg

Dispersivity

Calculate dependant on distance to compliance point (0), specify dispersivity (1), or calc after Xu & Eckstein (2) ? 2

		Enter value	Calc value Xu & Eckstein	
Longitudinal dispersivity	**ax**	[redacted]	1.11E+01	m
Transverse dispersivity	**az**	[redacted]	1.11E+00	m
Vertical dispersivity	**ay**	[redacted]	1.11E-01	m

For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report $ax = 0.83(\log_{10}x)^{2.414}$; 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.

This sheet calculates the Tier3 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

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 Tier 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.

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration
	mg/l
42.6	5.9E-13
85.0	1.6E-23
127.6	4.5E-34
170.0	1.2E-44
212.6	3.4E-55
266.0	9.1E-66
297.5	2.5E-76
340.0	6.7E-87
382.5	1.8E-97
426.0	4.9E-108
467.5	1.3E-118
610.0	3.6E-129
662.6	9.9E-140
595.0	2.7E-150
637.5	7.3E-161
680.0	2.0E-171
722.5	5.5E-182
765.0	1.5E-192
807.5	4.1E-203
850.0	1.1E-213

Site being assessed:	Bless 6 Res K20
Completed by	AJ
Date	24 11 2005
Version	12

R&D Publication 20 Remedial Targets Worksheet, Release 2.2a

ENVIRONMENT
AGENCY

Tier 3 - Groundwater

Input **Parameters (using** pull dorm menu)	Variable	Value	Unit	Source
Contaminant		Aliphatic C12-C16		
Target Concentration	C_T	7.14E-04	mg/l	

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

Ogata Banks — Equations in R&D Pub. 20

Enter '1' to simulate vertical dispersion in one direction, '2' for two directions (pull down menu) — 1

Enter '1' if biodegradation rate is for the substance in water,
'0' if rate is for decay in field conditions (i.e. field data from aquifer) (pull down menu — 0

	Variable	Value	Unit	Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	2.12E-02	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	1.83E+03	days	
Calculated decay rate	λ	3.80E-04	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	8.00E+01	m	
Plume thickness at source	Sy	5.60E+01	m	
Saturated aquifer thickness	da	5.71E+01	m	
Bulk density of aquifer materials	ρ	1.70E+00	g/cm^3	
Effective porosity of aquifer	n	1.82E-01	fraction	
Hydraulic gradient	i	7.00E-03	fraction	
Hydraulic conductivity of aquifer	K	2.00E+01	m/d	
Distance to compliance point	x	8.50E+02	m	
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	1.82E+04	l/kg	*see options*
Longitudinal dispersivity	ax	11.114	m	*see options*
Transverse dispersivity	az	1.111	m	*see options*
Vertical dispersivity	ay	0.111	m	*see options*

Calculated Parameters	Variable		
Groundwater flow velocity	v	7.69E-01	m/d
Retardation factor	Rf	1.70E+05	fraction
Decay rate used	λ	3.80E-04	d^{-1}
Rate of contaminant flow due to retardation	u	4.53E-06	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	INUY!	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	#NUM!	mg/l
Attenuation factor (one way vertical dispersion, C_0/C_{ED})	AF	#NUM!	
Attenuation factor (two way vertical dispersion, C_0/C_{ED})	AF	#NUM!	

Remedial Targets

Remedial Target	LTC3	#NUM!	mg/l	For comparison with measured groundwater concentration.
Ogata Banks				
Distance to compliance point		850	m	
Concentration of contaminant at compliance point	$C_{ED}/C0$	#NUM!	mg/l	Ogata Banks
after		9.9E+99	days	

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

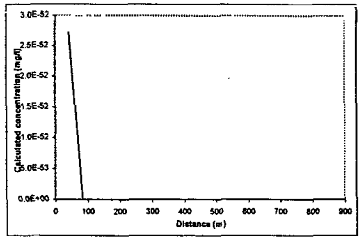
Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd		l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	1.00E+00	fraction
Organic carbon partition coefficient	Koc	1.82E+04	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$		l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Soil water partition coefficient	Kd	1.82E+04	l/kg

Dispersivity

Calculate dependant on distance to compliance point (0), specify dispersivity (1), or calc after Xu & Eckstein (2) ? — 2

		Enter value	Calc value Xu & Eckstein	
Longitudinal dispersivity	ax		1.11E+01	m
Transverse dispersivity	az		1.11E+00	m
Vertical dispersivity	ay		1.11E-01	m

For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report $ax = 0.83(\log_{10}x)^{2.414}$; 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.

This sheet calculates the Tier3 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
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 Tier 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.

Calculated concentrations for **distance-concentration graph**

Ogata Banks
From calculation sheet

Distance	Concentration
	mg/l
42.5	2.7E-52
85.0	3.5E-102
127.5	4.4E-152
170.0	5.5E-202
212.5	6.9E-252
255.0	#NUM!
297.5	#NUM!
340.0	#NUM!
382.5	#NUM!
425.0	#NUM!
467.5	#NUM!
510.0	#NUM!
552.5	#NUM!
595.0	#NUM!
637.5	#NUM!
680.0	#NUM!
722.5	#NUM!
765.0	#NUM!
807.5	#NUM!
850.0	#NUM!

Site being assessed	Bless 6 Res K20
Completed by	AJ
Date.	24 11 2005
Version:	12

R&D Publication 20 Remedial Targets Worksheet, Release 2.2a

Tier 3 - Groundwater

Input Parameters (using pull down menu)	Variable	Value	Unit	Source
Contaminant		Aromatic C12-C18		
Target Concentration	C_T	7.14E-04	mg/l	

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

Ogata Banks — Equations in R&D Pub. 20

Enter '1' to simulate vertical dispersion in one direction, '2' for two directions (pull down menu) 1

Enter '1' if biodegradation rate is for the substance in water,
'0' if rate is for decay in field conditions (i.e. field data from aquifer) (pull down menu) 0

	Variable	Value	Unit	Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	2.12E-02	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	1.83E+03	days	
Calculated decay rate	λ	3.80E-04	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	8.00E+01	m	
Plume thickness at source	Sy	5.60E+01	m	
Saturated aquifer thickness	da	5.71E+01	m	
Bulk density of aquifer materials	ρ	1.70E+00	g/cm^3	
Effective porosity of aquifer	n	1.82E-01	fraction	
Hydraulic gradient	i	1.25E-02	fraction	
Hydraulic conductivity of aquifer	K	2.00E+01	m/d	
Distance to compliance point	x	8.30E+02	m	
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	1.82E+01	l/kg	*see options*
Longitudinal dispersivity	ax	11.020	m	*see options*
Transverse dispersivity	az	1.102	m	*see options*
Vertical dispersivity	ay	0.110	m	*see options*

Calculated Parameters	Variable		
Groundwater flow velocity	v	1.37E+00	m/d
Retardation factor	Rf	1.71E+02	fraction
Decay rate used	λ	3.80E-04	d^{-1}
Rate of contaminant flow due to retardation	u	8.04E-03	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	5.96E-15	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	5.73E-15	mg/l
Attenuation factor (one way vertical dispersion, C_0/C_{ED})	AF	3.56E+12	
Attenuation factor (two way vertical dispersion, C_0/C_{ED})	AF	3.70E+12	

Remedial Targets

Remedial Target Ogata Banks	LTC3	2.54E+09	mg/l	For comparison with measured groundwater concentration.
Distance to compliance point		830	m	
Concentration of contaminant at compliance point	$C_{ED}/C0$	5.96E-15	mg/l	Ogata Banks
after		9.9E+99	days	

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

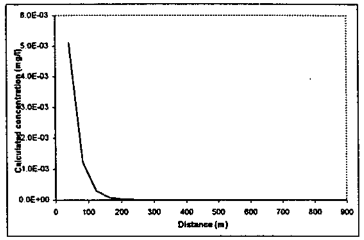
Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd		l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	1.00E+00	fraction
Organic carbon partition coefficient	Koc	1.82E+01	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$		l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Soil water partition coefficient	Kd	1.82E+01	l/kg

Dispersivity

Calculate dependant on distance to compliance point (0), specify dispersivity (1), or calc after Xu & Eckstein (2) ? 2

		Enter value	Calc value Xu & Eckstein	
Longitudinal dispersivity	ax		1.10E+01	m
Transverse dispersivity	az		1.10E+00	m
Vertical dispersivity	ay		1.10E-01	m

For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report ax = $0.83(\log_{10}x)^{2.414}$; 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.

This sheet calculates the Tier3 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
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 Tier 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.

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration
	mg/l
41.5	5.1E-03
83.0	1.2E-03
124.5	2.9E-04
166.0	6.9E-05
207.5	1.6E-05
249.0	3.8E-06
290.5	8.8E-07
332.0	2.1E-07
373.5	4.8E-08
415.0	1.1E-08
456.5	2.7E-09
498.0	6.3E-10
539.5	1.5E-10
581.0	3.5E-11
622.5	8.1E-12
664.0	1.9E-12
705.5	4.5E-13
747.0	1.1E-13
788.5	2.6E-14
830.0	6.0E-15

Site being assessed	Blessington Area 6 A Downshire K20
Completed by	AJ
Date.	24 11 2005
Version	12

R&D Publication20 Remedial Targets Worksheet, Release 2.2a

Tier 3 - Groundwater

ENVIRONMENT
AGENCY

Input Parameters (using pull down menu) Variable Value Unit Source

	Variable	Value	Unit
Contaminant		Aromatic C16-C21	
Target Concentration	C_T	7.14E-04	mg/l

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

Ogata Banks — Equations in R&D Pub. 20

Enter '1' to simulate vertical dispersion in one direction, '2' for two directions (pull down menu) 1

Enter '1' if biodegradation rate is for the substance in water,
'0' if rate is for decay in field conditions (i.e. field data from aquifer) (pull down menu 0

	Variable	Value	Unit	Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	2.12E-02	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	3.65E+03	days	
Calculated decay rate	λ	1.90E-04	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	8.00E+01	m	
Plume thickness at source	Sy	5.60E+01	m	
Saturated aquifer thickness	da	5.71E+01	m	
Bulk density of aquifer materials	ρ	1.70E+00	g/cm^3	
Effective porosity of aquifer	n	1.82E-01	fraction	
Hydraulic gradient	i	1.25E-02	fraction	
Hydraulic conductivity of aquifer	K	2.00E+01	m/d	
Distance to compliance point	x	8.30E+02	m	
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	5.75E+01	l/kg	*see options*
Longitudinal dispersivity	ax	11.020	m	*see options*
Transverse dispersivity	az	1.102	m	*see options*
Vertical dispersivity	ay	0.110	m	*see options*

Calculated Parameters Variable

	Variable	Value	Unit
Groundwater flow velocity	v	1.37E+00	m/d
Retardation factor	Rf	5.38E+02	fraction
Decay rate used	λ	1.90E-04	d^{-1}
Rate of contaminant flow due to retardation	u	2.55E-03	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	4.52E-20	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	4.34E-20	mg/l
Attenuation factor (one way vertical dispersion, C_0/C_{ED})	AF	4.69E+17	
Attenuation factor (two way vertical dispersion, C_0/C_{ED})	AF	4.88E+17	

Remedial Targets

Remedial Target	**LTC3**	**3.35E+14**	**mg/l**
Ogata Banks			

For comparison with measured groundwater concentration.

Distance to compliance point		**830**	**m**	
Concentration of contaminant at compliance point	$C_{ED}/C0$	**4.52E-20**	**mg/l**	Ogata Banks
after		**9.9E+99**	**days**	

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

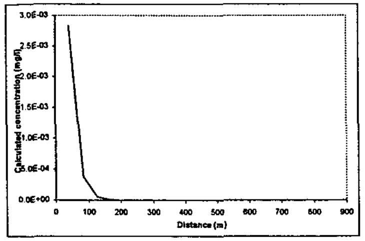
Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd	[redacted]	l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	1.00E+00	fraction
Organic carbon partition coefficient	Koc	5.75E+01	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$	[redacted]	l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Soil water partition coefficient	Kd	5.75E+01	l/kg

Dispersivity

Calculate dependant on distance to compliance point (0), 2
specify dispersivity (1), or calc after Xu & Eckstein (2) ?

		Enter value	Calc value Xu & Eckstein	
Longitudinal dispersivity	ax	[redacted]	1.10E+01	m
Transverse dispersivity	az		1.10E+00	m
Vertical dispersivity	ay		1.10E-01	m

For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report $ax = 0.83(\log_{10}x)^{2.414}$; 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.

This sheet calculates the Tier3 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

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 Tier 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.

Calculated concentrations for distance-concentration graph

Ogata Banks
DistancalcConcentration

	mg/l
41.5	2.8E-03
83.0	3.8E-04
166.0	6.6E-06
207.5	8.5E-07
N . O	1.1E-07
290.5	1.4E-08
332.0	1.9E-09
'37'3.6	2.4E-10
415.0	3.1E-11
456.5	4.1E-12
498.0	5.3E-13
539.5	6.9E-14
581.0	9.0E-15
622.5	1.2E-15
664.0	1.5E-16
705.5	2.0E-17
747.0	2.6E-18
768.S	3.4E-19
830.0	4.5E-20

Site being assessed	Blessington Area 6 A Downshire K20
Completed by	AJ
Date	24 11 2005
Version	12

R8D Publication20 Remedial Targets Worksheet, Release 2.2a

Tier 3 -Groundwater

ENVIRONMENT AGENCY

Input Parameters (using pull down menu)	Variable	Value	Unit	Source
Contaminant		Aromatic C21-C35		
Target Concentration	C_T	7.14E-04	mg/l	

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

Ogata Banks — Equations in R&D Pub. 20

Enter '1' to simulate vertical dispersion in one direction, '2' for two directions (pull down menu): 1

Enter '1' if biodegradation rate is for the substance in water,
'0' if rate is for decay in field conditions (i.e. field data from aquifer) (pull down menu): 0

	Variable	Value	Unit	Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	2.12E-02	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	3.65E+03	days	
Calculated decay rate	λ	1.90E-04	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	8.00E+01	m	
Plume thickness at source	Sy	5.60E+01	m	
Saturated aquifer thickness	da	5.71E+01	m	
Bulk density of aquifer materials	ρ	1.70E+00	g/cm^3	
Effective porosity of aquifer	n	1.82E-01	fraction	
Hydraulic gradient	i	1.25E-02	fraction	
Hydraulic conductivity of aquifer	K	2.00E+01	m/d	
Distance to compliance point	x	8.30E+02	m	
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	4.57E+02	l/kg	*see options*
Longitudinal dispersivity	ax	11.020	m	*see options*
Transverse dispersivity	az	1.102	m	*see options*
Vertical dispersivity	ay	0.110	m	*see options*

Calculated Parameters	Variable		
Groundwater flow velocity	v	1.37E+00	m/d
Retardation factor	Rf	4.27E+03	fraction
Decay rate used	λ	1.90E-04	d^{-1}
Rate of contaminant flow due to retardation	u	3.22E-04	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	3.02E-71	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	2.90E-71	mg/l
Attenuation factor (one way vertical dispersion, C_0/C_{ED})	AF	7.02E+68	
Attenuation factor (two way vertical dispersion, C_0/C_{ED})	AF	7.30E+68	

Remedial Targets

Remedial Target	LTC3	5.02E+65	mg/l

For comparison with measured groundwater concentration.

Ogata Banks

Distance to compliance point		830	m	
Concentration of contaminant at compliance point	$C_{ED}/C0$	3.02E-71	mg/l	Ogata Banks
after		9.9E+99	days	

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

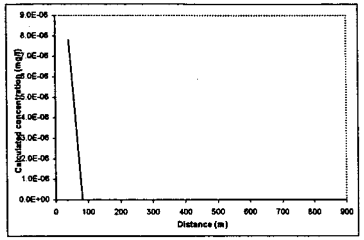
Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd		l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	1.00E+00	fraction
Organic carbon partition coefficient	Koc	4.57E+02	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$		l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Soil water partition coefficient	Kd	4.57E+02	l/kg

Dispersivity

Calculate dependant on distance to compliance point (0), specify dispersivity (1), or calc after Xu & Eckstein (2) ? 2

		Enter value	Calc value Xu & Eckstein	
Longitudinal dispersivity	ax		1.10E+01	m
Transverse dispersivity	az		1.10E+00	m
Vertical dispersivity	ay		1.10E-01	m

For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report ax = 0.83$(\log_{10}x)^{2.414}$; 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.

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration
	mg/l
41.5	7.8E-06
83.0	2.9E-09
124.6	1.0E-12
IU.O	3.8E-16
207.5	1.4E-19
249.0	4.9E-23
290.5	1.7E-26
332.0	6.3E-30
373.6	2.2E-33
416.0	8.1E-37
456.5	2.9E-40
498.0	1.0E-43
539.5	3.8E-47
681.0	1.4E-50
622.5	4.9E-54
664.0	1.8E-57
706.6	6.4E-61
747.0	2.3E-64
788.5	8.3E-68
830.0	3.0E-71

This sheet calculates the Tier3 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

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 Tier 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.

