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		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

	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	$t_{1/2}$	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	9.80E-03	fraction	
Hydraulic conductivity of aquifer	K	7.00E+00	m/d	
Distance to compliance point	x	1.50E+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	7.24E+00	l/kg	*see options*
Longitudinal dispersivity	ax	13.510	m	*see options*
Transverse dispersivity	az	1.351	m	*see options*
Vertical dispersivity	ay	0.135	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+00	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for ionised 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		1.35E+01	m
Transverse dispersivity	az		1.35E+00	m
Vertical dispersivity	ay		1.35E-01	m

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

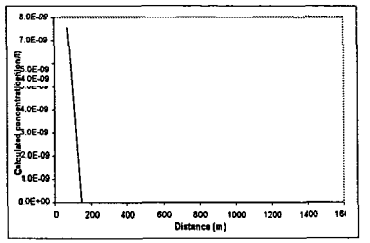
Xu & Eckstein (1995) report $ax = 0.83(\log_{10}x)^{2.414}$; az = ax/10, ay = ax/100 are assumed

Calculated Parameters	Variable		
Groundwater flow velocity	v	3.77E-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	5.49E-03	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	2.09E-106	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	1.08E-106	mg/l
Attenuation factor (one way vertical dispersion, C_0/C_{ED})	AF	4.78E+102	
Attenuation factor (two way vertical dispersion, C_0/C_{ED})	AF	9.27E+102	

Remedial Targets

Remedial Target Ogata Banks	LTC3	4.78E+100	mg/l	For comparison with measured groundwater concentration.
Distance to compliance point		1500	m	
Concentration of contaminant at compliance point	$C_{ED}/C0$	2.09E-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.



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:	Bloss Area 1 Res
Completed by:	AJ
Date:	24 11 2005
Version	11

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration
	mg/l
75.0	7.6E-09
150.0	6.3E-14
225.0	3.7E-19
300.0	2.7E-24
376.0	1.9E-29
450.0	1.4E-34
600.0	7.4E-45
676.0	5.4E-50
760.0	4.0E-55
826.0	2.9E-60
900.0	2.8E-66
1050.0	1.2E-75
1125.0	8.9E-81
1200.0	6.7E-86
1350.0	3.8E-96
1426.0	2.8E-101
1500.0	2.1E-106

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 25-07-2013:17:59:46

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	9.80E-03	fraction	
Hydraulic conductivity of aquifer	K	7.00E+00	m/d	
Distance to compliance point	x	1.50E+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	5.13E+01	l/kg	*see options*
Longitudinal dispersivity	ax	13.510	m	*see options*
Transverse dispersivity	az	1.351	m	*see options*
Vertical dispersivity	ay	0.135	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 | 5.13E+01 | l/kg

Entry for ionic organic chemicals (option)

Sorption coefficient for related species | $K_{oc\ a}$ | | 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		1.35E+01	m
Transverse dispersivity	az		1.35E+00	m
Vertical dispersivity	ay		1.35E-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

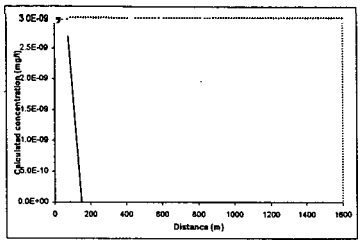
Calculated Parameters | Variable

Groundwater flow velocity	v	3.77E-01	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	7.85E-04	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	2.30E-153	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	1.19E-153	mg/l
Attenuation factor (one way vertical dispersion, C_0/C_{ED})	AF	4.35E+151	
Attenuation factor (two way vertical dispersion, C_0/C_{ED})	AF	8.43E+151	

Remedial Targets

Remedial Target Ogata Banks	LTC3	4.35E+152	mg/l	For comparison with measured groundwater concentration.
Distance to compliance point		**1500**	**m**	
Concentration of contaminant at compliance point	$C_{ED}/C0$	**2.30E-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.