Site being assessed	Blessington Area 6 A Downshire K20
Completed by	AJ
Date.	24 11 2005
Version	12

R&D Publication 20 Remedial Targets Worksheet, Release 2.2a

Tier 3 - Groundwater

ENVIRONMENT AGENCY

Input Parameters (using pull down menu)	Variable	Value	Unit	Source
Contaminant		Arsenic		
Target Concentration	C_T	1.00E-02	mg/l	

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

Ogata Banks — Equations in R&D Pub. 20

Enter '1' to simulate vertical dispersion in one direction, '2' for two directions (pull down menu): 1

Enter '1' if biodegradation rate is for the substance in water,
'0' if rate is for decay in field conditions (i.e. field data from aquifer) (pull down menu: 0

				Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	9.90E-99	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	9.90E+99	days	
Calculated decay rate	λ	7.00E-101	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	8.00E+01	m	
Plume thickness at source	Sy	5.60E+01	m	
Saturated aquifer thickness	da	5.71E+01	m	
Bulk density of aquifer materials	ρ	1.70E+00	g/cm^3	
Effective porosity of aquifer	n	1.82E-01	fraction	
Hydraulic gradient	i	1.25E-02	fraction	
Hydraulic conductivity of aquifer	K	2.00E+01	m/d	
Distance to compliance point	x	8.30E+02	m	
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	1.17E+02	l/kg	*see options*
Longitudinal dispersivity	ax	11.020	m	*see options*
Transverse dispersivity	az	1.102	m	*see options*
Vertical dispersivity	ay	0.110	m	*see options*

Calculated Parameters	Variable		
Groundwater flow velocity	V	1.37E+00	m/d
Retardation factor	Rf	1.10E+03	fraction
Decay rate used	λ	7.00E-101	d^{-1}
Rate of contaminant flow due to retardation	u	1.25E-03	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	6.44E-99	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	6.19E-99	mg/l
Attenuation factor (one way vertical dispersion, C_O/C_{ED})	AF	1.54E+00	
Attenuation factor (two way vertical dispersion, C_O/C_{ED})	AF	1.60E+00	

Remedial Targets

Remedial Target	LTC3	1.54E-02	mg/l

For comparison with measured groundwater concentration.

Ogata Banks

Distance to compliance point		830	m	
Concentration of contaminant at compliance point	$C_{ED}/C0$	6.44E-99	mg/l	Ogata Banks
after		9.9E+99	days	

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

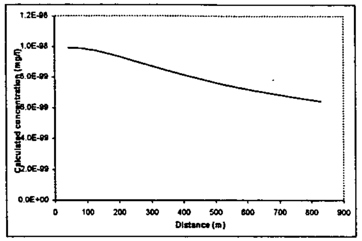
Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd		l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	1.00E+00	fraction
Organic carbon partition coefficient	Koc	1.17E+02	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$		l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Soil water partition coefficient	Kd	1.17E+02	l/kg

Dispersivity

Calculate dependant on distance to compliance point (0), specify dispersivity (1), or calc after Xu & Eckstein (2) ? 2

		Enter value	Calc value Xu & Eckstein	
Longitudinal dispersivity	ax		1.10E+01	m
Transverse dispersivity	az		1.10E+00	m
Vertical dispersivity	ay		1.10E-01	m

For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report ax = $0.83(\log_{10}x)^{2.414}$; 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.

This sheet calculates the Tier3 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

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 Tier 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.

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration mg/l
41.6	9.9E-99
83.0	9.9E-99
124.5	9.7E-99
166.0	9.5E-99
207.6	9.3E-99
249.0	9.0E-99
290.5	8.8E-99
332.0	8.5E-99
171.6	8.3E-99
416.0	8.1E-99
456.5	7.8E-99
498.0	7.6E-99
539.5	7.5E-99
581.0	7.3E-99
622.5	7.1E-99
664.0	7.0E-99
706.6	IJE-98
747.0	6.7E-99
7W.6	6.6E-99
830.0	6.4E-99

Site being assessed.	Blessington Area 6 A Downshire K20
Completed by	AJ
Date	24 11 2005
Version	12

R&D Publication20 Remedial Targets Worksheet, Release 2.2a

ENVIRONMENT AGENCY

Tier 3 • Groundwater

Input Parameters (using pull down menu)	Variable	Value	Unit	Source
Contaminant		Benzene		
Target Concentration	C_T	1.00E-03	mg/l	

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

Ogata Banks — Equations, in R&D Pub. 20

Enter '1' to simulate vertical dispersion in one direction, '2' for two directions (pull down menu) 1

Enter '1' if biodegradation rate is for the substance in water,
'0' if rate is for decay in field conditions (i.e. field data from aquifer) (pull down menu 0

				Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	9.90E-99	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	7.20E+02	days	
Calculated decay rate	λ	9.63E-04	days^{-1}	
Width of plume in aquifer at source (perpendicular to flow)	Sz	8.00E+01	m	
Plume thickness at source	Sy	5.60E+01	m	
Saturated aquifer thickness	da	5.71E+01	m	
Bulk density of aquifer materials	ρ	1.70E+00	g/cm^3	
Effective porosity of aquifer	n	1.82E-01	fraction	
Hydraulic gradient	i	1.25E-02	fraction	
Hydraulic conductivity of aquifer	K	2.00E+01	m/d	
Distance to compliance point	x	8.30E+02	m	
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	2.14E-01	l/kg	*see options*
Longitudinal dispersivity	ax	11.020	m	*see options*
Transverse dispersivity	az	1.102	m	*see options*
Vertical dispersivity	ay	0.110	m	*see options*

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

Calculate for non-polar organic chemicals

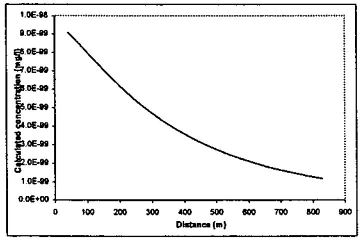
Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd	[redacted]	l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	1.00E+00	fraction
Organic carbon partition coefficient	Koc	2.14E-01	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$	[redacted]	l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Soil water partition coefficient	Kd	2.14E-01	l/kg

Dispersivity

Calculate dependant on distance to compliance point (0), 2
specify dispersivity (1), or calc after Xu & Eckstein (2) ?

		Enter value	Calc value Xu & Eckstein	
Longitudinal dispersivity	ax	[redacted]	1.10E+01	m
Transverse dispersivity	az		1.10E+00	m
Vertical dispersivity	ay		1.10E-01	m

For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report ax = 0.83(log$_{10}$x)$^{2.414}$; 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.

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration mg/l
41.6	9.1E-99
63.0	8.3E-99
124.6	7.5E-99
166.0	6.8E-99
207.6	6.1E-99
249.0	5.4E-99
290.5	4.8E-99
332.0	4.3E-99
373.5	3.8E-99
416.0	3.4E-99
456.5	3.1E-99
498.0	2.8E-99
639.6	2.5E-99
581.0	2.2E-99
622.5	2.0E-99
664.0	1.8E-99
706.6	1.6E-99
747.0	1.4E-99
788.5	1.3E-99
630.0	1.2E-99

This sheet calculates the Tier3 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

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 Tier 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

Calculated Parameters	Variable		
Groundwater flow velocity	v	1.37E+00	m/d
Retardation factor	Rf	3.00E+00	fraction
Decay rate used	λ	9.63E-04	d^{-1}
Rate of contaminant flow due to retardation	u	4.58E-01	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	1.17E-99	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	1.13E-99	mg/l
Attenuation factor (one way vertical dispersion, C_0/C_{ED})	AF	8.46E+00	
Attenuation factor (two way vertical dispersion, C_0/C_{ED})	AF	8.79E+00	

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Completed by	AJ
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Remedial Targets

Remedial Target LTC3 8.45E-03 mg/l For comparison with measured groundwater concentration.
Ogata Banks

Distance to compliance point		830	m	
Concentration of contaminant at compliance point	$C_{ED}/C0$	1.17E-99	mg/l	Ogata Banks
after		9.9E+99	days	

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.

R&D Publication20 Remedial Targets Worksheet, Release 2.2a

ENVIRONMENT AGENCY

Tier 3 - Groundwater

Input Parameters (using pull down menu)	Variable	Value	Unit	Source
Contaminant		Boron		
Target Concentration	C_T	1.00E+00	mg/l	

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

Ogata Banks — Equations in R&D Pub. 20

Enter '1' to simulate vertical dispersion in one direction, '2' for two directions (pull down menu): 1

Enter '1' if biodegradation rate is for the substance in water,
'0' if rate is for decay in field conditions (i.e. field data from aquifer) (pull down menu): 0

	Variable	Value	Unit	Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	1.00E-01	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	9.90E+99	days	
Calculated decay rate	λ	7.00E-101	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	8.00E+01	m	
Plume thickness at source	Sy	5.60E+01	m	
Saturated aquifer thickness	da	5.71E+01	m	
Bulk density of aquifer materials	ρ	1.70E+00	g/cm^3	
Effective porosity of aquifer	n	1.82E-01	fraction	
Hydraulic gradient	i	1.25E-02	fraction	
Hydraulic conductivity of aquifer	K	2.00E+01	m/d	
Distance to compliance point	x	8.30E+02	m	
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	0.00E+00	l/kg	*see options*
Longitudinal dispersivity	ax	11.020	m	*see options*
Transverse dispersivity	az	1.102	m	*see options*
Vertical dispersivity	ay	0.110	m	*see options*

Calculated Parameters	Variable		
Groundwater flow velocity	v	1.37E+00	m/d
Retardation factor	Rf	1.00E+00	fraction
Decay rate used	λ	7.00E-101	d^{-1}
Rate of contaminant flow due to retardation	u	1.37E+00	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	6.50E-02	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	6.25E-02	mg/l
Attenuation factor (one way vertical dispersion, C_0/C_{ED})	AF	1.54E+00	
Attenuation factor (two way vertical dispersion, C_0/C_{ED})	AF	1.60E+00	

Remedial Targets

Remedial Target	LTC3	1.54E+00	mg/l	For comparison with measured groundwater concentration.
Ogata Banks				
Distance to compliance point		830	m	
Concentration of contaminant at compliance point	$C_{ED}/C0$	6.50E-02	mg/l	Ogata Banks
after		9.9E+99	days	

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

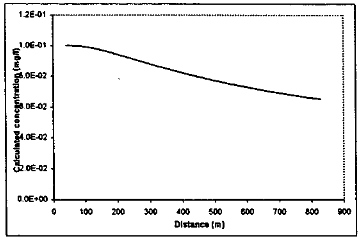
Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd		l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	1.00E+00	fraction
Organic carbon partition coefficient	Koc	0.00E+00	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$		l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Soil water partition coefficient	Kd	0.00E+00	l/kg

Dispersivity

Calculate dependant on distance to compliance point (0), specify dispersivity (1), or calc after Xu & Eckstein (2) ? 2

		Enter value	Calc value Xu & Eckstein	
Longitudinal dispersivity	ax		1.10E+01	m
Transverse dispersivity	az		1.10E+00	m
Vertical dispersivity	ay		1.10E-01	m

For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report ax = 0.83$(\log_{10}x)^{2.414}$; 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.

This sheet calculates the Tier3 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

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 Tier 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.

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration
	mg/l
41.6	1.0E-01
83.0	I.OE-O1
124.5	9.8E-02
166.0	9.6E-02
107.6	9.4E-02
249.0	9.1E-02
290.5	8.9E-02
332.0	8.6E-02
373.5	8.4E-02
416.0	8.1E-02
456.5	7.9E-02
498.0	7.7E-02
539.5	7.5E-02
661.0	7.4E-02
622.5	7.2E-02
664.0	7.OE-02
706.6	6.9E-02
747.0	6.8E-02
7M.6	6.6E-02
830.0	6.5E-02

Site being assessed	Blessington Area 6 A Downshire K20
Completed by	AJ
Date	24 11 2005
Version	12

R&D Publication 20 Remedial Targets Worksheet, Release 2.2a

Tier 3 - Soil

ENVIRONMENT AGENCY

Input Parameters	Variable	Value	Unit	Source
Contaminant		Chlroethane		from Tier 1
Target Concentration	C_T	0.001	mg/l	from Tier 1
Dilution Factor	DF	2.56E+02		from Tier 2

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

Ogata Banks — Equations in R&D Pub. 20

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

	Variable	Value	Unit	Source of parameter value
Enter '1' if biodegradation rate is for the substance in water, '0' if rate is for decay in field conditions (i.e. field data from aquifer)		0		
Half life for degradation of contaminant in water	$t_{1/2}$	5.60E+01	days	
Calculated decay rate	λ	1.24E-02	$days^{-1}$	
Width of plume in aquifer at source	Sz	8.00E+01	m	
Plume thickness in aquifer at source	Sy	[redacted]	m	
Bulk density of aquifer materials	ρ	1.70E+00	g/cm^3	
Effective porosity of aquifer	n	1.82E-01	fraction	
Hydraulic gradient	i	[redacted]	fraction	
Hydraulic conductivity of saturated aquifer	K	[redacted]	m/d	
Distance to compliance point	x	8.30E+02	m	
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	6.46E-02	l/kg	*see options*
Longitudinal dispersivity	ax	1.10E+01	m	*see options*
Transverse dispersivity	az	1.10E+00	m	*see options*
Vertical dispersivity	ay	1.10E-01	m	*see options*

Parameter values should be checked against Tier 1 and 2

Calculated Parameters	Variable		
Groundwater flow velocity	v	1.38E+00	m/d
Retardation factor	Rf	1.60E+00	fraction
Decay rate used	λ	1.24E-02	d^{-1}
Hydraulic gradient used in aquifer flow down-gradient	i	1.25E-02	fraction
Rate of contaminant flow due to retardation	u	8.60E-01	m/d
Ratio of Compliance Point to Source Concentration	C_{ED}/C_0	1.82E-05	fraction
Attenuation factor (C_0/C_{ED})	AF	5.51E+04	fraction

Remedial Targets

Remedial Target	**LTC3**	**1.41E+04**	**mg/l**	For comparison with measured pore water concentration. This assumes Tier 1 Remedial Target is based on Target Concentration.
Ogata Banks		**or**		
		2.56E+03	**mg/kg**	For comparison with measured soil concentration. This assumes Tier 1 Remedial Target calculated from soil-water partitioning equation.
Distance to compliance point		**830**	**m**	
Ratio of Compliance Point to Source Concentration	**C_{ED}/C_0**	**1.82E-05**	**fraction**	Ogata Banks
after		**9.9E+99**	**days**	

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

Enter method of defining partition co-efficient (using pull down list)

Calculate for non-polar organic chemicals

Note: For Non-polar, Calculates Kd as: Kd = Koc . foc

Calculates Kd as: Kd = Koc,n(1 + 10pH-pKa)-1 + Koc,i[1-(1 + 10pH-pKa)-1]

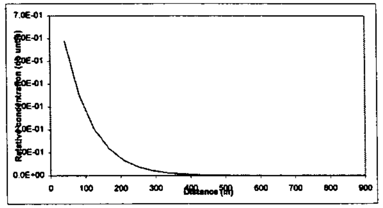
Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd	[redacted]	l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	1.00E+00	fraction
Organic carbon partition coefficient	Koc	6.46E-02	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$	[redacted]	l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
Acid dissociation constant	pKa		
Soil water partition coefficient	Kd	6.46E-02	l/kg

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

Calculate dependant on distance to compliance point (0), specify dispersivity (1), or calc after Xu & Eckstein (2) ? — 2

		Enter value	Calc value	Xu 6 Eckstein	
Longitudinal dispersivity	**ax**	[redacted]		11.02	m
Transverse dispersivity	**az**			1.10	m
Vertical dispersivity	**ay**			0.11	m

For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report ax = $0.83(\log_{10}x)^{2.414}$; az = ax/10, ay = ax/100 are assumed



Note: 'Relative concentration' is the ratio of calculated concentation at a given position compared to the source concentration. The calculations assume plume disperses from the top of the aquifer. An alternative solution assuming the centre of the plume is located at the mid-depth of the aquifer is presented in the calculation sheets.

Calculated (relative) concentrations f distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Relative concentration (No units)
41.5	5.9E-01
83.0	3.5E-01
166.0	2.0E-01
207.5	6.8E-02
290.5	2.9E-02
3320	1.3E-02
373.5	7.5E-03
415.0	4.3E-03
456.5	2.5E-03
498.0	1.4E-03
539.5	8.2E-X
581.0	4.7E-04
622.5	2.7E-04
664.0	1.6E-04
705.5	9.1E-05
747.0	5.2E-05
788.5	3.OE-05
830.0	1.7E-05

This sheet calculates the Tier3 remedial target for soils(mg/kg) or for pore water (mg/l), 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 (e.g. 9E99) it will give the steady state solution, which should always be used when calculating remedial targets.

The measured soil concentration as mg/kg or pore water concentration should be compared with the Tier 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 9.9E+99.

Site being assessed	Blessington appeal
Completed by	Anna Jeffcoat
Date:	25/7/2005
Version	12

R&D Publication 20 **Remedial** Targets Worksheet, Release 2.2a

Tier 3 -Groundwater

ENVIRONMENT AGENCY

Input Parameters (using pull down menu)

Input Parameters (using pull down menu)	Variable	Value	Unit	Source
Contaminant		Chlorobenzene		
Target Concentration	C_T	1.00E-03	mg/l	

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

Ogata Banks — Equations in R&D Pub. 20

Enter '1' to simulate vertical dispersion in one direction, '2' for two directions (pull down menu): 1

Enter '1' if biodegradation rate is for the substance in water,
'0' if rate is for decay in field conditions (i.e. field data from aquifer) (pull down menu: 0

				Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	9.90E-99	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	3.00E+02	days	
Calculated decay rate	λ	2.31E-03	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	8.00E+01	m	
Plume thickness at source	Sy	5.60E+01	m	
Saturated aquifer thickness	da	5.71E+01	m	
Bulk density of aquifer materials	ρ	1.70E+00	g/cm^3	
Effective porosity of aquifer	n	1.82E-01	fraction	
Hydraulic gradient	i	1.25E-02	fraction	
Hydraulic conductivity of aquifer	K	2.00E+01	m/d	
Distance to compliance point	x	8.30E+02	m	
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	7.94E-01	l/kg	*see options*
Longitudinal dispersivity	ax	11.020	m	*see options*
Transverse dispersivity	az	1.102	m	*see options*
Vertical dispersivity	ay	0.110	m	*see options*

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	[redacted]	l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	1.00E+00	fraction
Organic carbon partition coefficient	Koc	7.94E-01	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$	[redacted]	l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Soil water partition coefficient	Kd	7.94E-01	l/kg

Dispersivity

Calculate dependant on distance to compliance point (0), specify dispersivity (1), or calc after Xu & Eckstein (2) ? 2

		Enter value	Calc value Xu & Eckstein	
Longitudinal dispersivity	ax	[redacted]	1.10E+01	m
Transverse dispersivity	az		1.10E+00	m
Vertical dispersivity	ay		1.10E-01	m

For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report ax = 0.83(log$_{10}$x)$^{2.414}$; az = ax/10, ay = ax/100 are assumed

Calculated Parameters Variable

Groundwater flow velocity	v	1.37E+00	m/d
Retardation factor	Rf	8.42E+00	fraction
Decay rate used	λ	2.31E-03	d^{-1}
Rate of contaminant flow due to retardation	u	1.63E-01	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	2.09E-103	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	2.01E-103	mg/l
Attenuation factor (one way vertical dispersion, C_0/C_{ED})	AF	4.73E+04	
Attenuation factor (two way vertical dispersion, C_0/C_{ED})	AF	4.92E+04	

Remedial Targets

Remedial Target	LTC3	4.73E+01	mg/l

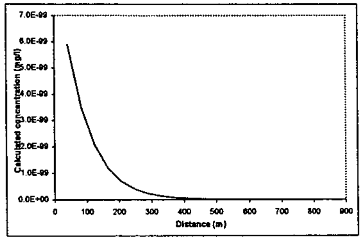
For comparison with measured groundwater concentration.

Ogata Banks

Distance to compliance point 830 m

Concentration of contaminant at compliance point	$C_{ED}/C0$	2.09E-103	mg/l	Ogata Banks
after		9.9E+99	days	

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.



Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration mg/l
41.6	5.9E-99
[illegible]	2.5E-99
166.0	1.2E-99
207.6	7.0E-100
249.0	4.1E-100
290.5	2.4E-100
332.0	1.4E-100
373.5	7.9E-101
416.0	4.6E-101
456.5	2.7E-101
498.0	1.6E-101
539.5	9.0E-102
581.0	5.3E-102
622.5	3.1E-102
664.0	1.8E-102
706.6	1.0E-102
747.0	6.1E-103
788.5	3.6E-103
830.0	2.1E-103

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.

This sheet calculates the Tier3 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

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 Tier 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.

Site being assessed	Bless Downshire K20 b
Completed by:	AJ
Date:	24 11 2005
Version	12

R&D Publication20 Remedial Targets Worksheet. Release 2.2a

ENVIRONMENT AGENCY

Tier 3 • Groundwater

Input Parameters (using pull down menu)	Variable	Value	Unit	Source
Contaminant		Ethylbenzene		
Target Concentration	C_T	1.00E-02	mg/l	

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

Ogata Banks | Equations in R&D Pub. 20

Enter '1' to simulate vertical dispersion in one direction, '2' for two directions (pull down menu) | 1

Enter '1' if biodegradation rate is for the substance in water,
'0' if rate is for decay in field conditions (i.e. field data from aquifer) (pull down menu | 0

				Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	9.90E-99	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	2.28E+02	days	
Calculated decay rate	λ	3.04E-03	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	8.00E+01	m	
Plume thickness at source	Sy	5.60E+01	m	
Saturated aquifer thickness	da	5.71E+01	m	
Bulk density of aquifer materials	ρ	1.70E+00	g/cm^3	
Effective porosity of aquifer	n	1.82E-01	fraction	
Hydraulic gradient	i	1.25E-02	fraction	
Hydraulic conductivity of aquifer	K	2.00E+01	m/d	
Distance to compliance point	x	8.30E+02	m	
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	1.32E+00	l/kg	*see options*
Longitudinal dispersivity	ax	11.020	m	*see options*
Transverse dispersivity	az	1.102	m	*see options*
Vertical dispersivity	ay	0.110	m	*see options*

Calculated Parameters	Variable		
Groundwater flow velocity	v	1.37E+00	m/d
Retardation factor	Rf	1.33E+01	fraction
Decay rate used	λ	3.04E-03	d^{-1}
Rate of contaminant flow due to retardation	u	1.03E-01	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	2.33E-107	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	2.24E-107	mg/l
Attenuation factor (one way vertical dispersion, C_0/C_{ED})	AF	4.25E+08	
Attenuation factor (two way vertical dispersion, C_0/C_{ED})	AF	4.42E+08	

Remedial Targets

Remedial Target	LTC3	4.25E+06	mg/l	For comparison with measured groundwater concentration.
Ogata Banks				
Distance to compliance point		830	m	
Concentration of contaminant at compliance point	$C_{ED}/C0$	2.33E-107	mg/l	Ogata Banks
after		9.9E+99	days	

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

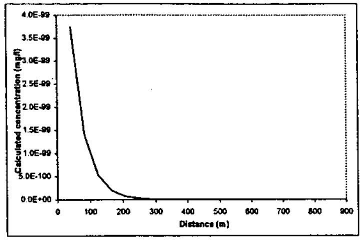
Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd	[redacted]	l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	1.00E+00	fraction
Organic carbon partition coefficient	Koc	1.32E+00	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$	[redacted]	l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Soil water partition coefficient	Kd	1.32E+00	l/kg

Dispersivity

Calculate dependant on distance to compliance point (0), specify dispersivity (1), or calc after Xu & Eckstein (2) ? | 2

		Enter value	Calc value Xu & Eckstein	
Longitudinal dispersivity	ax	[redacted]	1.10E+01	m
Transverse dispersivity	az		1.10E+00	m
Vertical dispersivity	ay		1.10E-01	m

For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report ax = 0.83($log_{10}x$)$^{2.414}$; 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.

This sheet calculates the Tier3 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
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 Tier 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.

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration
	mg/l
4t.6	3.7E-99
83.0	1.4E-99
124.5	5.3E-100
166.0	2.0E-100
207.6	7.2E-101
249.0	2.7E-101
2W.6	9.7E-102
332.0	3.6E-102
373.5	1.3E-102
415.0	4.8E-103
456.5	1.8E-103
498.0	6.6E-104
539.5	2.4E-104
581.0	9.0E-105
622.5	3.3E-105
664.0	1.2E-105
705.5	4.6E-106
747.0	1.7E-106
788.5	6.3E-107
830.0	2.3E-107

Site being assessed	Bless Downshire K20 b
Completed by	AJ
Date	24 11 2005
Version	12

R&D Publication20 RemedialTargets Worksheet, Release 2.2a

Tier 3 -Groundwater

ENVIRONMENT
AGENCY

Input Parameters (using pull down menu)

	Variable	Value	Unit	Source
Contaminant		Isopropylbenzene		
Target Concentration	C_T	1.00E-02	mg/l	

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

Ogata Banks — Equations in R&D Pub. 20

Enter '1' to simulate vertical dispersion in one direction, '2' for two directions (pull down menu) 1

Enter '1' if biodegradation rate is for the substance in water,
'0' if rate is for decay in field conditions (i.e. field data from aquifer) (pull down menu 0

				Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	9.90E-99	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	7.20E+02	days	
Calculated decay rate	λ	9.63E-04	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	8.00E+01	m	
Plume thickness at source	Sy	5.60E+01	m	
Saturated aquifer thickness	da	5.71E+01	m	
Bulk density of aquifer materials	ρ	1.70E+00	g/cm^3	
Effective porosity of aquifer	n	1.82E-01	fraction	
Hydraulic gradient	i	1.25E-02	fraction	
Hydraulic conductivity of aquifer	K	2.00E+01	m/d	
Distance to compliance point	x	8.30E+02	m	
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	2.14E-01	l/kg	*see options*
Longitudinal dispersivity	ax	*11.020*	m	*see options*
Transverse dispersivity	az	1.102	m	*see options*
Vertical dispersivity	ay	0.110	m	*see options*

Calculated Parameters

	Variable		
Groundwater flow velocity	v	1.37E+00	m/d
Retardation factor	Rf	3.00E+00	fraction
Decay rate used	λ	9.63E-04	d^{-1}
Rate of contaminant flow due to retardation	u	4.58E-01	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	1.17E-99	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	1.13E-99	mg/l
Attenuation factor (one way vertical dispersion, C_0/C_{ED})	AF	8.46E+00	
Attenuation factor (two way vertical dispersion, C_0/C_{ED})	AF	8.79E+00	

Remedial Targets

Remedial Target	LTC3	8.46E-02	mg/l

For comparison with measured groundwater concentration.

Ogata Banks

Distance to compliance point 830 m

Concentration of contaminant at compliance point $C_{ED}/C0$ 1.17E-99 mg/l Ogata Banks
after 9.9E+99 days

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

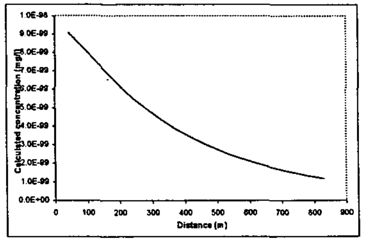
Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd	[redacted]	l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	1.00E+00	fraction
Organic carbon partition coefficient	Koc	2.14E-01	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$	[redacted]	l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Soil water partition coefficient	Kd	2.14E-01	l/kg

Dispersivity

Calculate dependant on distance to compliance point (0),
specify dispersivity (1), or calc after Xu & Eckstein (2) ? 2

		Enter value	Calc value	Xu & Eckstein	
Longitudinal dispersivity	ax	[redacted]		1.10E+01	m
Transverse dispersivity	az			1.10E+00	m
Vertical dispersivity	ay			1.10E-01	m

For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report ax = $0.83(\log_{10}x)^{2.414}$; 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.

This sheet calculates the Tier3 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

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 Tier 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.

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	*Concentration*
	mg/l
41.6	9.1E-99
83.0	8.3E-99
124.5	7.6E-99
166.0	6.8E-99
207.5	6.1E-99
241.0	6.4E-W
290.5	4.8E-99
332.0	4.3E-99
373.5	3.8E-99
416.0	3.4E-99
456.5	3.1E-99
498.0	2.6E-W
631.6	2.6E-W
681.0	2.2E-99
622.5	2.0E-99
664.0	1.8E-99
705.5	1.6E-99
141.0	1.4E-M
188.6	1.3E-99
830.0	1.2E-99

Site being assessed	Bless Downshire K20 5
Completed by:	AJ
Date:	24 11 2005
Version	12

R&D Publication 20 Remedial Targets Worksheet, Release 2.2a

ENVIRONMENT AGENCY

Tier 3 - Groundwater

Input Parameters (using pull down menu)

	Variable	Value	Unit	Source
Contaminant		n- butylbenzene		
Target Concentration	C_T	1.00E-03	mg/l	

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

Ogata Banks — Equations in R&D Pub. 20

Enter 1 to simulate vertical dispersion in one direction, '2' for two directions (pull down menu): 1

Enter '1' if biodegradation rate is for the substance in water,
'0' if rate is for decay in field conditions (i.e. field data from aquifer) (pull down menu): 0

	Variable	Value	Unit	Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	9.90E-99	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	9.99E+99	days	
Calculated decay rate	λ	6.94E-101	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	8.00E+01	m	
Plume thickness at source	Sy	5.60E+01	m	
Saturated aquifer thickness	da	5.71E+01	m	
Bulk density of aquifer materials	ρ	1.70E+00	g/cm^3	
Effective porosity of aquifer	n	1.82E-01	fraction	
Hydraulic gradient	i	1.25E-02	fraction	
Hydraulic conductivity of aquifer	K	2.00E+01	m/d	
Distance to compliance point	x	8.30E+02	m	
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	8.91E+00	l/kg	*see options*
Longitudinal dispersivity	ax	11.020	m	*see options*
Transverse dispersivity	az	1.102	m	*see options*
Vertical dispersivity	ay	0.110	m	*see options*

Calculated Parameters

	Variable		
Groundwater flow velocity	v	1.37E+00	m/d
Retardation factor	Rf	8.42E+01	fraction
Decay rate used	λ	6.94E-101	d^{-1}
Rate of contaminant flow due to retardation	u	1.63E-02	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	6.44E-99	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	6.19E-99	mg/l
Attenuation factor (one way vertical dispersion, C_0/C_{ED})	AF	1.54E+00	
Attenuation factor (two way vertical dispersion, C_0/C_{ED})	AF	1.60E+00	

Remedial Targets

Remedial Target	LTC3	1.54E-03	mg/l

For comparison with measured groundwater concentration.

Ogata Banks

Distance to compliance point		830	m	
Concentration of contaminant at compliance point	$C_{ED}/C0$	6.44E-99	mg/l	Ogata Banks
after		9.9E+99	days	

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

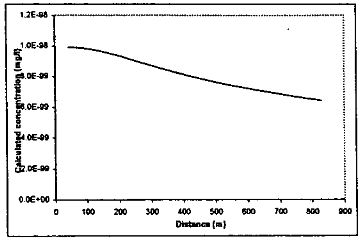
Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd	[redacted]	l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	1.00E+00	fraction
Organic carbon partition coefficient	Koc	8.91E+00	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$	[redacted]	l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Soil water partition coefficient	Kd	8.91E+00	l/kg

Dispersivity

Calculate dependant on distance to compliance point (0), specify dispersivity (1), or calc after Xu & Eckstein (2) ? 2

		Enter value	Calc value Xu & Eckstein	
Longitudinal dispersivity	ax	[redacted]	1.10E+01	m
Transverse dispersivity	az		1.10E+00	m
Vertical dispersivity	ay		1.10E-01	m

For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report ax = $0.83(\log_{10}x)^{2.414}$; 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.

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet
DIN — Concentration

	mg/l
41.6	9.9E-99
83.0	9.9E-99
124.6	9.7E-99
166.0	9.5E-99
207.5	9.3E-99
249.0	9.0E-99
290.5	8.8E-99
332.0	8.5E-99
373.6	8.3E-99
416.0	8.1E-99
456.5	7.8E-M
4W.0	7.6E-99
539.5	7.5E-99
581.0	7.3E-99
622.5	7.1E-99
664.0	7.0E-99
706.6	6.8E-99
747.0	6.7E-99
788.5	6.6E-99
830.0	6.4E-99

This sheet calculates the Tier3 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

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 Tier 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

Site being assessed	Bless Downshire K20 b
Completed by	AJ
Date	24 11 2005
Version	12

R&D Publication 20 Remedial Targets Worksheet, Release 2.2a

Tier 3 -Groundwater

ENVIRONMENT AGENCY

Input Parameters (using pull down menu)	Variable	Value	Unit	Source
Contaminant		Napthalene		
Target Concentration	C_T	1.00E-03	mg/l	

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

Ogata Banks — Equations in R&D Pub. 20

Enter '1' to simulate vertical dispersion in one direction, '2' for two directions (pull down menu) 1

Enter '1' if biodegradation rate is for the substance in water,
'0' if rate is for decay in field conditions (i.e. field data from aquifer) (pull down menu) 0

	Variable	Value	Unit	Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	9.90E-99	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	2.58E+02	days	
Calculated decay rate	λ	2.69E-03	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	8.00E+01	m	
Plume thickness at source	Sy	5.60E+01	m	
Saturated aquifer thickness	da	5.71E+01	m	
Bulk density of aquifer materials	ρ	1.70E+00	g/cm^3	
Effective porosity of aquifer	n	1.82E-01	fraction	
Hydraulic gradient	i	1.25E-02	fraction	
Hydraulic conductivity of aquifer	K	2.00E+01	m/d	
Distance to compliance point	x	8.30E+02	m	
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	7.24E+00	l/kg	*see options*
Longitudinal dispersivity	ax	11.020	m	*see options*
Transverse dispersivity	az	1.102	m	*see options*
Vertical dispersivity	ay	0.110	m	*see options*

Calculated Parameters	Variable		
Groundwater flow velocity	v	1.37E+00	m/d
Retardation factor	Rf	6.87E+01	fraction
Decay rate used	λ	2.69E-03	d^{-1}
Rate of contaminant flow due to retardation	u	2.00E-02	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	1.39E-125	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	1.34E-125	mg/l
Attenuation factor (one way vertical dispersion, C_O/C_{ED})	AF	7.12E+26	
Attenuation factor (two way vertical dispersion, C_O/C_{ED})	AF	7.40E+26	

Remedial Targets

Remedial Target	LTC3	7.12E+23	mg/l	For comparison with measured groundwater concentration.
Ogata Banks				
Distance to compliance point		**830**	**m**	
Concentration of contaminant at compliance point	$C_{ED}/C0$	**1.39E-125**	**mg/l**	Ogata Banks
after		**9.9E+99**	**days**	

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

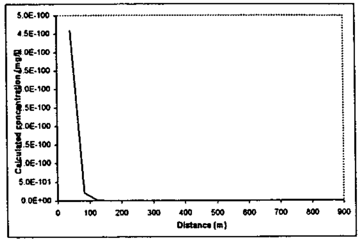
Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd	[redacted]	l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	1.00E+00	fraction
Organic carbon partition coefficient	Koc	7.24E+00	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$	[redacted]	l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Soil water partition coefficient	Kd	7.24E+00	l/kg

Dispersivity

Calculate dependant on distance to compliance point (0), specify dispersivity (1), or calc after Xu & Eckstein (2) ? 2

		Enter value	Calc value Xu & Eckstein	
Longitudinal dispersivity	ax	[redacted]	1.10E+01	m
Transverse dispersivity	az		1.10E+00	m
Vertical dispersivity	ay		1.10E-01	m

For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report ax = 0.83$(\log_{10}x)^{2.414}$; 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.