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
75.0	2.7E-09
150.0	6.8E-17
226.0	1.7E-24
100.0	4.3E-32
376.0	1.1E-39
450.0	2.8E-47
525.0	7.4E-55
600.0	1.9E-62
675.0	5.0E-70
IM.O	1.3E-77
825.0	3.5E-85
900.0	9.2E-93
016.0	2.4E-100
1050.0	6.4E-108
1125.0	1.7E-115
1200.0	4.5E-123
1216.0	1.2E-130
1350.0	3.2E-138
1426.0	8.6E-146
1500.0	2.3E-153

Site being assessed	Bless Area 1 Res
Completed by	AJ
Date	24 11 2005
Version	11

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 25-07-2013:17:59:46

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

Tier 3 - Groundwater

ENVIRONMENT AGENCY

Input Parameters (using pulldown 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	1.06E+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	9.80E-03	fraction	
Hydraulic conductivity of aquifer	K	7.00E+00	m/d	
Distance to compliance point	x	1.50E+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	13.510	m	*see options*
Transverse dispersivity	az	1.351	m	*see options*
Vertical dispersivity	ay	0.135	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		1.35E+01	m
Transverse dispersivity	az		1.35E+00	m
Vertical dispersivity	ay		1.35E-01	m

For calculated value, assumes ax = 0.1 *y, 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

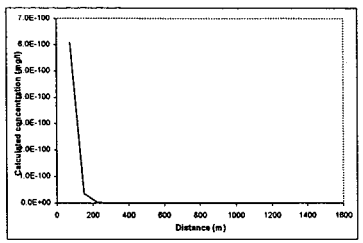
Calculated Parameters | Variable

Groundwater flow velocity	v	3.77E-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	6.89E-03	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	3.30E-123	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	1.70E-123	mg/l
Attenuation factor (one way vertical dispersion, C_0/C_{ED})	AF	3.00E+24	
Attenuation factor (two way vertical dispersion, C_0/C_{ED})	AF	5.82E+24	

Remedial Targets

Remedial Target	LTC3	2.14E+21	mg/l	For comparison with measured groundwater concentration.
Ogata Banks				
Distance to compliance point		1500	m	
Concentration of contaminant at compliance point	$C_{ED}/C0$	3.30E-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.



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

Site being assessed:	Bless Area 1 Res
Completed by:	AJ
Date:	24.11.2005
Version:	11

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration
	mg/l
76.0	6.1E-100
150.0	3.6E-101
226.0	2.0E-102
300.0	1.2E-103
176.0	6.7E-105
450.0	4.0E-106
626.0	2.3E-107
600.0	1.4E-108
675.0	8.3E-110
750.0	5.0E-111
825.0	3.0E-112
900.0	1.8E-113
976.0	1.1E-114
1060.0	6.5E-116
1125.0	4.0E-117
1200.0	2.4E-118
1275.0	1.5E-119
1350.0	8.8E-122
1500.0	3.3E-123

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 25-07-2013:17:59:46

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 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	9.80E-03	fraction	
Hydraulic conductivity of aquifer	K	7.00E+00	m/d	
Distance to compliance point	x	1.50E+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	13.510	m	*see options*
Transverse dispersivity	az	1.351	m	*see options*
Vertical dispersivity	ay	0.135	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	$K_{oc\ a}$		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		1.35E+01	m
Transverse dispersivity	az		1.35E+00	m
Vertical dispersivity	ay		1.35E-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

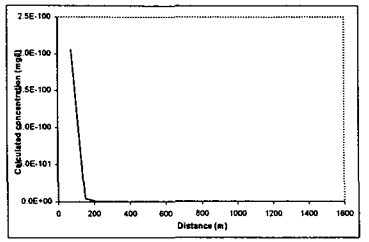
Calculated Parameters | Variable

Groundwater flow velocity	v	3.77E-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	4.37E-03 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}	6.48E-133 mg/l
Attenuation factor (one way vertical dispersion, C_0/C_{ED})	AF	7.87E+33
Attenuation factor (two way vertical dispersion, C_0/C_{ED})	AF	1.53E+34

Remedial Targets

Remedial Target	LTCS	6.62E+30	mg/l	For comparison with measured groundwater concentration.
Ogata Banks				
Distance to compliance point		1500	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.



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

Site being assessed:	Bless Area 1 Res
Completed by:	AJ
Date:	24 11 2005
Version	11

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration
	mg/l
76.0	2.1E-100
160.0	4.0E-102
225.0	7.7E-104
3M.0	1.5E-105
376.0	3.0E-107
450.0	5.9E-109
525.0	1.2E-110
606.0	8.5E-113
750.0	9.7E-116
896.0	4.0E-119
975.0	8.2E-121
1086.0	3.3E-124
1200.0	7.0E-126
1276.0	1.4E-127
1350.0	3.0E-129
1426.0	6.1E-131
16W.O	1.3E-132