This sheet calculates the Tier3 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

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 Tier 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.

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration mg/l
41.5	4.6E-100
83.0	2.1E-101
124.5	9.7E-103
166.0	4.4E-104
207.5	2.0E-105
249.0	9.0E-107
290.5	4.1E-108
332.0	1.8E-109
373.5	8.3E-111
415.0	3.7E-112
456.5	1.7E-113
498.0	7.7E-115
539.5	3.5E-116
581.0	1.6E-117
622.5	7.1E-119
664.0	3.2E-120
705.5	1.5E-121
747.0	6.7E-123
788.5	3.1E-124
830.0	1.4E-125

Site being assessed	Bless Downshire K20 b
Completed by	AJ
Date	24 11 2005
Version	12

ENVIRONMENT
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R&D Publication20 Remedial Targets Worksheet, Release 2.2a

Tier 3 -Groundwater

Input Parameters (using pull down menu)	Variable	Value	Unit	Source
Contaminant		Phenol		
Target Concentration	C_T	5.00E-04	mg/l	

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

Ogata Banks — Equations in R&D Pub. 20

Enter '1' to simulate vertical dispersion in one direction, '2' for two directions (pull down menu) 1

Enter '1' if biodegradation rate is for the substance in water,
'0' if rate is for decay in field conditions (i.e. field data from aquifer) (pull down menu 0

	Variable	Value	Unit	Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	9.90E-99	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	1.00E+01	days	
Calculated decay rate	λ	6.93E-02	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	8.00E+01	m	
Plume thickness at source	Sy	5.60E+01	m	
Saturated aquifer thickness	da	5.71E+01	m	
Bulk density of aquifer materials	ρ	1.70E+00	g/cm^3	
Effective porosity of aquifer	n	1.82E-01	fraction	
Hydraulic gradient	i	1.25E-02	fraction	
Hydraulic conductivity of aquifer	K	2.00E+01	m/d	
Distance to compliance point	x	8.30E+02	m	
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	1.05E-01	l/kg	*see options*
Longitudinal dispersivity	ax	11.020	m	*see options*
Transverse dispersivity	az	1.102	m	*see options*
Vertical dispersivity	ay	0.110	m	*see options*

Calculated Parameters	Variable		
Groundwater flow velocity	v	1.37E+00	m/d
Retardation factor	Rf	1.98E+00	fraction
Decay rate used	λ	6.93E-02	d^{-1}
Rate of contaminant flow due to retardation	u	6.94E-01	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	1.44E-120	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	1.39E-120	mg/l
Attenuation factor (one way vertical dispersion, C_O/C_{ED})	AF	6.86E+21	
Attenuation factor (two way vertical dispersion, C_O/C_{ED})	AF	7.13E+21	

Remedial Targets

Remedial Target	LTC3	3.43E+16	mg/l	For comparison with measured groundwater concentration.
Ogata Banks				
Distance to compliance point		**830**	**m**	
Concentration of contaminant at compliance point	$C_{ED}/C0$	**1.44E-120**	**mg/l**	Ogata Banks
after		**9.9E+99**	**days**	

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

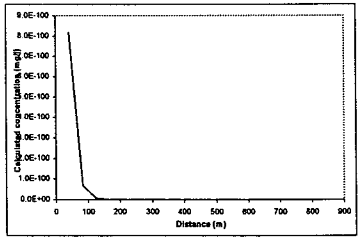
Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd		l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	1.00E+00	fraction
Organic carbon partition coefficient	Koc	1.05E-01	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$		l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Soil water partition coefficient	Kd	1.05E-01	l/kg

Dispersivity

Calculate dependant on distance to compliance point (0) 2
specify dispersivity (1), or calc after Xu & Eckstein (2) ?

		Enter value	Calc value Xu & Eckstein	
Longitudinal dispersivity	ax		1.10E+01	m
Transverse dispersivity	az		1.10E+00	m
Vertical dispersivity	ay		1.10E-01	m

For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report ax = $0.83(\log_{10}x)^{2.414}$; 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.

This sheet calculates the Tier3 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

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 Tier 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.

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration
	mg/l
41.6	8.2E-100
83.0	6.8E-101
124.5	5.6E-102
207.5	3.6E-104
249.0	2.9E-105
290.5	2.3E-106
332.0	1.9E-107
373.6	1.6E-108
416.0	1.2E-109
456.5	9.7E-111
498.0	7.8E-112
639.6	6.3E-113
581.0	5.1E-114
622.5	4.1E-115
664.0	3.3E-116
705.5	2.7E-117
747.0	2.2E-118
788.5	1.8E-119
830.0	1.4E-120

Site being assessed	Bless Downshire K20 b
Completed by	AJ
Date:	24 11 2005
Version	12

R&D Publication 20 Remedial Targets Worksheet, Release 2.2a

ENVIRONMENT AGENCY

Tier 3 - Groundwater

Input Parameters (using pull down menu)

	Variable	Value	Unit	Source
Contaminant		Propylbenzene		
Target Concentration	C_T	1.00E-03	mg/l	

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

Ogata Banks — Equations in R&D Pub. 20

Enter '1' to simulate vertical dispersion in one direction, '2' for two directions (pull down menu) 1

Enter '1' if biodegradation rate is for the substance in water,
'0' if rate is for decay in field conditions (i.e. field data from aquifer) (pull down menu) 0

	Variable	Value	Unit	Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	9.90E-99	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	7.20E+02	days	
Calculated decay rate	λ	9.63E-04	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	8.00E+01	m	
Plume thickness at source	Sy	5.60E+01	m	
Saturated aquifer thickness	da	5.71E+01	m	
Bulk density of aquifer materials	ρ	1.70E+00	g/cm^3	
Effective porosity of aquifer	n	1.82E-01	fraction	
Hydraulic gradient	i	1.25E-02	fraction	
Hydraulic conductivity of aquifer	K	2.00E+01	m/d	
Distance to compliance point	x	8.30E+02	m	
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	2.14E-01	l/kg	*see options*
Longitudinal dispersivity	ax	11.020	m	*see options*
Transverse dispersivity	az	1.102	m	*see options*
Vertical dispersivity	ay	0.110	m	*see options*

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	[redacted]	l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	1.00E+00	fraction
Organic carbon partition coefficient	Koc	2.14E-01	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$	[redacted]	l/kg
Sorption coefficient for ionised species	$K_{oc,i}$	[redacted]	l/kg
pH value	pH	[redacted]	
acid dissociation constant	pKa	[redacted]	
Soil water partition coefficient	Kd	2.14E-01	l/kg

Dispersivity

Calculate dependant on distance to compliance point (0), 2
specify dispersivity (1), or calc after Xu & Eckstein (2) ?

		Enter value	Calc value Xu & Eckstein	
Longitudinal dispersivity	ax	[redacted]	1.10E+01	m
Transverse dispersivity	az	[redacted]	1.10E+00	m
Vertical dispersivity	ay	[redacted]	1.10E-01	m

For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report ax = $0.83(\log_{10}x)^{2.414}$; az = ax/10, ay = ax/100 are assumed

Calculated Parameters

	Variable		
Groundwater flow velocity	v	1.37E+00	m/d
Retardation factor	Rf	3.00E+00	fraction
Decay rate used	λ	9.63E-04	d^{-1}
Rate of contaminant flow due to retardation	u	4.58E-01	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	1.17E-99	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	1.13E-99	mg/l
Attenuation factor (one way vertical dispersion, C_0/C_{ED})	AF	8.46E+00	
Attenuation factor (two way vertical dispersion, C_0/C_{ED})	AF	8.79E+00	

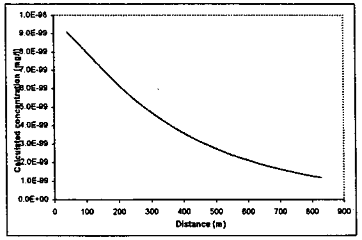
Remedial Targets

Remedial Target LTC3 8.46E-03 mg/l For comparison with measured groundwater concentration.
Ogata Banks

Distance to compliance point 830 m

Concentration of contaminant at compliance point $C_{ED}/C0$ 1.17E-99 mg/l Ogata Banks
after 9.9E+99 days

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.



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.

This sheet calculates the Tier3 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

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 Tier 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

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration
	mg/l
41.5	9.1E-99
[illegible]	7.5E-99
166.0	6.8E-99
207.5	6.1E-99
249.0	5.4E-99
290.5	4.8E-99
332.0	4.3E-99
373.5	3.8E-99
415.0	3.4E-99
456.5	3.1E-99
498.0	2.8E-99
539.5	2.5E-99
581.0	2.2E-99
622.5	2.0E-99
664.0	1.8E-99
705.5	1.6E-99
741.0	1.4E-99
788.5	1.3E-99
830.0	1.2E-99

Site being assessed:	Bless Downshire K20 b
Completed by	AJ
Date:	24 11 2005
Version	12

R8D Publication 20 Remedial Targets Worksheet, Release 2.2a

Tier 3 - Groundwater

ENVIRONMENT AGENCY

Input Parameters (using pull down menu)	Variable	Value	Unit	Source
Contaminant		sec butylbenzene		
Target Concentration	C_T	1.00E-03	mg/l	

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

Ogata Banks — Equations in R&D Pub. 20

Enter '1' to simulate vertical dispersion in one direction, '2' for two directions (pull down menu): 1

Enter '1' if biodegradation rate is for the substance in water,
'0' if rate is for decay in field conditions (i.e. field data from aquifer) (pull down menu: 0

	Variable	Value	Unit	Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	9.90E-99	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	7.20E+02	days	
Calculated decay rate	I	9.63E-04	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	8.00E+01	m	
Plume thickness at source	Sy	5.60E+01	m	
Saturated aquifer thickness	da	5.71E+01	m	
Bulk density of aquifer materials	ρ	1.70E+00	g/cm^3	
Effective porosity of aquifer	n	1.82E-01	fraction	
Hydraulic gradient	i	1.25E-02	fraction	
Hydraulic conductivity of aquifer	K	2.00E+01	m/d	
Distance to compliance point	x	8.30E+02	m	
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	2.14E-01	l/kg	*see options*
Longitudinal dispersivity	ax	11.020	m	*see options*
Transverse dispersivity	az	1.102	m	*see options*
Vertical dispersivity	ay	0.110	m	*see options*

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	[redacted]	l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	1.00E+00	fraction
Organic carbon partition coefficient	Koc	2.14E-01	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$	[redacted]	l/kg
Sorption coefficient for ionised species	$K_{oc,i}$	[redacted]	l/kg
pH value	pH	[redacted]	
acid dissociation constant	pKa	[redacted]	
Soil water partition coefficient	Kd	2.14E-01	l/kg

Dispersivity

Calculate dependant on distance to compliance point (0), specify dispersivity (1), or calc after Xu & Eckstein (2) ? 2

		Enter value	Calc value Xu & Eckstein	
Longitudinal dispersivity	ax	[redacted]	1.10E+01	m
Transverse dispersivity	az	[redacted]	1.10E+00	m
Vertical dispersivity	ay	[redacted]	1.10E-01	m

For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report ax = 0.83$(\log_{10}x)^{2.414}$; az = ax/10, ay = ax/100 are assumed

Calculated Parameters	Variable		
Groundwater flow velocity	v	1.37E+00	m/d
Retardation factor	Rf	3.00E+00	fraction
Decay rate used	λ	9.63E-04	d^{-1}
Rate of contaminant flow due to retardation	u	4.58E-01	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	1.17E-99	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	1.13E-99	mg/l
Attenuation factor (one way vertical dispersion, C_0/C_{ED})	AF	8.45E+00	
Attenuation factor (two way vertical dispersion, C_0/C_{ED})	AF	8.79E+00	

Remedial Targets

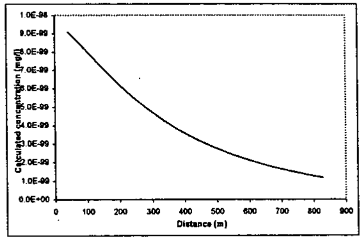
Remedial Target	LTC3	8.45E-03	mg/l

For comparison with measured groundwater concentration.

Ogata Banks

Distance to compliance point		830	m	
Concentration of contaminant at compliance point	$C_{ED}/C0$	1.17E-99	mg/l	Ogata Banks
after		9.9E+99	days	

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.



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.

This sheet calculates the Tier3 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

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 Tier 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.

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration
	mg/l
41.5	9.1E-99
83.0	8.3E-99
124.5	7.5E-99
166.0	6.8E-99
207.5	6.1E-99
249.0	5.4E-99
290.5	4.8E-99
332.0	4.3E-99
373.5	3.8E-99
415.0	3.4E-99
456.5	3.1E-99
498.0	2.8E-99
539.5	2.5E-99
581.0	2.2E-99
622.5	2.0E-99
664.0	1.8E-99
705.5	1.6E-99
747.0	1.4E-99
788.5	1.3E-99
830.0	1.2E-99

Site being assessed	Bless Downshire K20 b
Completed by	AJ
Date.	24 11 2005
Version	12

R&D Publication 20 Remedial Targets Worksheet, Release 2.2a

Tier 3 - Groundwater

ENVIRONMENT AGENCY

Input Parameters (using pull down menu)	Variable	Value	Unit	Source
Contaminant Target Concentration	C_T	1.00E-02	mg/l	

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

Ogata Banks Equations in R&D Pub. 20

Enter '1' to simulate vertical dispersion in one direction, '2' for two directions (pull down menu) **1**

Enter '1' if biodegradation rate is for the substance in water,
'0' if rate is for decay in field conditions (i.e. field data from aquifer) (pull down menu **0**

	Variable	Value	Unit	Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	3.00E+00	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	9.90E+99	days	
Calculated decay rate	λ	7.00E-101	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	8.00E+01	m	
Plume thickness at source	Sy	5.60E+01	m	
Saturated aquifer thickness	da	5.71E+01	m	
Bulk density of aquifer materials	ρ	1.70E+00	g/cm^3	
Effective porosity of aquifer	n	1.82E-01	fraction	
Hydraulic gradient	i	1.25E-02	fraction	
Hydraulic conductivity of aquifer	K	2.00E+01	m/d	
Distance to compliance point	x	8.30E+02	m	
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	9.55E+00	l/kg	*see options*
Longitudinal dispersivity	ax	11.020	m	*see options*
Transverse dispersivity	az	1.102	m	*see options*
Vertical dispersivity	ay	0.110	m	*see options*

Calculated Parameters	Variable		
Groundwater flow velocity	v	1.37E+00	m/d
Retardation factor	Rf	9.02E+01	fraction
Decay rate used	λ	7.00E-101	d^{-1}
Rate of contaminant flow due to retardation	u	1.52E-02	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	1.95E+00	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	1.88E+00	mg/l
Attenuation factor (one way vertical dispersion, C_0/C_{ED})	AF	1.54E+00	
Attenuation factor (two way vertical dispersion, C_0/C_{ED})	AF	1.60E+00	

Remedial Targets

Remedial Target LTC3 1.54E-02 mg/l For comparison with measured groundwater concentration.
Ogata Banks

Distance to compliance point		**830**	**m**	
Concentration of contaminant at compliance point	$C_{ED}/C0$	**1.95E+00**	**mg/l**	Ogata Banks
after		**9.9E+99**	**days**	

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

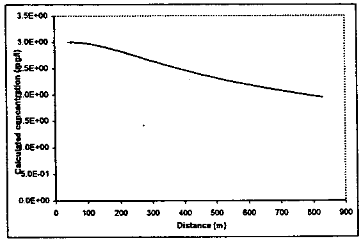
Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd	[redacted]	l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	1.00E+00	fraction
Organic carbon partition coefficient	Koc	9.55E+00	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$	[redacted]	l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Soil water partition coefficient	Kd	9.55E+00	l/kg

Dispersivity

Calculate dependant on distance to compliance point (0) **2**
specify dispersivity (1), or calc after Xu & Eckstein (2) ?

		Enter value	Calc value Xu & Eckstein	
Longitudinal dispersivity	ax	[redacted]	1.10E+01	m
Transverse dispersivity	az		1.10E+00	m
Vertical dispersivity	ay		1.10E-01	m

For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report $ax = 0.83(\log_{10}x)^{2.414}$; 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.

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration mg/l
41.5	3.0E+00
83.0	3.0E+00
124.5	3.0E+00
166.0	2.9E+00
207.5	2.8E+00
249.0	2.7E+00
290.5	2.7E+00
332.0	2.6E+00
373.5	2.5E+00
415.0	2.4E+00
456.5	2.4E+00
498.0	2.3E+00
539.5	2.3E+00
581.0	2.2E+00
622.5	2.2E+00
664.0	2.1E+00
705.5	2.1E+00
747.0	2.0E+00
788.5	2.0E+00
830.0	2.0E+00

This sheet calculates the Tier3 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

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 Tier 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.