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 25-07-2013:17:59:46

Simple hydrogeological calculations

(These are not specific to, or required in, the Remedial Targets Methodology)

Parameter	symbol		unit	justification
Hydraulic conductivity	K	8.10E-05	mls	
Hydraulic gradient	i	9.80E-03	unitless	
Effective porosity of aquifer	n	1.82E-01	fraction	
Thickness of saturated aquifer	b	1.90E+02	m	
Width of aquifer perpendicular to flow	w	1.00E+01	m	
Distance to receptor	x	1.50E+03	m	
Density of stratum	ρ	1.70E+00	g/cm^3	
Soil-water partition co-efficient	Kd	3.16E+04	llkg	
Retardation factor of pollutant	R	295378.5836		

Groundwater flow velocity	v(GW)	4.36E-06	m/s	3.77E-01	m/day	1.38E+02	m/year
Time for groundwater to reach receptor	t(GW)	3.44E+08	seconds	3.98E+03	days	1.09E+01	years
Rate of groundwater flow through aquifer	Q	1.51E-03	m^3/s	1.30E+02	m^3/day	4.76E+04	$m^3/year$
Contaminant flow velocity	v(contam)	1.48E-11	m/s	1.28E-06	m/day	4.66E-04	m/year
Time for contaminant to reach receptor	t(contam)	1.02E+14	seconds	1.18E+09	days	3.22E+06	years

Consent of copyright owner required for any other use.
For inspection purposes only.

EPA Export 25-07-2013:17:59:46

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 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	1.06E+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	9.80E-03	fraction	
Hydraulic conductivity of aquifer	K	7.00E+00	m/d	
Distance to compliance point	x	1.50E+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	13.510	m	*see options*
Transverse dispersivity	az	1.351	m	*see options*
Vertical dispersivity	ay	0.135	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	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		1.35E+01	m
Transverse dispersivity	az		1.35E+00	m
Vertical dispersivity	ay		1.35E-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

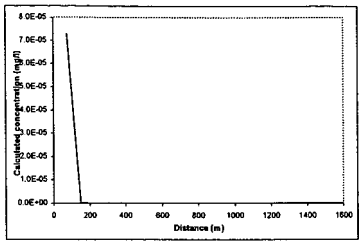
Calculated Parameters | Variable

Groundwater flow velocity	v	3.77E-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	2.21E-03	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	5.74E-56	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	2.96E-56	mg/l
Attenuation factor (one way vertical dispersion, C_0/C_{ED})	AF	6.05E+53	
Attenuation factor (two way vertical dispersion, C_0/C_{ED})	AF	1.17E+54	

Remedial Targets

Remedial Target	LTC3	4.32E+60	mg/l	For comparison with measured groundwater concentration.
Ogata Banks				
Distance to compliance point		1500	m	
Concentration of contaminant at compliance point	$C_{ED}/C0$	5.74E-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.



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 1 Res
Completed by	AJ
Date	24 11 2005
Version	11

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration
	mg/l
76.0	7.1E-05
150.0	1.4E-07
226.0	2.8E-10
300.0	5.6E-13
376.0	1.1E-15
450.0	2.2E-18
525.0	4.6E-21
600.0	9.3E-24
976.0	1.9E-26
760.0	3.9E-29
826.0	8.0E-32
900.0	1.6E-34
176.0	3.4E-37
1060.0	7.1E-40
1126.0	1.5E-42
1200.0	3.0E-45
1276.0	6.3E-48
1350.0	1.3E-50
1426.0	2.7E-53
16W.0	5.7E-56

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 25-07-2013:17:59:46

Simple hydrogeological calculations

(These are not specific to, or required in, the Remedial Targets Methodology)

Parameter	symbol		unit	justification
Hydraulic conductivity	K	8.10E-05	m/s	
Hydraulic gradient	i	9.80E-03	unitless	
Effective porosity of aquifer	n	1.82E-01	fraction	
Thickness of saturated aquifer	b	1.90E+02	m	
Width of aquifer perpendicular to flow	w	1.00E+01	m	
Distance to receptor	x	1.50E+03	m	
Density of stratum	ρ	1.70E+00	g/cm^3	
Soil-water partition co-efficient	Kd	0.00E+00	l/kg	
Retardation factor of pollutant	R	1		

Consent of copyright owner required for any other use.
For inspection purposes only.

Groundwater flow velocity	v(GW)	4.36E-06	m/s	3.77E-01	m/day	1.38E+02	m/year
Time for groundwater to reach receptor	t(GW)	3.44E+08	seconds	3.98E+03	days	1.09E+01	years
Rate of groundwater flow through aquifer	Q	1.51E-03	m^3/s	1.30E+02	m^3/day	4.76E+04	m^3/year

Contaminant flow velocity	v(contam)	4.36E-06	m/s	3.77E-01	m/day	1.38E+02	m/year
Time for contaminant to reach receptor	t(contam)	3.44E+08	seconds	3.98E+03	days	1.09E+01	years

EPA Export 25-07-2013:17:59:46

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

				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	9.80E-03	fraction	
Hydraulic conductivity of aquifer	K	7.00E+00	m/d	
Distance to compliance point	x	1.50E+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	*13510*	m	*see options*
Transverse dispersivity	az		m	*see options*
Vertical dispersivity	ay	0.135	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+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		1.35E+01	m
Transverse dispersivity	az		1.35E+00	m
Vertical dispersivity	ay		1.35E-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 = az/100 are assumed

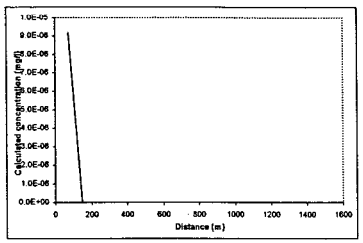
Calculated Parameters | Variable

Groundwater flow velocity	v	3.77E-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	7.00E-04	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	5.77E-74	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	2.98E-74	mg/l
Attenuation factor (one way vertical dispersion, C_0/C_{ED})	AF	6.01E+71	
Attenuation factor (two way vertical dispersion, C_0/C_{ED})	AF	1.17E+72	

Remedial Targets

Remedial Target Ogata Banks	LTC3	4.29E+00	mg/l	For comparison with measured groundwater concentration.
Distance to compliance point		**1500**	m	
Concentration of contaminant at compliance point after	$C_{ED}/C0$	**5.77E-74** **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.



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 1 Res
Completed by	AJ
Date:	24 11 2005
Version:	11

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration
	mg/l
76.0	9.2E-06
150.0	2.3E-09
225.0	5.6E-13
300.0	1.4E-16
376.0	3.5E-20
450.0	9.0E-24
525.0	2.3E-27
600.0	5.9E-31
676.0	1.5E-34
760.0	3.9E-38
825.0	1.0E-41
900.0	2.6E-45
976.0	6.8E-49
1050.0	1.8E-52
1126.0	4.6E-56
1200.0	1.2E-59
1176.0	3.2E-63
1350.0	8.4E-67
1426.0	2.2E-70
16W.0	5.8E-74

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 25-07-2013:17:59:47

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

				Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_o	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	1.05E+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	9.80E-03	fraction	
Hydraulic conductivity of aquifer	K	7.00E+00	m/d	
Distance to compliance point	x	1.50E+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	13.510	m	*see options*
Transverse dispersivity	az	1.351	m	*see options*
Vertical dispersivity	ay	0.135	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 — 4.57E+02 — l/kg

Entry for ionic organic chemicals (option)

Sorption coefficient for ionised 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		1.35E+01	m
Transverse dispersivity	az		1.35E+00	m
Vertical dispersivity	ay		1.35E-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

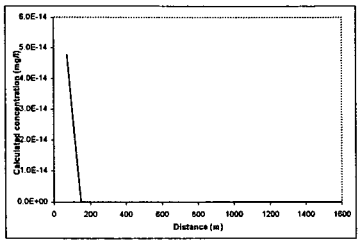
Calculated Parameters | Variable

Groundwater flow velocity	v	3.77E-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	8.83E-05	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	1.26E-239	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	8.49E-240	mg/l
Attenuation factor (one way vertical dispersion, C_o/C_{ED})	AF	2.76E+237	
Attenuation factor (two way vertical dispersion, C_o/C_{ED})	AF	5.35E+237	

Remedial Targets

Remedial Target LTC3		1.97E+234	mg/l	For comparison with measured groundwater concentration.
Ogata Banks				
Distance to compliance point		**1500**	**m**	
Concentration of contaminant at compliance point after	$C_{ED}/C0$	**1.26E-239**	**mg/l**	Ogata Banks
		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.