Site being assessed	Blessington Area 6 A Downshire K20
Completed by	AJ
Date	24 11 2005
Version	12

R&D Publication20 Remedial Targets Worksheet, Release 2.2a

Tier 3 - Groundwater

ENVIRONMENT AGENCY

Input Parameters (using pull down menu)	Variable	Value	Unit	Source
Contaminant		Strontium		
Target Concentration	C_T	1.00E+00	mg/l	

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

Ogata Banks — Equations in R&D Pub. 20

Enter '1' to simulate vertical dispersion in one direction, '2' for two directions (pull down menu)	1
Enter '1' if biodegradation rate is for the substance in water, '0' if rate is for decay in field conditions (i.e. field data from aquifer) (pull down menu)	0

				Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	2.30E+01	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	9.90E+99	days	
Calculated decay rate	λ	7.00E-101	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	8.00E+01	m	
Plume thickness at source	Sy	5.60E+01	m	
Saturated aquifer thickness	da	5.71E+01	m	
Bulk density of aquifer materials	ρ	1.70E+00	g/cm^3	
Effective porosity of aquifer	n	1.82E-01	fraction	
Hydraulic gradient	i	1.25E-02	fraction	
Hydraulic conductivity of aquifer	K	2.00E+01	m/d	
Distance to compliance point	x	8.30E+02	m	
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	0.00E+00	l/kg	*see options*
Longitudinal dispersivity	ax	11.020	m	*see options*
Transverse dispersivity	az	1.102	m	*see options*
Vertical dispersivity	ay	0.110	m	*see options*

Calculated Parameters	Variable		
Groundwater flow velocity	v	1.37E+00	m/d
Retardation factor	Rf	1.00E+00	fraction
Decay rate used	λ	7.00E-101	d^{-1}
Rate of contaminant flow due to retardation	u	1.37E+00	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	1.50E+01	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	1.44E+01	mg/l
Attenuation factor (one way vertical dispersion, C_0/C_{ED})	AF	1.54E+00	
Attenuation factor (two way vertical dispersion, C_0/C_{ED})	AF	1.60E+00	

Remedial Targets

Remedial Target	LTC3	1.54E+00	mg/l	For comparison with measured groundwater concentration.
Ogata Banks				
Distance to compliance point		**830**	**m**	
Concentration of contaminant at compliance point	$C_{ED}/C0$	**1.50E+01**	**mg/l**	Ogata Banks
after		**9.9E+99**	**days**	

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

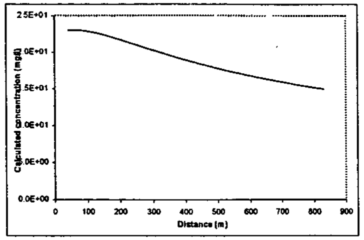
Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd		l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	1.00E+00	fraction
Organic carbon partition coefficient	Koc	0.00E+00	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$		l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Soil water partition coefficient	Kd	0.00E+00	l/kg

Dispersivity

Calculate dependant on distance to compliance point (0), specify dispersivity (1), or calc after Xu & Eckstein (2) ? — 2

		Enter value	Calc value Xu & Eckstein	
Longitudinal dispersivity	ax		1.10E+01	m
Transverse dispersivity	az		1.10E+00	m
Vertical dispersivity	ay		1.10E-01	m

For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report ax = $0.83(\log_{10}x)^{2.414}$; 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.

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration mg/l
41.5	2.3E+01
83.0	2.3E+01
124.5	2.3E+01
166.0	2.2E+01
207.5	2.2E+01
249.0	2.1E+01
290.5	2.0E+01
332.0	2.0E+01
373.5	1.9E+01
416.0	1.9E+01
456.5	1.8E+01
498.0	1.8E+01
539.5	1.7E+01
581.0	1.7E+01
622.5	1.7E+01
664.0	1.6E+01
705.5	1.6E+01
747.0	1.6E+01
788.5	1.5E+01
830.0	1.5E+01

This sheet calculates the Tier3 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

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 Tier 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.

Site being assessed	Blessington Area 6 A Downshire K20
Completed by	AJ
Date.	24 11 2005
Version	12

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R&D Publication20 Remedial Targets Worksheet, Release 2.2a

Tier 3 - Groundwater

ENVIRONMENT AGENCY

Input Parameters (using pull down menu)	**Variable**	**Value**	**Unit**	**Source**
Contaminant		Styrene		
Target Concentration	C_T	5.00E-02	mg/l	

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

Ogata Banks — Equations in R&D Pub. 20

Enter '1' to simulate vertical dispersion in one direction, '2' for two directions (pull down menu): 1

Enter '1' if biodegradation rate is for the substance in water,
'0' if rate is for decay in field conditions (i.e. field data from aquifer) (pull down menu: 0

				Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	9.90E-99	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	2.10E+02	days	
Calculated decay rate	λ	3.30E-03	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	8.00E+01	m	
Plume thickness at source	Sy	5.60E+01	m	
Saturated aquifer thickness	da	5.71E+01	m	
Bulk density of aquifer materials	ρ	1.70E+00	g/cm^3	
Effective porosity of aquifer	n	1.82E-01	fraction	
Hydraulic gradient	i	1.25E-02	fraction	
Hydraulic conductivity of aquifer	K	2.00E+01	m/d	
Distance to compliance point	x	8.30E+02	m	
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	4.64E+00	l/kg	*see options*
Longitudinal dispersivity	ax	11.020	m	*see options*
Transverse dispersivity	az	1.102	m	*see options*
Vertical dispersivity	ay	0.110	m	*see options*

Calculated Parameters	**Variable**		
Groundwater flow velocity	v	1.37E+00	m/d
Retardation factor	Rf	4.43E+01	fraction
Decay rate used	λ	3.30E-03	d^{-1}
Rate of contaminant flow due to retardation	u	3.10E-02	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	1.35E-121	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	1.30E-121	mg/l
Attenuation factor (one way vertical dispersion, C_0/C_{ED})	AF	7.34E+22	
Attenuation factor (two way vertical dispersion, C_0/C_{ED})	AF	7.64E+22	

Remedial Targets

Remedial Target	LTC3	3.67E+21	mg/l	For comparison with measured groundwater concentration.
Ogata Banks				

Distance to compliance point		**830**	**m**	
Concentration of contaminant at compliance point	$C_{ED}/C0$	**1.35E-121**	**mg/l**	Ogata Banks
after		**9.9E+99**	**days**	

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

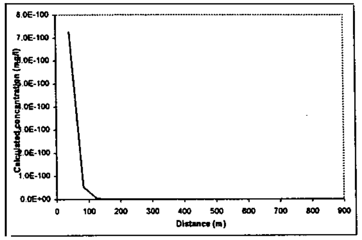
Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd		l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	1.00E+00	fraction
Organic carbon partition coefficient	Koc	4.64E+00	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$		l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Soil water partition coefficient	Kd	4.64E+00	l/kg

Dispersivity

Calculate dependant on distance to compliance point (0), specify dispersivity (1), or calc after Xu & Eckstein (2) ? 2

		Enter value	Calc value Xu & Eckstein	
Longitudinal dispersivity	ax		1.10E+01	m
Transverse dispersivity	az		1.10E+00	m
Vertical dispersivity	ay		1.10E-01	m

For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report ax = 0.83$(\log_{10}x)^{2.414}$; 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.

Calculated concentrations for distance-concentration graph

Ogata Bank.
From calculation sheet

Distance	Concentration
	mg/l
41.5	7.3E-100
83.0	6.3E-101
124.5	3.9E-102
166.0	2.8E-103
207.5	2.0E-104
249.0	1.4E-105
290.5	1.0E-106
373.5	5.2E-109
416.0	3.7E-110
456.5	2.6E-111
498.0	1.9E-112
539.5	1.4E-113
622.6	9.7E-116
664.6	3.6E-118
788.6	1.9E-120
830.0	1.3E-121

This sheet calculates the Tier3 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

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 Tier 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.

Site being assessed	Bless Downshire K20 b
Completed by	AJ
Date.	24 11 2005
Version	12

R&D Publication 20 Remedial Targets Worksheet, Release 2.2a

Tier 3 - Groundwater

ENVIRONMENT AGENCY

Input Parameters (using pull down menu)

	Variable	Value	Unit	Source
Contaminant		Sulphide		
Target Concentration	C_T	2.50E-04	mg/l	

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

Ogata Banks | Equations in R&D Pub. 20

Enter '1' to simulate vertical dispersion in one direction, '2' for two directions (pull down menu): 1

Enter '1' if biodegradation rate is for the substance in water,
'0' if rate is for decay in field conditions (i.e. field data from aquifer) (pull down menu): 0

				Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	6.20E-01	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	9.90E+99	days	
Calculated decay rate	λ	7.00E-101	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	8.00E+01	m	
Plume thickness at source	Sy	5.60E+01	m	
Saturated aquifer thickness	da	5.71E+01	m	
Bulk density of aquifer materials	ρ	1.70E+00	g/cm^3	
Effective porosity of aquifer	n	1.82E-01	fraction	
Hydraulic gradient	i	1.25E-02	fraction	
Hydraulic conductivity of aquifer	K	2.00E+01	m/d	
Distance to compliance point	x	8.30E+02	m	
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	0.00E+00	l/kg	*see options*
Longitudinal dispersivity	ax	11.020	m	*see options*
Transverse dispersivity	az	1.102	m	*see options*
Vertical dispersivity	ay	0.110	m	*see options*

Calculated Parameters

	Variable		
Groundwater flow velocity	v	1.37E+00	m/d
Retardation factor	Rf	1.00E+00	fraction
Decay rate used	λ	7.00E-101	d^{-1}
Rate of contaminant flow due to retardation	u	1.37E+00	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	4.03E-01	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	3.88E-01	mg/l
Attenuation factor (one way vertical dispersion, C_0/C_{ED})	AF	1.54E+00	
Attenuation factor (two way vertical dispersion, C_0/C_{ED})	AF	1.60E+00	

Remedial Targets

Remedial Target LTCS 3.94E-04 mg/l For comparison with measured groundwater concentration.
Ogata Banks

Distance to compliance point		830	m	
Concentration of contaminant at compliance point	$C_{ED}/C0$	4.03E-01	mg/l	Ogata Banks
after		9.9E+99	days	

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

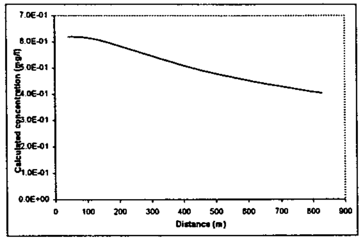
Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd	[redacted]	l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	1.00E+00	fraction
Organic carbon partition coefficient	Koc	0.00E+00	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$	[redacted]	l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Soil water partition coefficient	Kd	0.00E+00	l/kg

Dispersivity

Calculate dependant on distance to compliance point (0), specify dispersivity (1), or calc after Xu & Eckstein (2) ? 2

		Enter value	Calc value Xu & Eckstein	
Longitudinal dispersivity	ax	[redacted]	1.10E+01	m
Transverse dispersivity	az		1.10E+00	m
Vertical dispersivity	ay		1.10E-01	m

For calculated value, assumes ax = 0.1 * x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report $ax = 0.83(\log_{10}x)^{2.414}$; az = ax/10, ay = ax/100 are assumed



Calculated concentrations for distance-concentration graph

Ogata Banks

Distance	Concentration mg/l
41d	6.2E-01
83.0	6.2E-01
124.6	6.1E-M
159.0	6.0E-01
207.6	5.8E-01
249.0	5.7E-01
290.6	6.6E-01
332.0	5.3E-01
373.6	5.2E-01
416.0	5.0E-01
456.6	4.9E-01
498.0	4.8E-01
539.6	4.7E-01
581.0	4.6E-01
622.6	4.5E-01
664.0	4.4E-01
706.6	4.3E-01
747.0	4.2E-01
788.6	4.1E-01
830.0	4.0E-01

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.

This sheet calculates the Tier3 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

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 Tier 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.

Site being assessed.	Blessington Area 6 A Downshire K20
Completed by	AJ
Date	24 11 2005
Version	12

R&D Publication20 Remedial Targets Worksheet, Release 2.2a

Tier 3 - Groundwater

ENVIRONMENT AGENCY

Input Parameters (using pull down menu)

	Variable	Value	Unit	Source
Contaminant		tert butylbenzne		
Target Concentration	C_T	1.00E-03	mg/l	

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

Ogata Banks — Equations in R&D Pub. 20

Enter '1' to simulate vertical dispersion in one direction, '2' for two directions (pull down menu): 1

Enter '1' if biodegradation rate is for the substance in water,
'0' if rate is for decay in field conditions (i.e. field data from aquifer) (pull down menu): 0

	Variable	Value	Unit	Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	9.90E-99	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	9.99E+99	days	
Calculated decay rate	λ	6.94E-101	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	8.00E+01	m	
Plume thickness at source	Sy	5.60E+01	m	
Saturated aquifer thickness	da	5.71E+01	m	
Bulk density of aquifer materials	ρ	1.70E+00	g/cm^3	
Effective porosity of aquifer	n	1.82E-01	fraction	
Hydraulic gradient	i	1.25E-02	fraction	
Hydraulic conductivity of aquifer	K	2.00E+01	m/d	
Distance to compliance point	x	8.30E+02	m	
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	2.14E-01	l/kg	*see options*
Longitudinal dispersivity	ax	11.020	m	*see options*
Transverse dispersivity	az	1.102	m	*see options*
Vertical dispersivity	ay	0.110	m	*see options*

Calculated Parameters

	Variable		
Groundwater flow velocity	v	1.37E+00	m/d
Retardation factor	Rf	3.00E+00	fraction
Decay rate used	λ	6.94E-101	d^{-1}
Rate of contaminant flow due to retardation	u	4.58E-01	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	6.44E-99	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	6.19E-99	mg/l
Attenuation factor (one way vertical dispersion, C_0/C_{ED})	AF	1.54E+00	
Attenuation factor (two way vertical dispersion, C_0/C_{ED})	AF	1.60E+00	

Remedial Targets

Remedial Target	LTC3	1.54E-03	mg/l	For comparison with measured groundwater concentration.
Ogata Banks				
Distance to compliance point		830	m	
Concentration of contaminant at compliance point	$C_{ED}/C0$	6.44E-99	mg/l	Ogata Banks
after		9.9E+99	days	

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

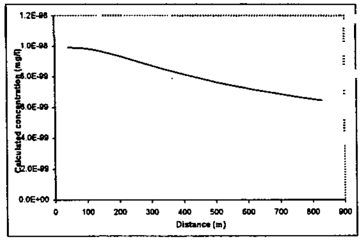
Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd		l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	1.00E+00	fraction
Organic carbon partition coefficient	Koc	2.14E-01	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$		l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Soil water partition coefficient	Kd	2.14E-01	l/kg

Dispersivity

Calculate dependant on distance to compliance point (0), specify dispersivity (1), or calc after Xu & Eckstein (2) ? 2

		Enter value	Calc value Xu & Eckstein	
Longitudinal dispersivity	ax		1.10E+01	m
Transverse dispersivity	az		1.10E+00	m
Vertical dispersivity	ay		1.10E-01	m

For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report ax = 0.83($log_{10}x$)$^{2.414}$; 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.

This sheet calculates the Tier3 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

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 Tier 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

Calculated concentrations for distance-concentration graph

OgataBankslation sheet

Distance	Concentration mg/l
41.5	9.9E-99
83.0	9.9E-99
124.5	9.7E.w
166.0	9.5E-99
207.5	9.3E-99
249.0	9.0E-99
290.5	8.8E-99
332.0	8.6E-99
575.6	8.3E-99
415.0	8.1E-99
456.5	7.8E-W
498.0	7.6E-99
539.5	7.5E-99
581.0	7.3E-99
622.5	7.1E-99
664.0	7.0E-99
705.5	6.8E-99
741.0	6.7E-99
788.5	6.6E-99
830.0	6.4E-99

Site being assessed	Sless Downshire K20 b
Completed by	AJ
Date.	24 11 2005
Version	12

RBD Publication20 Remedial Targets Worksheet, Release 2.2a

ENVIRONMENT AGENCY

Tier 3 -Groundwater

Input Parameters (using pull down menu)

	Variable	Value	Unit	Source
Contaminant		Total Cyanide		
Target Concentration	C_T	1.00E-02	mg/l	

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

Ogata Banks — Equations in R&D Pub. 20

Enter '1' to simulate vertical dispersion in one direction, '2' for two directions (pull down menu): 1

Enter '1' if biodegradation rate is for the substance in water,
'0' if rate is for decay in field conditions (i.e. field data from aquifer) (pull down menu): 0

	Variable	Value	Unit	Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	6.40E+01	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	2.92E+01	days	
Calculated decay rate	λ	2.38E-02	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	8.00E+01	m	
Plume thickness at source	Sy	5.60E+01	m	
Saturated aquifer thickness	da	5.71E+01	m	
Bulk density of aquifer materials	ρ	1.70E+00	g/cm^3	
Effective porosity of aquifer	n	1.82E-01	fraction	
Hydraulic gradient	i	1.25E-02	fraction	
Hydraulic conductivity of aquifer	K	2.00E+01	m/d	
Distance to compliance point	x	8.30E+02	m	
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	9.90E+00	l/kg	*see options*
Longitudinal dispersivity	ax	11.020	m	*see options*
Transverse dispersivity	az	1.102	m	*see options*
Vertical dispersivity	ay	0.110	m	*see options*

Calculated Parameters

	Variable		
Groundwater flow velocity	v	1.37E+00	m/d
Retardation factor	Rf	9.35E+01	fraction
Decay rate used	λ	2.38E-02	d^{-1}
Rate of contaminant flow due to retardation	u	1.47E-02	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	8.33E-122	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	8.01E-122	mg/l
Attenuation factor (one way vertical dispersion, C_0/C_{ED})	AF	7.68E+122	
Attenuation factor (two way vertical dispersion, C_0/C_{ED})	AF	7.99E+122	

Remedial Targets

Remedial Target	LTC3	7.68E+120	mg/l	For comparison with measured groundwater concentration.
Ogata Banks				
Distance to compliance point		830	m	
Concentration of contaminant at compliance point	$C_{ED}/C0$	8.33E-122	mg/l	Ogata Banks
after		9.9E+99	days	

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

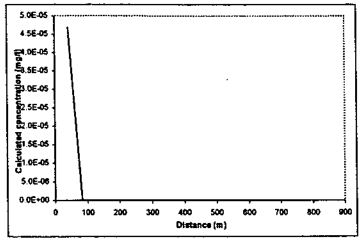
Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd		l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	1.00E+00	fraction
Organic carbon partition coefficient	Koc	9.90E+00	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$		l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Soil water partition coefficient	Kd	9.90E+00	l/kg

Dispersivity

Calculate dependant on distance to compliance point (0), specify dispersivity (1), or calc after Xu & Eckstein (2) ? 2

		Enter value	Calc value Xu & Eckstein	
Longitudinal dispersivity	ax		1.10E+01	m
Transverse dispersivity	az		1.10E+00	m
Vertical dispersivity	ay		1.10E-01	m

For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report ax = $0.83(\log_{10}x)^{2.414}$; 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.