Site being assessed:	Bless Area 1 Res
Completed by:	AJ
Date:	24.11.2005
Version:	11

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration
	mg/l
76.0	4.8E-14
150.0	6.2E-26
226.0	7.9E-38
300.0	1.0E-49
376.0	1.4E-61
450.0	1.8E-73
526.0	2.4E-85
600.0	3.2E-97
673.0	4.3E-109
160.0	5.8E-121
826.0	7.8E-133
900.0	1.1E-144
976.0	1.4E-156
1050.0	1.9E-168
1126.0	2.6E-180
1200.0	3.6E-192
1216.0	4.9E-204
1350.0	6.7E-216
1426.0	9.2E-228
1500.0	1.3E-239

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 25-07-2013:17:59:47

EPA Export 25-07-2013:17:59:47

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

				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	$t_{1/2}$	1.38E+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	9.80E-03	fraction	
Hydraulic conductivity of aquifer	K	7.00E+00	m/d	
Distance to compliance point	x	1.50E+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	5.01E+03	l/kg	*see options*
Longitudinal dispersivity	ax	13.510	m	*see options*
Transverse dispersivity	az	1.351	m	*see options*
Vertical dispersivity	ay	0.135	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	5.01E+03	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{ow\,n}$		l/kg
Sorption coefficient for ionised species	$K_{ow\,i}$		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		1.35E+01	m
Transverse dispersivity	az		1.35E+00	m
Vertical dispersivity	ay		1.35E-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 = az/100 are assumed

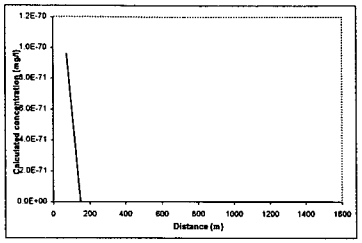
Calculated Parameters | Variable

Groundwater flow velocity	v	3.77E-01	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	8.05E-06	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{xo}	#NUM!	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{xo}	#NUM!	mg/l
Attenuation factor (one way vertical dispersion, C_o/C_{xo})	AF	#NUM!	
Attenuation factor (two way vertical dispersion, C_o/C_{xo})	AF	#NUM!	

Remedial Targets

Remedial Target Ogata Banks	LTC3	#NUM!	mg/l	For comparison with measured groundwater concentration.
Distance to compliance point		**1500**	m	
Concentration of contaminant at compliance point after	$C_{xo}/C0$	**#NUM! 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.



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.

Site being assessed	Bless Area 1 Res
Completed by	AJ
Date:	24 11 2005
Version	11

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration
	mg/l
75.0	9.6E-71
150.0	4.3E-140
225.0	1.9E-209
300.0	8.8E-279
375.0	#NUM!
450.0	#NUM!
525.0	#NUM!
600.0	#NUM!
675.0	#NUM!
750.0	#NUM!
825.0	#NUM!
900.0	#NUM!
975.0	#NUM!
1050.0	#NUM!
1125.0	#NUM!
1200.0	#NUM!
1275.0	#NUM!
1350.0	#NUM!
1425.0	#NUM!
1500.0	#NUM!

For inspection purposes only. Consent of copyright owner required for any other use.

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

	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	9.80E-03	fraction	
Hydraulic conductivity of aquifer	K	7.00E+00	m/d	
Distance to compliance point	x	1.50E+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	5.89E+02	l/kg	*see options*
Longitudinal dispersivity	ax	13.510	m	*see options*
Transverse dispersivity	az	1.351	m	*see options*
Vertical dispersivity	ay	0.135	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	5.89E+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		1.35E+01	m
Transverse dispersivity	az		1.35E+00	m
Vertical dispersivity	ay		1.35E-01	m

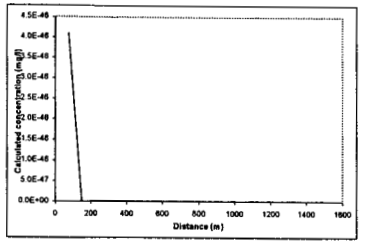
For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report $ax = 0.83(\log_{10}x)^{2.414}$; az = ax/10, ay = ax/100 are assumed

Calculated Parameters	Variable		
Groundwater flow velocity	v	3.77E-01	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	6.85E-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		1500	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.

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:	Bliss Area 1 Res
Completed by	AJ
Date:	24 11 2005
Version:	11

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration
	mg/l
75.0	4.1E-46
150.0	3.7E-90
225.0	3.4E-134
300.0	3.1E-178
375.0	2.9E-222
450.0	2.7E-266
525.0	#NUM!
600.0	#NUM!
675.0	#NUM!
750.0	#NUM!
825.0	#NUM!
900.0	#NUM!
975.0	#NUM!
1050.0	#NUM!
1125.0	#NUM!
1200.0	#NUM!
1275.0	#NUM!
1350.0	#NUM!
1425.0	#NUM!
1500.0	#NUM!

Copyright of copyright owner required for any other use.
For inspection purposes only.

EPA Export 25-07-2013:17:59:47

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

				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	9.80E-03	fraction	
Hydraulic conductivity of aquifer	K	7.00E+00	m/d	
Distance to compliance point	x	1.50E+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	7.24E+02	l/kg	*see options*
Longitudinal dispersivity	ax	13.510	m	*see options*
Transverse dispersivity	az	1.351	m	*see options*
Vertical dispersivity	ay	0.135	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 — $K_{wc,n}$ — l/kg
Sorption coefficient for ionised species — $K_{wc,i}$ — 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		1.35E+01	m
Transverse dispersivity	ax		1.35E+00	m
Vertical dispersivity	ay		1.35E-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

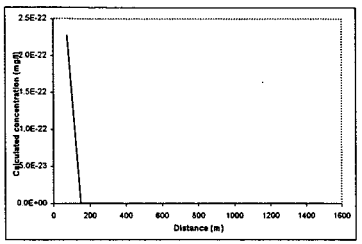
Calculated Parameters | Variable

Groundwater flow velocity	v	3.77E-01	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	5.57E-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_O/C_{ED})	AF	#NUM!	
Attenuation factor (two way vertical dispersion, C_O/C_{ED})	AF	#NUM!	

Remedial Targets

Remedial Target Ogata Banks	LTC3	#NUM!	mg/l	For comparison with measured groundwater concentration.
Distance to compliance point		1500	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
75.0	2.3E-22
150.0	2.4E-43
225.0	2.6E-64
300.0	2.8E-85
375.0	3.0E-106
450.0	3.2E-127
525.0	3.6E-148
600.0	3.9E-169
675.0	4.3E-190
750.0	4.8E-211
825.0	5.4E-232
900.0	6.0E-253
975.0	6.7E-274
1050.0	#NUM!
1125.0	#NUM!
1200.0	#NUM!
1275.0	#NUM!
1350.0	#NUM!
1425.0	#NUM!
1500.0	#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	Bless Area 1 Res
Completed by	AJ
Date	24 11 2005
Version	11

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 25-07-2013:17:59:47

EPA Export 25-07-2013:17:59:47

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	day^{-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	9.80E-03	fraction	
Hydraulic conductivity of aquifer	K	7.00E+00	m/d	
Distance to compliance point	x	1.50E+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	13.510	m	*see options*
Transverse dispersivity	az	1.351	m	*see options*
Vertical dispersivity	ay	0.135	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	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		1.35E+01	m
Transverse dispersivity	az		1.35E+00	m
Vertical dispersivity	ay		1.35E-01	m

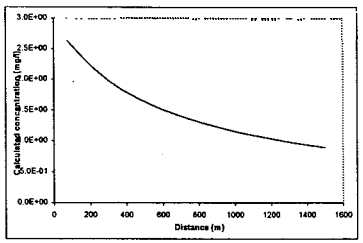
For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report $ax = 0.83(\log_{10}x)^{2.414}$; az = ax/10, ay = ax/100 are assumed

Calculated Parameters	Variable		
Groundwater flow velocity	v	3.77E-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	3.77E-01	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	8.88E-01	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	4.58E-01	mg/l
Attenuation factor (one way vertical dispersion, C_0/C_{ED})	AF	3.04E+00	
Attenuation factor (two way vertical dispersion, C_0/C_{ED})	AF	5.90E+00	

Remedial Targets

Remedial Target Ogata Banks	LTC3	3.04E+00	mg/l	For comparison with measured groundwater concentration.
Distance to compliance point		1500	m	
Concentration of contaminant at compliance point after	$C_{ED}/C0$	8.88E-01 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.



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.

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

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration
	mg/l
75.0	2.6E+00
150.0	2.4E+00
225.0	2.2E+00
300.0	2.0E+00
375.0	1.8E+00
450.0	1.7E+00
525.0	1.6E+00
600.0	1.5E+00
675.0	1.4E+00
750.0	1.3E+00
825.0	1.3E+00
900.0	1.2E+00
975.0	1.2E+00
1050.0	1.1E+00
1125.0	1.1E+00
1200.0	1.0E+00
1275.0	9.9E-01
1350.0	9.5E-01
1425.0	9.2E-01
1500.0	8.9E-01

For inspection purposes only. Consent of copyright owner required for any other use.