This sheet calculates the Tier3 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

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 Tier 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.

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration mg/l
41.5	4.7E-05
83.0	3.4E-11
124.5	2.5E-17
166.0	1.8E-23
207.5	1.3E-29
249.0	9.1E-36
290.5	6.4E-42
332.0	4.6E-48
373.5	3.3E-54
416.0	2.3E-60
456.5	1.7E-66
498.0	1.2E-72
539.5	8.5E-79
581.0	6.1E-85
622.5	4.4E-91
664.0	3.1E-97
705.5	2.2E-103
747.0	1.6E-109
71.6	1.2E-115
830.0	8.3E-122

Site being assessed:	Blessington Area 6 A Downshire K20
Completed by:	AJ
Date	24 11 2005
Version	12

R&D Publication20 Remedial Targets Worksheet Release 2.2a

Tier 3 - Groundwater

ENVIRONMENT AGENCY

Input Parameters (using pull down menu)	Variable	Value	Unit	Source
Contaminant		Zinc		
Target Concentration	C_T	1.00E-01	mg/l	

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

Ogata Banks — Equations in R&D Pub. 20

Enter '1' to simulate vertical dispersion in one direction, '2' for two directions (pull down menu) 1

Enter '1' if biodegradation rate is for the substance in water,
'0' if rate is for decay in field conditions (i.e. field data from aquifer) (pull down menu 0

				Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	1.47E-01	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	9.90E+99	days	
Calculated decay rate	λ	7.00E-101	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	8.00E+01	m	
Plume thickness at source	Sy	5.60E+01	m	
Saturated aquifer thickness	da	5.71E+01	m	
Bulk density of aquifer materials	ρ	1.70E+00	g/cm^3	
Effective porosity of aquifer	n	1.82E-01	fraction	
Hydraulic gradient	i	1.25E-02	fraction	
Hydraulic conductivity of aquifer	K	2.00E+01	m/d	
Distance to compliance point	x	8.30E+02	m	
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	0.00E+00	l/kg	*see options*
Longitudinal dispersivity	ax	11.020	m	*see options*
Transverse dispersivity	az	1.102	m	*see options*
Vertical dispersivity	ay	0.110	m	*see options*

Calculated Parameters	Variable		
Groundwater flow velocity	v	1.37E+00	m/d
Retardation factor	Rf	1.00E+00	fraction
Decay rate used	λ	7.00E-101	d^{-1}
Rate of contaminant flow due to retardation	u	1.37E+00	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	9.56E-02	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	9.19E-02	mg/l
Attenuation factor (one way vertical dispersion, C_0/C_{ED})	AF	1.54E+00	
Attenuation factor (two way vertical dispersion, C_0/C_{ED})	AF	1.60E+00	

Remedial Targets

Remedial Target Ogata Banks	LTC3	1.54E-01	mg/l	For comparison with measured groundwater concentration.
Distance to compliance point		**830**	**m**	
Concentration of contaminant at compliance point	$C_{ED}/C0$	**9.56E-02**	**mg/l**	Ogata Banks
after		**9.9E+99**	**days**	

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

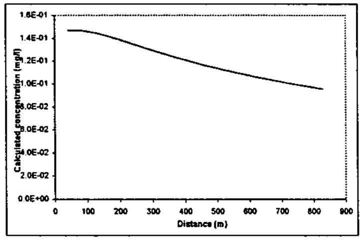
Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd	[redacted]	l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	1.00E+00	fraction
Organic carbon partition coefficient	Koc	0.00E+00	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$	[redacted]	l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Soil water partition coefficient	Kd	0.00E+00	l/kg

Dispersivity

Calculate dependant on distance to compliance point (0), 2
specify dispersivity (1), or calc after Xu & Eckstein (2) ?

		Enter value	Calc value Xu & Eckstein	
Longitudinal dispersivity	ax	[redacted]	1.10E+01	m
Transverse dispersivity	az		1.10E+00	m
Vertical dispersivity	ay		1.10E-01	m

For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report ax = $0.83(\log_{10}x)^{2.414}$; 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.

This sheet calculates the Tier3 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

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 Tier 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

Calculated concentrations for distance-concentration graph

Ogata Banks
DistarcalcConcensheetn

	mg/l
41.6	1.5E-01
68.0	1.5E-01
124.5	1.4E-01
110.0	1.4E-01
207.5	1.4E-01
249.0	1.3E-01
290.5	1.3E-01
332.0	1.3E-01
373.5	1.2E-01
416.0	1.2E-01
456.5	1.2E-01
498.0	1.1E-01
689.6	1.1E-01
581.0	1.1E-01
622.5	1.1E-01
664.0	1.0E-01
706.6	1.0E-01
747.0	9.9E-02
788.5	9.7E-02
830.0	9.6E-02

Site being assessed	Blessington Area 6 A Downshire K20
Completed by	AJ
Date:	24 11 2005
Version:	12

ENVIRONMENT
AGENCY

R&D Publication 20 Remedial Targets Worksheet, Release 2.2a

Tier 3 - Groundwater

Input Parameters (using pull down menu)	Variable	Value	Unit	Source
Contaminant		1 2 4 trimethylbenzene		
Target Concentration	C_T	1.00E-02	mg/l	

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

Ogata Banks — Equations in R&D Pub. 20

Enter '1' to simulate vertical dispersion in one direction, '2' for two directions (pull down menu): 1

Enter '1' if biodegradation rate is for the substance in water,
'0' if rate is for decay in field conditions (i.e. field data from aquifer) (pull down menu): 0

	Variable	Value	Unit	Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	3.00E-03	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	3.60E+02	days	
Calculated decay rate	λ	1.93E-03	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	8.00E+01	m	
Plume thickness at source	Sy	5.60E+01	m	
Saturated aquifer thickness	da	5.71E+01	m	
Bulk density of aquifer materials	ρ	1.70E+00	g/cm^3	
Effective porosity of aquifer		1.82E-01	fraction	
Hydraulic gradient		1.25E-02	fraction	
Hydraulic conductivity of aquifer	K	2.00E+01	m/d	
Distance to compliance point	x	8.30E+02	m	
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	2.95E+01	l/kg	*see options*
Longitudinal dispersivity	ax	11.020	m	*see options*
Transverse dispersivity	az	1.102	m	*see options*
Vertical dispersivity	av	0.110	m	*see options*

Calculated Parameters	Variable		
Groundwater flow velocity	v	1.37E+00	m/d
Retardation factor	Rf	2.77E+02	fraction
Decay rate used	λ	1.93E-03	d^{-1}
Rate of contaminant flow due to retardation	u	4.97E-03	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	1.21E-56	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	1.16E-56	mg/l
Attenuation factor (one way vertical dispersion, C_0/C_{ED})	AF	2.49E+53	
Attenuation factor (two way vertical dispersion, C_0/C_{ED})	AF	2.59E+53	

Remedial Targets

Remedial Target	LTC3	2.49E+51	mg/l

For comparison with measured groundwater concentration.

Ogata Banks

Distance to compliance point		**830**	**m**	
Concentration of contaminant at compliance point	$C_{ED}/C0$	**1.21E-56**	**mg/l**	Ogata Banks
after		**9.9E+99**	**days**	

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

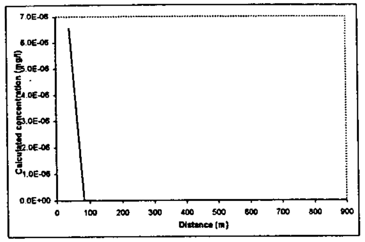
Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd		l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	1.00E+00	fraction
Organic carbon partition coefficient	Koc	2.95E+01	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$		l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Soil water partition coefficient	Kd	2.95E+01	l/kg

Dispersivity

Calculate dependant on distance to compliance point (0), specify dispersivity (1), or calc after Xu & Eckstein (2) ? 2

		Enter value	Calc value Xu & Eckstein	
Longitudinal dispersivity	ax		1.10E+01	m
Transverse dispersivity	az		1.10E+00	m
Vertical dispersivity	ay		1.10E-01	m

For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report ax = $0.83(\log_{10}x)^{2.414}$; 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.

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration mg/l
41.5	6.6E-06
83.0	1.4E-08
124.5	3.1E-11
166.0	6.6E-14
207.5	1.4E-16
249.0	3.0E-19
290.5	6.3E-22
332.0	1.3E-24
373.5	2.9E-27
415.0	6.1E-30
456.5	1.3E-32
498.0	2.8E-35
539.5	5.9E-38
581.0	1.3E-40
622.5	2.7E-43
664.0	5.7E-46
705.5	1.2E-48
747.0	2.6E-51
788.5	5.6E-54
830.0	1.2E-56

This sheet calculates the Tier3 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

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 Tier 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.

Site being assessed	Bless Downshire K20 b
Completed by	AJ
Date:	24 11 2005
Version:	12

R&D Publication 20 Remedial Targets Worksheet, Release 2.2a

ENVIRONMENT AGENCY

Tier 3 - Groundwater

Input Parameters (using pull down menu)	Variable	Value	Unit	Source
Contaminant		1 3 5 trimethylbenzene		
Target Concentration	C_T	1.00E-02	mg/l	

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

Ogata Banks — Equations in R&D Pub. 20

Enter '1' to simulate vertical dispersion in one direction, '2' for two directions (pull down menu): 1

Enter '1' if biodegradation rate is for the substance in water,
'0' if rate is for decay in field conditions (i.e. field data from aquifer) (pull down menu): 0

				Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	1.00E-03	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	3.60E+02	days	
Calculated decay rate	λ	1.93E-03	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	8.00E+01	m	
Plume thickness at source	Sy	5.60E+01	m	
Saturated aquifer thickness	da	5.71E+01	m	
Bulk density of aquifer materials	ρ	1.70E+00	g/cm^3	
Effective porosity of aquifer	n	1.82E-01	fraction	
Hydraulic gradient	i	1.25E-02	fraction	
Hydraulic conductivity of aquifer	K	2.00E+01	m/d	
Distance to compliance point	x	8.30E+02	m	
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	2.95E+01	l/kg	*see options*
Longitudinal dispersivity	ax	11.020	m	*see options*
Transverse dispersivity	az	1.102	m	*see options*
Vertical dispersivity	ay	0.110	m	*see options*

Calculated Parameters	Variable		
Groundwater flow velocity	v	1.37E+00	m/d
Retardation factor	Rf	2.77E+02	fraction
Decay rate used	λ	1.93E-03	d^{-1}
Rate of contaminant flow due to retardation	u	4.97E-03	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	4.02E-57	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	3.87E-57	mg/l
Attenuation factor (one way vertical dispersion, C_0/C_{ED})	AF	2.49E+53	
Attenuation factor (two way vertical dispersion, C_0/C_{ED})	AF	2.59E+53	

Remedial Targets

Remedial Target LTC3 2.49E+61 mg/l — For comparison with measured groundwater concentration.

Ogata Banks

Distance to compliance point		830	m	
Concentration of contaminant at compliance point	$C_{ED}/C0$	4.02E-57	mg/l	Ogata Banks
after		9.9E+99	days	

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

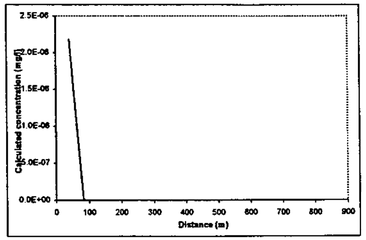
Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd		l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	1.00E+00	fraction
Organic carbon partition coefficient	Koc	2.95E+01	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$		l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Soil water partition coefficient	Kd	2.95E+01	l/kg

Dispersivity

Calculate dependant on distance to compliance point (0), specify dispersivity (1), or calc after Xu & Eckstein (2) ? 2

		Enter value	Calc value Xu & Eckstein	
Longitudinal dispersivity	ax		1.10E+01	m
Transverse dispersivity	az		1.10E+00	m
Vertical dispersivity	ay		1.10E-01	m

For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report ax = 0.83(log$_{10}$x)$^{2.414}$; 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.

This sheet calculates the Tier3 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

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 Tier 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.

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration
	mg/l
41.5	2.2E-06
83.0	4.8E-09
124.5	1.0E-11
166.0	2.2E-14
207.5	4.7E-17
249.0	9.9E-20
[illegible]	[illegible]
373.5	9.5E-28
415.0	2.0E-30
456.5	4.3E-33
498.0	9.2E-36
639.6	2.0E-38
661.0	4.2E-41
622.5	8.9E-44
664.0	t.9E.U
70S.6	4.1E.U
747.0	8.7E-52
711.6	1.9E-54
830.0	4.0E-57

Site being assessed	Bless Downshire K20 b
Completed by	AJ
Date	24 11 2005
Version	12

R&D Publication 20 Remedial Targets Worksheet, Release 2.2a

Tier 3 - Groundwater

ENVIRONMENT AGENCY

Input Parameters (using pull down menu)	Variable	Value	Unit	Source
Contaminant		1 4 Dichlorobenzene		
Target Concentration	C_T	1.00E-02	mg/l	

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

Ogata Banks — Equations in RAD Pub. 20

Enter '1' to simulate vertical dispersion in one direction, '2' for two directions (pull down menu): 1

Enter '1' if biodegradation rate is for the substance in water,
'0' if rate is for decay in field conditions (i.e. field data from aquifer) (pull down menu): 0

	Variable	Value	Unit	Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	9.90E-99	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	3.60E+02	days	
Calculated decay rate	λ	1.93E-03	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	8.00E+01	m	
Plume thickness at source	Sy	5.60E+01	m	
Saturated aquifer thickness	da	5.71E+01	m	
Bulk density of aquifer materials	ρ	1.70E+00	g/cm^3	
Effective porosity of aquifer	n	1.82E-01	fraction	
Hydraulic gradient	i	1.25E-02	fraction	
Hydraulic conductivity of aquifer	K	2.00E+01	m/d	
Distance to compliance point	x	8.30E+02	m	
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	7.76E+00	l/kg	*see options*
Longitudinal dispersivity	ax	11.020	m	*see options*
Transverse dispersivity	az	1.102	m	*see options*
Vertical dispersivity	ay	0.110	m	*see options*

Calculated Parameters	Variable		
Groundwater flow velocity	v	1.37E+00	m/d
Retardation factor	Rf	7.35E+01	fraction
Decay rate used	λ	1.93E-03	d^{-1}
Rate of contaminant flow due to retardation	u	1.87E-02	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	4.63E-121	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	4.45E-121	mg/l
Attenuation factor (one way vertical dispersion, C_0/C_{ED})	AF	2.14E+22	
Attenuation factor (two way vertical dispersion, C_0/C_{ED})	AF	2.22E+22	

Remedial Targets

Remedial Target	LTC3	2.14E+20	mg/l	For comparison with measured groundwater concentration.
Ogata Banks				
Distance to compliance point		830	m	
Concentration of contaminant at compliance point	$C_{ED}/C0$	4.63E-121	mg/l	Ogata Banks
after		9.9E+99	days	

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 pulldown menu)

Calculate for non-polar organic chemicals

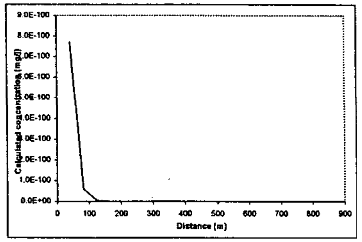
Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd		l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	1.00E+00	fraction
Organic carbon partition coefficient	Koc	7.76E+00	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$		l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Soil water partition coefficient	Kd	7.76E+00	l/kg

Dispersivity

Calculate dependant on distance to compliance point (0), specify dispersivity (1), or calc after Xu & Eckstein (2) ? 2

		Enter value	Calc value Xu & Eckstein	
Longitudinal dispersivity	ax		1.10E+01	m
Transverse dispersivity	az		1.10E+00	m
Vertical dispersivity	ay		1.10E-01	m

For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report ax = 0.83$(\log_{10}x)^{2.414}$; 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.

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration
	mg/l
41.5	7.7E-100
83.0	6.0E-101
124.5	4.6E-102
166.0	3.6E-103
207.5	2.7E-104
249.0	2.1E-105
m5	1.6E-106
332.0	1.2E-107
373.5	9.0E-109
415.0	6.8E-110
460.6	5.2E-111
498.0	4.0E-112
539.5	3.0E-113
581.0	2.3E-114
622.5	1.8E-115
664.0	1.3E-116
706.5	1.0E-117
747.0	7.9E-119
788.5	6.0E-120
830.0	4.6E-121

This sheet calculates the Tier3 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

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 Tier 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.