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		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	$t_{1/2}$	6.80E+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	1.06E+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	9.80E-03	fraction	
Hydraulic conductivity of aquifer	K	7.00E+00	m/d	
Distance to compliance point	x	1.50E+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 varient options only*
Parameters values determined from options				
Partition coefficient	Kd	1.38E+02	l/kg	*see options*
Longitudinal dispersivity	ax	13.510	m	*see options*
Transverse dispersivity	az	1.351	m	*see options*
Vertical dispersivity	ay	0.135	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 — 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		1.35E+01	m
Transverse dispersivity	az		1.35E+00	m
Vertical dispersivity	ay		1.35E-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 = az/100 are assumed

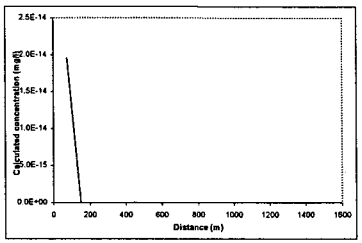
Calculated Parameters | Variable

Groundwater flow velocity	v	3.77E-01	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	2.92E-04	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{zo}	#NUM!	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{zo}	#NUM!	mg/l
Attenuation factor (one way vertical dispersion, C_o/C_{zo})	AF	#NUM!	
Attenuation factor (two way vertical dispersion, C_o/C_{zo})	AF	#NUM!	

Remedial Targets

Remedial Target	LTC3	#NUM!	mg/l	For comparison with measured groundwater concentration.
Ogata Banks				
Distance to compliance point		1500	m	
Concentration of contaminant at compliance point	$C_{zo}/C0$	#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.

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 Area 1 Res
Completed by:	AJ
Date:	24 11 2005
Version:	11

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration
	mg/l
76.0	2.0E-14
160.0	7.2E-28
225.0	2.6E-41
300.0	9.6E-55
376.0	3.6E-68
450.0	1.3E-81
525.0	5.1E-95
6W.0	1.9E-108
676.0	7.3E-122
760.0	2.8E-135
825.0	1.1E-148
900.0	4.1E-162
876.0	1.6E-175
1060.0	6.1E-189
1125.0	2.4E-202
1200.0	9.1E-216
1275.0	3.5E-229
1360.0	1.4E-242
1426.0	5.3E-256
16W.0	#NUM!

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 25-07-2013:17:59:47

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		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

				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	1.06E+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	9.80E-03	fraction	
Hydraulic conductivity of aquifer	K	7.00E+00	m/d	
Distance to compliance point	x	1.50E+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	2.63E+01	l/kg	*see options*
Longitudinal dispersivity	ax	13.510	m	*see options*
Transverse dispersivity	az	1.351	m	*see options*
Vertical dispersivity	ay	0.135	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 — 2.63E+01 — l/kg

Entry for ionic organic chemicals (option)
Sorption coefficient for related species — $K_{HC\,n}$ — l/kg
Sorption coefficient for ionised species — $K_{HC\,i}$ — 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		1.35E+01	m
Transverse dispersivity	az		1.35E+00	m
Vertical dispersivity	ay		1.35E-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

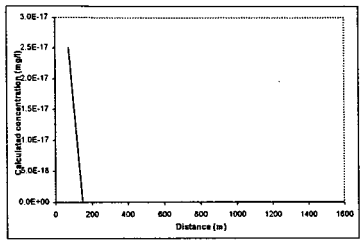
Calculated Parameters | Variable

Groundwater flow velocity	v	3.77E-01	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	1.53E-03	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		1500	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.

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 Area 1 Res
Completed by:	AJ
Date:	24 11 2005
Version:	11

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration
	mg/l
76.0	2.5E-17
150.0	2.0E-33
225.0	1.5E-49
300.0	9.8E-65
450.0	7.7E-98
525.0	6.2E-114
600.0	5.0E-130
676.0	4.1E-146
750.0	3.3E-162
825.0	2.7E-178
900.0	2.2E-194
976.0	1.8E-210
1050.0	1.5E-226
1200.0	1.0E-258
1350.0	#NUM!
1425.0	#NUM!
1500.0	#NUM!