Site being assessed	Bless Downshire K20 b
Completed by	AJ
Date	24 11 2005
Version	12

ENVIRONMENT AGENCY

R&D Publication 20 Remedial Targets Worksheet, Release 2.2a

Tier 3 - Groundwater

Input Parameters (using pull down menu)	Variable	Value	Unit	Source
Contaminant		Aliphatic C8-C10		
Target Concentration	C_T	7.14E-04	mg/l	

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

Ogata Banks — Equations in R&D Pub. 20

Enter '1' to simulate vertical dispersion in one direction, '2' for two directions (pull down menu): 1

Enter '1' if biodegradation rate is for the substance in water,
'0' if rate is for decay in field conditions (i.e. field data from aquifer) (pull down menu): 0

	Variable	Value	Unit	Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	2.12E-02	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	1.83E+03	days	
Calculated decay rate	λ	3.80E-04	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	8.00E+01	m	
Plume thickness at source	Sy	5.60E+01	m	
Saturated aquifer thickness	da	5.71E+01	m	
Bulk density of aquifer materials	ρ	1.70E+00	g/cm^3	
Effective porosity of aquifer	n	1.82E-01	fraction	
Hydraulic gradient	i	1.25E-02	fraction	
Hydraulic conductivity of aquifer	K	2.00E+01	m/d	
Distance to compliance point	x	8.30E+02	m	
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	1.15E+02	l/kg	*see options*
Longitudinal dispersivity	ax	11.020	m	*see options*
Transverse dispersivity	az	1.102	m	*see options*
Vertical dispersivity	ay	0.110	m	*see options*

Calculated Parameters	Variable		
Groundwater flow velocity	v	1.37E+00	m/d
Retardation factor	Rf	1.07E+03	fraction
Decay rate used	λ	3.80E-04	d^{-1}
Rate of contaminant flow due to retardation	u	1.28E-03	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	1.33E-47	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	1.28E-47	mg/l
Attenuation factor (one way vertical dispersion, C_0/C_{ED})	AF	1.60E+45	
Attenuation factor (two way vertical dispersion, C_0/C_{ED})	AF	1.66E+45	

Remedial Targets

Remedial Target Ogata Banks	LTC3	1.14E+42	mg/l

For comparison with measured groundwater concentration.

Distance to compliance point		830	m	
Concentration of contaminant at compliance point	$C_{ED}/C0$	1.33E-47	mg/l	Ogata Banks
after		9.9E+99	days	

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

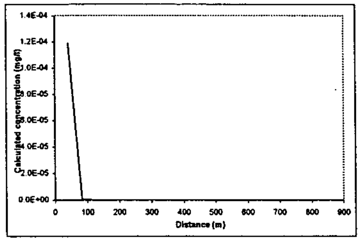
Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd	[redacted]	l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	1.00E+00	fraction
Organic carbon partition coefficient	Koc	1.15E+02	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$	[redacted]	l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Soil water partition coefficient	Kd	1.15E+02	l/kg

Dispersivity

Calculate dependant on distance to compliance point (0), specify dispersivity (1), or calc after Xu & Eckstein (2) ? 2

		Enter value	Calc value Xu & Eckstein	
Longitudinal dispersivity	ax	[redacted]	1.10E+01	m
Transverse dispersivity	az		1.10E+00	m
Vertical dispersivity	ay		1.10E-01	m

For calculated value, assumes ax = 0.1 * x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report $ax = 0.83(\log_{10}x)^{2.414}$; 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.

This sheet calculates the Tier3 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

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 Tier 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.

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration
	mg/l
41.5	1.2E-04
83.0	6.7E-07
124.5	3.7E-09
166.0	2.0E-11
207.5	1.1E-13
249.0	6.0E-16
290.5	3.3E-18
332.0	1.8E-20
373.5	9.8E-23
415.0	5.4E-25
456.5	2.9E-27
498.0	1.6E-29
539.5	8.8E-32
581.0	4.8E-34
622.5	2.6E-36
664.0	1.4E-38
705.5	8.0E-41
747.0	4.4E-43
788.5	2.4E-45
830.0	1.3E-47

Site being assessed	Blessington Area 6 A Downshire K20
Completed by	AJ
Date	24 11 2005
Version	12

R&D Publication 20 Remedial Targets Worksheet, Release 2.2a

ENVIRONMENT AGENCY

Tier 3 - Groundwater

Input Parameters (using pull down menu)	Variable	Value	Unit	Source
Contaminant		Aliphatic C10-C12		
Target Concentration	C_T	7.14E-04	mg/l	

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

Ogata Banks — Equations in R&D Pub. 20

Enter '1' to simulate vertical dispersion in one direction, '2' for two directions (pull down menu) — 1

Enter '1' if biodegradation rate is for the substance in water,
'0' if rate is for decay in field conditions (i.e. field data from aquifer) (pull down menu) — 0

	Variable	Value	Unit	Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	2.12E-02	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	1.83E+03	days	
Calculated decay rate	λ	3.80E-04	days^{-1}	
Width of plume in aquifer at source (perpendicular to flow)	Sz	8.00E+01	m	
Plume thickness at source	Sy	5.60E+01	m	
Saturated aquifer thickness	da	5.71E+01	m	
Bulk density of aquifer materials	ρ	1.70E+00	g/cm^3	
Effective porosity of aquifer	n	1.82E-01	fraction	
Hydraulic gradient	i	1.25E-02	fraction	
Hydraulic conductivity of aquifer	K	2.00E+01	m/d	
Distance to compliance point	x	8.30E+02	m	
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	9.12E+02	l/kg	*see options*
Longitudinal dispersivity	ax	11.020	m	*see options*
Transverse dispersivity	az	1.102	m	*see options*
Vertical dispersivity	ay	0.110	m	*see options*

Calculated Parameters	Variable		
Groundwater flow velocity	v	1.37E+00	m/d
Retardation factor	Rf	8.52E+03	fraction
Decay rate used	λ	3.80E-04	d^{-1}
Rate of contaminant flow due to retardation	u	1.61E-04	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	1.12E-153	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	1.07E-153	mg/l
Attenuation factor (one way vertical dispersion, C_0/C_{ED})	AF	1.90E+151	
Attenuation factor (two way vertical dispersion, C_0/C_{ED})	AF	1.97E+151	

Remedial Targets

Remedial Target Ogata Banks	LTC3	1.36E+148	mg/l	For comparison with measured groundwater concentration.
Distance to compliance point		**830**	**m**	
Concentration of contaminant at compliance point	$C_{ED}/C0$	**1.12E-153**	**mg/l**	Ogata Banks
after		**9.9E+99**	**days**	

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

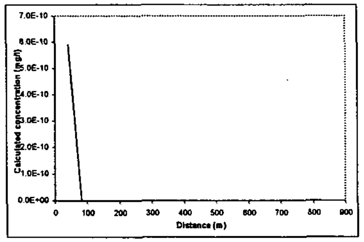
Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd	[redacted]	l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	1.00E+00	fraction
Organic carbon partition coefficient	Koc	9.12E+02	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$	[redacted]	l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Soil water partition coefficient	Kd	9.12E+02	l/kg

Dispersivity

Calculate dependant on distance to compliance point (0), specify dispersivity (1), or calc after Xu & Eckstein (2) ? — 2

		Enter value	Calc value Xu & Eckstein	
Longitudinal dispersivity	ax	[redacted]	1.10E+01	m
Transverse dispersivity	az		1.10E+00	m
Vertical dispersivity	ay		1.10E-01	m

For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report ax = 0.83$(\log_{10}x)^{2.414}$; 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.

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration mg/l
41.5	5.9E-10
83.0	1.6E-17
124.5	4.5E-25
166.0	1.2E-32
207.5	3.4E-40
290.5	9.6E-55
332.0	6.7E-63
376.6	4.8E-70
456.5	1.3E-85
498.5	[illegible]
581.0	2.7E-108
622.5	7.3E-116
704.6	6.6E-123
741.0	1.5E-138
788.6	4.1E-146

This sheet calculates the Tier3 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

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 Tier 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.

Site being assessed	Blessington Area 6 A Downshire K20
Completed by	AJ
Date.	24 11 2005
Version	12

a

ENVIRONMENT AGENCY

R&D Publication 20 Remedial Targets Worksheet, Release 2.2a

Tier 3 - Groundwater

Input Parameters (using pull down menu)	Variable	Value	Unit	Source
Contaminant		Aliphatic C12-C16		
Target Concentration	C_T	7.14E-04	mg/l	

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

Ogata Banks — Equations in R&D Pub. 20

Enter' 1' to simulate vertical dispersion in one direction, '2' for two directions (pull down menu) 1

Enter '1' if biodegradation rate is for the substance in water,
'0' if rate is for decay in field conditions (i.e. field data from aquifer) (pull down menu 0

	Variable	Value	Unit	Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	2.12E-02	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	1.83E+03	days	
Calculated decay rate	λ	3.80E-04	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	8.00E+01	m	
Plume thickness at source	Sy	5.60E+01	m	
Saturated aquifer thickness	da	5.71E+01	m	
Bulk density of aquifer materials	ρ	1.70E+00	g/cm^3	
Effective porosity of aquifer	n	1.82E-01	fraction	
Hydraulic gradient	i	1.25E-02	fraction	
Hydraulic conductivity of aquifer	K	2.00E+01	m/d	
Distance to compliance point	x	8.30E+02	m	
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	1.82E+04	l/kg	*see options*
Longitudinal dispersivity	ax	11.020	m	*see options*
Transverse dispersivity	az	1.102	m	*see options*
Vertical dispersivity	ay	0.110	m	*see options*

Calculated Parameters	Variable		
Groundwater flow velocity	v	1.37E+00	m/d
Retardation factor	Rf	1.70E+05	fraction
Decay rate used	λ	3.80E-04	d^{-1}
Rate of contaminant flow due to retardation	u	8.08E-06	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	#NUM!	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	#NUM!	mg/l
Attenuation factor (one way vertical dispersion, C_0/C_{ED})	AF	#NUM!	
Attenuation factor (two way vertical dispersion, C_0/C_{ED})	AF	#NUM!	

Remedial Targets

Remedial Target LTC3 #NUM! mg/l For comparison with measured groundwater concentration.
Ogata Banks

Distance to compliance point		830	m	
Concentration of contaminant at compliance point	$C_{ED}/C0$	#NUM!	mg/l	Ogata Banks
after		9.9E+99	days	

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

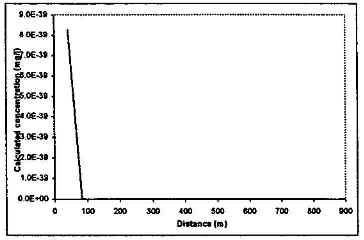
Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd		l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	1.00E+00	fraction
Organic carbon partition coefficient	Koc	1.82E+04	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$		l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Soil water partition coefficient	Kd	1.82E+04	l/kg

Dispersivity

Calculate dependant on distance to compliance point (0), specify dispersivity (1), or calc after Xu & Eckstein (2) ? 2

		Enter value	Calc value Xu & Eckstein	
Longitudinal dispersivity	ax		1.10E+01	m
Transverse dispersivity	az		1.10E+00	m
Vertical dispersivity	ay		1.10E-01	m

For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report ax = $0.83(\log_{10}x)^{2.414}$; 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.

This sheet calculates the Tier3 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

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 Tier 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.

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration
	mg/l
41.5	8.3E-39
83.0	3.2E-75
124.5	1.2E-111
166.0	4.8E-148
207.5	1.8E-184
249.0	6.9E-221
290.5	2.6E-257
332.0	9.9E-294
373.5	#NUM!
415.0	#NUM!
456.5	#NUM!
498.0	#NUM!
539.5	#NUM!
581.0	#NUM!
622.5	#NUM!
664.0	#NUM!
705.5	#NUM!
747.0	#NUM!
788.5	#NUM!
830.0	#NUM!

Site being assessed:	Blessington Area 6 A Downshire K20
Completed by.	AJ
Date.	24 11 2005
Version	12

R&D Publication20 Remedial Targets Worksheet, Release 2.2a

Tier 3 -Groundwater

ENVIRON AGENCY

Input Parameters (using pull down menu)	Variable	Value	Unit	Source
Contaminant		Aliphatic C16-C21		
Target Concentration	C_T	7.14E-04	mg/l	

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

Ogata Banks — Equations in R&D Pub. 20

Enter '1' to simulate vertical dispersion in one direction, '2' for two directions (pull down menu) 1

Enter '1' if biodegradation rate is for the substance in water,
'0' if rate is for decay in field conditions (i.e. field data from aquifer) (pull down menu 0

	Variable	Value	Unit	Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	2.12E-02	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	3.65E+03	days	
Calculated decay rate	λ	1.90E-04	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	8.00E+01	m	
Plume thickness at source	Sy	5.60E+01	m	
Saturated aquifer thickness	da	5.71E+01	m	
Bulk density of aquifer materials	ρ	1.70E+00	g/cm^3	
Effective porosity of aquifer	n	1.82E-01	fraction	
Hydraulic gradient	i	1.25E-02	fraction	
Hydraulic conductivity of aquifer	K	2.00E+01	m/d	
Distance to compliance point	x	8.30E+02	m	
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	2.29E+06	l/kg	*see options*
Longitudinal dispersivity	ax	11.020	m	*see options*
Transverse dispersivity	az	1.102	m	*see options*
Vertical dispersivity	ay	0.110	m	*see options*

Calculated Parameters	Variable		
Groundwater flow velocity	v	1.37E+00	m/d
Retardation factor	Rf	2.14E+07	fraction
Decay rate used	λ	1.90E-04	d^{-1}
Rate of contaminant flow due to retardation	u	6.42E-08	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	#NUM!	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	#NUM!	mg/l
Attenuation factor (one way vertical dispersion, C_0/C_{ED})	AF	#NUM!	
Attenuation factor (two way vertical dispersion, C_0/C_{ED})	AF	#NUM!	

Remedial Targets

Remedial Target LTC3 #NUM! mg/l For comparison with measured groundwater concentration.
Ogata Banks

Distance to compliance point		830	m	
Concentration of contaminant at compliance point	$C_{ED}/C0$	#NUM!	mg/l	Ogata Banks
after		9.9E+99	days	

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

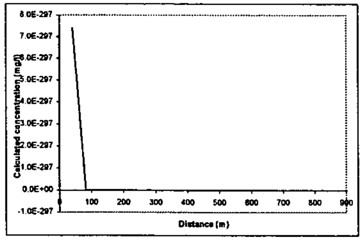
Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd		l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	1.00E+00	fraction
Organic carbon partition coefficient	Koc	2.29E+06	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$		l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Soil water partition coefficient	Kd	2.29E+06	l/kg

Dispersivity

Calculate dependant on distance to compliance point (0), specify dispersivity (1), or calc after Xu & Eckstein (2) ? 2

		Enter value	Calc value Xu & Eckstein	
Longitudinal dispersivity	ax		1.10E+01	m
Transverse dispersivity	az		1.10E+00	m
Vertical dispersivity	ay		1.10E-01	m

For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report ax = $0.83(\log_{10}x)^{2.414}$; 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.

This sheet calculates the Tier3 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

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 Tier 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.

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration
	mg/l
41.5	7.4E-297
83.0	#NUM!
124.5	#NUM!
166.0	#NUM!
207.5	#NUM!
249.0	#NUM!
290.5	#NUM!
332.0	#NUM!
373.5	#NUM!
415.0	#NUM!
456.5	#NUM!
498.0	#NUM!
539.5	#NUM!
581.0	#NUM!
622.5	#NUM!
664.0	#NUM!
705.5	#NUM!
747.0	#NUM!
788.5	#NUM!
830.0	#NUM!

Site being assessed	Blessington Area 6 A Downshire K20
Completed by	AJ
Date.	24 11 2005
Version	12

R&D Publication 20 Remedial Targets Worksheet, Release 2.2a

Tier 3 - Groundwater

ENVIRONMENT AGENCY

Input Parameters (using pull down menu)	Variable	Value	Unit	Source
Contaminant		Aliphatics C6-C8		
Target Concentration	C_T	7.14E-04	mg/l	

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

Ogata Banks — Equations in R&D Pub. 20

Enter '1' to simulate vertical dispersion in one direction, '2' for two directions (pull down menu) 1

Enter '1' if biodegradation rate is for the substance in water,
'0' if rate is for decay in field conditions (i.e. field data from aquifer) (pull down menu 0

				Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	2.12E-02	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	7.30E+02	days	
Calculated decay rate	λ	9.50E-04	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	8.00E+01	m	
Plume thickness at source	Sy	5.60E+01	m	
Saturated aquifer thickness	da	5.71E+01	m	
Bulk density of aquifer materials	ρ	1.70E+00	g/cm^3	
Effective porosity of aquifer	n	1.82E-01	fraction	
Hydraulic gradient	i	1.25E-02	fraction	
Hydraulic conductivity of aquifer	K	2.00E+01	m/d	
Distance to compliance point	x	8.30E+02	m	
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	1.45E+01	l/kg	*see options*
Longitudinal dispersivity	ax	11.020	m	*see options*
Transverse dispersivity	az	1.102	m	*see options*
Vertical dispersivity	ay	0.110	m	*see options*

Calculated Parameters	Variable		
Groundwater flow velocity	v	1.37E+00	m/d
Retardation factor	Rf	1.36E+02	fraction
Decay rate used	λ	9.50E-04	d^{-1}
Rate of contaminant flow due to retardation	u	1.01E-02	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	2.52E-23	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	2.43E-23	mg/l
Attenuation factor (one way vertical dispersion, C_0/C_{ED})	AF	8.40E+20	
Attenuation factor (two way vertical dispersion, C_0/C_{ED})	AF	8.74E+20	

Remedial Targets

Remedial Target	LTC3	8.00E+17	mg/l
Ogata Banks			

For comparison with measured groundwater concentration.

Distance to compliance point		830	m	
Concentration of contaminant at compliance point	$C_{ED}/C0$	2.52E-23	mg/l	Ogata Banks
after		9.9E+99	days	

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

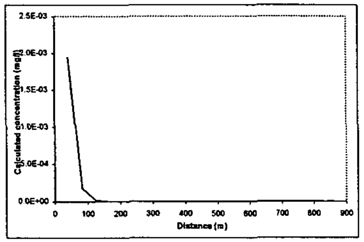
Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd		l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	1.00E+00	fraction
Organic carbon partition coefficient	Koc	1.45E+01	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$		l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Soil water partition coefficient	Kd	1.45E+01	l/kg

Dispersivity

Calculate dependant on distance to compliance point (0), specify dispersivity (1), or calc after Xu & Eckstein (2) ? 2

		Enter value	Calc value Xu & Eckstein	
Longitudinal dispersivity	ax		1.10E+01	m
Transverse dispersivity	az		1.10E+00	m
Vertical dispersivity	ay		1.10E-01	m

For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report ax = 0.83$(\log_{10}x)^{2.414}$; 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.

Calculated concentrations for distance-concentration graph

Ogata Banks
DistaıcalcConcensheetn

	mg/l
41.5	1.9E-03
83.0	1.8E-04
124.6	1.6E-05
166.0	1.5E-06
249.6	1.3E-08
IW.6	1.0E-09
332.0	9.3E-11
J736	8.3E-12
415.0	7.4E-13
456.5	IRE-14
498.0	5.9E-15
6W.6	5.3E-16
661.0	4.8E-17
622.5	4.3E-18
664.0	3.8E-19
705.5	3.5E-20
747.0	3.1E-21
788.5	2.8E-22
830.0	2.5E-23

This sheet calculates the Tier3 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

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 Tier 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.

Site being assessed:	Blessington Area 6 A Downshire K20
Completed by:	AJ
Date:	24 11 2005
Version	12

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R&D Publication20 Remedial Targets Worksheet, Release 2.2a

Tier 3 -Groundwater

ENVIRONMENT AGENCY

Input Parameters (using pull down menu)

Input Parameters	Variable	Value	Unit	Source
Contaminant		mmoniacal Nitrogen as		
Target Concentration	C_T	1.20E-01	mg/l	

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

Ogata Banks — Equations in R&D Pub. 20

Enter '1' to simulate vertical dispersion in one direction, '2' for two directions (pull down menu) 1

Enter '1' if biodegradation rate is for the substance in water,
'0' if rate is for decay in field conditions (i.e. field data from aquifer) (pull down menu 0

	Variable	Value	Unit	Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	4.40E+00	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	2.19E+03	days	
Calculated decay rate	λ	3.17E-04	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	8.00E+01	m	
Plume thickness at source	Sy	5.60E+01	m	
Saturated aquifer thickness	da	5.71E+01	m	
Bulk density of aquifer materials	ρ	1.70E+00	g/cm^3	
Effective porosity of aquifer	n	1.82E-01	fraction	
Hydraulic gradient	i	1.25E-02	fraction	
Hydraulic conductivity of aquifer	K	2.00E+01	m/d	
Distance to compliance point	x	8.30E+02	m	
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	5.00E-01	l/kg	*see options*
Longitudinal dispersivity	ax	11.020	m	*see options*
Transverse dispersivity	az	1.102	m	*see options*
Vertical dispersivity	ay	0.110	m	*see options*

Calculated Parameters

Calculated Parameters	Variable		
Groundwater flow velocity	v	1.37E+00	m/d
Retardation factor	Rf	5.67E+00	fraction
Decay rate used	λ	3.17E-04	d^{-1}
Rate of contaminant flow due to retardation	u	2.42E-01	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	9.82E-01	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	9.44E-01	mg/l
Attenuation factor (one way vertical dispersion, C_O/C_{ED})	AF	4.48E+00	
Attenuation factor (two way vertical dispersion, C_O/C_{ED})	AF	4.66E+00	

Remedial Targets

Remedial Target Ogata Banks	LTC3	5.38E-01	mg/l	For comparison with measured groundwater concentration.
Distance to compliance point		830	m	
Concentration of contaminant at compliance point	$C_{ED}/C0$	9.82E-01	mg/l	Ogata Banks
after		9.9E+99	days	

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

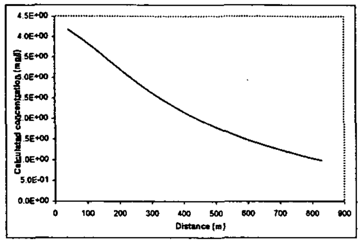
Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd		l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	1.00E+00	fraction
Organic carbon partition coefficient	Koc	5.00E-01	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$		l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Soil water partition coefficient	Kd	5.00E-01	l/kg

Dispersivity

Calculate dependant on distance to compliance point (0), 2
specify dispersivity (1), or calc after Xu & Eckstein (2) ?

		Enter value	Calc value Xu & Eckstein	
Longitudinal dispersivity	ax		1.10E+01	m
Transverse dispersivity	az		1.10E+00	m
Vertical dispersivity	ay		1.10E-01	m

For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report ax = $0.83(\log_{10}x)^{2.414}$; 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.

This sheet calculates the Tier3 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

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 Tier 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.

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration mg/l
41.6	4.2E+00
[illegible]	3.9E+00
166.0	3.4E+00
207.6	3.2E+00
249.0	2.9E+00
290.5	2.7E+00
332.0	2.5E+00
373.6	2.3E+00
416.0	2.1E+00
456.5	1.9E+00
438.0	1.8E+00
639.5	1.7E+00
01.0	1.5E+00
622.5	1.4E+00
664.0	1.3E+00
706.6	1.2E+00
747.0	1.1E+00
738.6	1.1E+00
830.0	9.8E-01

Site being assessed	Blessington Area 6 A Downshire K20
Completed by	AJ
Date	24 11 2005
Version	12

R&D Publication 20 Remedial Targets Worksheet, Release 2.2a

Tier 3 -Groundwater

ENVIRONMENT AGENCY

Input Parameters (using pull down menu)	Variable	Value	Unit	Source
Contaminant		Aromatic C7-C8		
Target Concentration	C_T	7.14E-04	mg/l	

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

Ogata Banks — Equations in R&D Pub. 20

Enter '1' to simulate vertical dispersion in one direction, '2' for two directions (pull down menu): 1

Enter '1' if biodegradation rate is for the substance in water,
'0' if rate is for decay in field conditions (i.e. field data from aquifer) (pull down menu): 0

	Variable	Value	Unit	Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	7.70E-02	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	7.30E+02	days	
Calculated decay rate	λ	9.50E-04	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	8.00E+01	m	
Plume thickness at source	Sy	5.60E+01	m	
Saturated aquifer thickness	da	5.71E+01	m	
Bulk density of aquifer materials	ρ	1.70E+00	g/cm^3	
Effective porosity of aquifer	n	1.82E-01	fraction	
Hydraulic gradient	i	1.25E-02	fraction	
Hydraulic conductivity of aquifer	K	2.00E+01	m/d	
Distance to compliance point	x	8.30E+02	m	
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	`y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	9.12E-01	l/kg	*see options*
Longitudinal dispersivity	ax	11.020	m	*see options*
Transverse dispersivity	az	1.102	m	*see options*
Vertical dispersivity	ay	0.110	m	*see options*

Calculated Parameters	Variable		
Groundwater flow velocity	v	1.37E+00	m/d
Retardation factor	Rf	9.52E+00	fraction
Decay rate used	λ	9.50E-04	d^{-1}
Rate of contaminant flow due to retardation	u	1.44E-01	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	3.01E-04	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	2.90E-04	mg/l
Attenuation factor (one way vertical dispersion, C_0/C_{ED})	AF	2.56E+02	
Attenuation factor (two way vertical dispersion, C_0/C_{ED})	AF	2.88E+02	

Remedial Targets

Remedial Target	LTCS	1.92E-01	mg/l	For comparison with measured groundwater concentration.
Ogata Banks				
Distance to compliance point		830	m	
Concentration of contaminant at compliance point	$C_{ED}/C0$	3.01E-04	mg/l	Ogata Banks
after		9.9E+99	days	

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

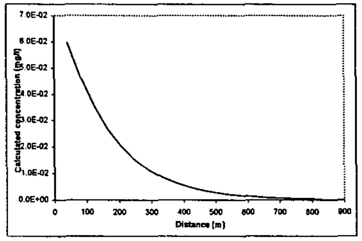
Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd	[redacted]	l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	1.00E+00	fraction
Organic carbon partition coefficient	Koc	9.12E-01	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$	[redacted]	l/kg
Sorption coefficient for ionised species	$K_{oc,i}$	[redacted]	l/kg
pH value	pH	[redacted]	
acid dissociation constant	pKa	[redacted]	
Soil water partition coefficient	Kd	9.12E-01	l/kg

Dispersivity

Calculate dependant on distance to compliance point (0), specify dispersivity (1), or calc after Xu & Eckstein (2) ? 2

		Enter value	Calc value Xu & Eckstein	
Longitudinal dispersivity	ax	[redacted]	1.10E+01	m
Transverse dispersivity	az	[redacted]	1.10E+00	m
Vertical dispersivity	ay	[redacted]	1.10E-01	m

For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report $ax = 0.83(\log_{10}x)^{2.414}$; 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.

This sheet calculates the Tier3 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

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 Tier 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.

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration
	mg/l
41.5	6.0E-02
63.0	4.8E-02
124.5	3.5E-02
166.0	2.7E-02
207.5	2.0E-02
249.0	1.5E-02
290.5	1.1E-02
332.0	8.6E-03
373.5	6.5E-03
416.9	4.9E-03
456.5	5.7E-W
4M.0	2.8E-03
539.5	2.1E-03
581.0	I.EE-W
622.5	1.2E.W
664.5	9.3E-04
747.0	6.2E-04
788.5	4.0E-04
830.0	3.0E-04

Site being assessed	Blessington Area 6 A Downshire K20
Completed by.	AJ
Date:	24 11 2005
Version.	12

RBD Publication20 Remedial Targets Worksheet, Release 2.2a

Tier 3 -Groundwater

ENVIRONMENT AGENCY

Input Parameters (using pull down menu)	Variable	Value	Unit	Source
Contaminant		Aromatic C8-C10		
Target Concentration	C_T	7.14E-04	mg/l	

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

Ogata Banks — Equations in R&D Pub. 20

Enter '1' to simulate vertical dispersion in one direction, '2' for two directions (pull down menu): 1

Enter '1' if biodegradation rate is for the substance in water,
'0' if rate is for decay in field conditions (i.e. field data from aquifer) (pull down menu): 0

	Variable	Value	Unit	Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	2.12E-02	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	1.83E+03	days	
Calculated decay rate	λ	3.80E-04	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	8.00E+01	m	
Plume thickness at source	Sy	5.60E+01	m	
Saturated aquifer thickness	da	5.71E+01	m	
Bulk density of aquifer materials	ρ	1.70E+00	g/cm^3	
Effective porosity of aquifer	n	1.82E-01	fraction	
Hydraulic gradient	i	1.25E-02	fraction	
Hydraulic conductivity of aquifer	K	2.00E+01	m/d	
Distance to compliance point	x	8.30E+02	m	
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	5.75E+00	l/kg	*see options*
Longitudinal dispersivity	ax	11.020	m	*see options*
Transverse dispersivity	az	1.102	m	*see options*
Vertical dispersivity	ay	0.110	m	*see options*

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	1.00E+00	fraction
Organic carbon partition coefficient	Koc	5.75E+00	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$		l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Soil water partition coefficient	Kd	5.75E+00	l/kg

Dispersivity

Calculate dependant on distance to compliance point (0), specify dispersivity (1), or calc after Xu & Eckstein (2) ? 2

		Enter value	Calc value Xu & Eckstein	
Longitudinal dispersivity	**ax**		1.10E+01	m
Transverse dispersivity	**az**		1.10E+00	m
Vertical dispersivity	**ay**		1.10E-01	m

For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report ax = 0.83$(\log_{10}x)^{2.414}$; az = ax/10, ay = ax/100 are assumed

Calculated Parameters	Variable		
Groundwater flow velocity	v	1.37E+00	m/d
Retardation factor	Rf	5.47E+01	fraction
Decay rate used	λ	3.80E-04	d^{-1}
Rate of contaminant flow due to retardation	u	2.51E-02	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	2.38E-07	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	2.29E-07	mg/l
Attenuation factor (one way vertical dispersion, C_0/C_{ED})	AF	8.90E+04	
Attenuation factor (two way vertical dispersion, C_0/C_{ED})	AF	9.25E+04	

Remedial Targets

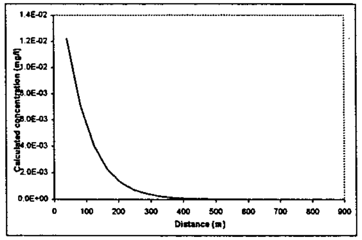
Remedial Target	LTC3	6.35E+01	mg/l

For comparison with measured groundwater concentration.

Ogata Banks

Distance to compliance point		**830**	**m**	
Concentration of contaminant at compliance point	**$C_{ED}/C0$**	**2.38E-07**	**mg/l**	Ogata Banks
after		**9.9E+99**	**days**	

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.



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.

This sheet calculates the Tier3 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

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 Tier 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.

Calculated concentrations for distance-concentration graph

Ogata Banks
Distance calculated concentration

	mg/l
41.6	1.2E-02
83.0	7.1E-03
124.6	4.0E-03
166.0	2.3E-03
207.6	1.3E-03
249.0	7.2E-04
290.5	4.0E-04
332.0	2.3E-04
373.5	1.3E-04
416.0	7.2E-05
456.5	4JE.M
498.0	2.3E-05
539.5	1.3E-05
581.0	7.2E-06
622.5	4.1E-06
664.0	2.3E-06
106.6	1.3E-06
141.0	7.4E-07
788.5	4.2E-07
830.0	2.4E-07

Site being assessed	Blessington Area 6 A Downshire K20
Completed by	AJ
Date	24 11 2005
Version	12

R&D Publication 20 Remedial Targets Worksheet, Release 2.2a

Tier 3 - Groundwater

ENVIRONMENT AGENCY

Input Parameters (using pull down menu)

Input Parameters (using pull down menu)	Variable	Value	Unit	Source
Contaminant		Aromatic C10-C12		
Target Concentration	C_T	7.14E-04	mg/l	

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

Ogata Banks — Equations in R&D Pub. 20

Enter '1' to simulate vertical dispersion in one direction, '2' for two directions (pull down menu): 1

Enter '1' if biodegradation rate is for the substance in water,
'0' if rate is for decay in field conditions (i.e. field data from aquifer) (pull down menu: 0

	Variable	Value	Unit	Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	2.12E-02	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	1.83E+03	days	
Calculated decay rate	λ	3.80E-04	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	8.00E+01	m	
Plume thickness at source	Sy	5.60E+01	m	
Saturated aquifer thickness	da	5.71E+01	m	
Bulk density of aquifer materials	ρ	1.70E+00	g/cm^3	
Effective porosity of aquifer	n	1.82E-01	fraction	
Hydraulic gradient	i	1.25E-02	fraction	
Hydraulic conductivity of aquifer	K	2.00E+01	m/d	
Distance to compliance point	x	8.30E+02	m	
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	9.12E+00	l/kg	*see options*
Longitudinal dispersivity	ax	11.020	m	*see options*
Transverse dispersivity	az	1.102	m	*see options*
Vertical dispersivity	ay	0.110	m	*see options*

Calculated Parameters

Calculated Parameters	Variable		
Groundwater flow velocity	v	1.37E+00	m/d
Retardation factor	Rf	8.62E+01	fraction
Decay rate used	λ	3.80E-04	d^{-1}
Rate of contaminant flow due to retardation	u	1.59E-02	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	1.19E-09	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	1.15E-09	mg/l
Attenuation factor (one way vertical dispersion, C_0/C_{ED})	AF	1.78E+07	
Attenuation factor (two way vertical dispersion, C_0/C_{ED})	AF	1.85E+07	

Remedial Targets

Remedial Target	LTC3	1.27E+04	mg/l	For comparison with measured groundwater concentration.
Ogata Banks				

Distance to compliance point		**830**	**m**	
Concentration of contaminant at compliance point	$C_{ED}/C0$	**1.19E-09**	**mg/l**	Ogata Banks
after		**9.9E+99**	**days**	

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

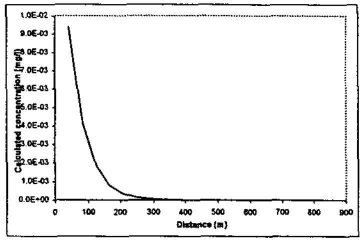
Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd	[redacted]	l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	1.00E+00	fraction
Organic carbon partition coefficient	Koc	9.12E+00	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$	[redacted]	l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Soil water partition coefficient	Kd	9.12E+00	l/kg

Dispersivity

Calculate dependant on distance to compliance point (0), specify dispersivity (1), or calc after Xu & Eckstein (2) ? 2

		Enter value	Calc value Xu & Eckstein	
Longitudinal dispersivity	ax	[redacted]	1.10E+01	m
Transverse dispersivity	az		1.10E+00	m
Vertical dispersivity	ay		1.10E-01	m

For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report ax = $0.83(\log_{10}x)^{2.414}$; 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.

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration
	mg/l
41.6	9.4E-03
83.0	4.2E-03
124.5	1.8E-03
IU.O	7.IE-M
207.5	3.4E-04
249.0	1.6E-M
290.5	6.3E-05
332.0	2.7E-05
373.6	1.2E-05
415.0	5.1E-06
456.5	2.2E-06
498.0	9.5E-07
539.5	4.1E-07
581.0	1.8E-07
622.5	7.7E-08
664.0	3.3E-08
705.5	1.4E-08
747.0	6.3E-09
788.5	2.7E-09
830.0	1.2E-09

This sheet calculates the Tier3 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

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 Tier 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.

Site being assessed:	Blessington Area 6 A Downshire K20
Completed by:	AJ
Date:	24 11 2005
Version	12