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 25-07-2013:17:59:48

RBD 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

				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	9.80E-03	fraction	
Hydraulic conductivity of aquifer	K	7.00E+00	m/d	
Distance to compliance point	x	1.50E+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	5.13E+01	l/kg	*see options*
Longitudinal dispersivity	ax	13.510	m	*see options*
Transverse dispersivity	az	1.351	m	*see options*
Vertical dispersivity	ay	0.135	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	5.13E+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		1.35E+01	m
Transverse dispersivity	az		1.35E+00	m
Vertical dispersivity	ay		1.35E-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 = az/100 are assumed

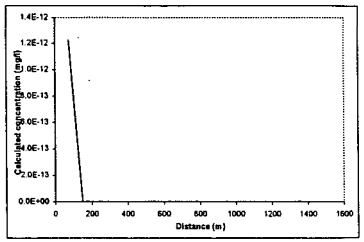
Calculated Parameters | Variable

Groundwater flow velocity	v	3.77E-01	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	7.85E-04	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	2.31E-241	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	1.19E-241	mg/l
Attenuation factor (one way vertical dispersion, C_0/C_{ED})	AF	5.63E+240	
Attenuation factor (two way vertical dispersion, C_0/C_{ED})	AF	1.09E+241	

Remedial Targets

Remedial Target Ogata Banks	LTC$	3.52E+235	mg/l	For comparison with measured groundwater concentration.
Distance to compliance point		1500	m	
Concentration of contaminant at compliance point after	$C_{ED}/C0$	2.31E-241 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.



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
75.0	1.2E-12
160.0	1.1E-24
226.0	9.5E-37
300.0	8.4E-49
375.0	7.6E-61
450.0	6.8E-73
525.0	6.2E-85
600.0	5.7E-97
675.0	5.2E-109
760.0	4.8E-121
825.0	4.4E-133
900.0	4.1E-145
976.0	3.8E-157
1060.0	3.5E-169
1125.0	3.2E-181
1200.0	3.0E-193
1276.0	2.8E-205
1350.0	2.6E-217
1426.0	2.5E-229
1500.0	2.3E-241

Site being assessed:	Bless Area 1 Res
Completed by:	AJ
Date:	24 11 2005
Version:	11

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 25-07-2013:17:59:48

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

				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	1.09E+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	9.80E-03	fraction	
Hydraulic conductivity of aquifer	K	7.00E+00	m/d	
Distance to compliance point	x	1.50E+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 vetires determined from options				
Partition coefficient	Kd	1.05E-01	l/kg	*see options*
Longitudinal dispersivity	ax	13.510	m	*see options*
Transverse dispersivity	az	1.351	m	*see options*
Vertical dispersivity	ay	0.135	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	1.05E-01	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for retated 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		1.35E+01	m
Transverse dispersivity	az		1.35E+00	m
Vertical dispersivity	ay		1.35E-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

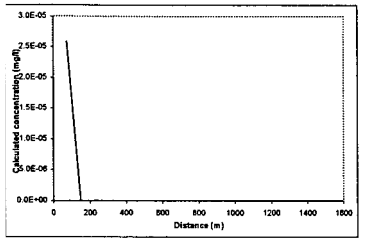
Calculated Parameters | Variable

Groundwater flow velocity	v	3.77E-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	1.91E-01	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	5.61E-87	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	2.89E-87	mg/l
Attenuation factor (one way vertical dispersion, C_0/C_{ED})	AF	8.92E+85	
Attenuation factor (two way vertical dispersion, C_0/C_{ED})	AF	1.73E+88	

Remedial Targets

Remedial Target Ogata Banks	LTC3	4.46E+02	mg/l	For comparison with measured groundwater concentration.
Distance to compliance point		**1500**	m	
Concentration of contaminant at compliance point after	$C_{ED}/C0$	**5.61E-87** **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.



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 9.0 99

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration
	mg/l
75.0	2.6E-05
150.0	1.3E-09
225.0	6.1E-14
300.0	3.0E-18
375.0	1.5E-22
450.0	7.2E-27
525.0	3.6E-31
600.0	1.8E-35
675.0	9.1E-40
750.0	4.6E-44
825.0	2.3E-48
900.0	1.2E-52
975.0	6.0E-57
1050.0	3.1E-61
1125.0	1.6E-65
1200.0	8.1E-70
1275.0	4.1E-74
1350.0	2.1E-78
1425.0	1.1E-82
1500.0	5.6E-87

Site being assessed:	Bloss Area 1 Res
Completed by:	AJ
Date:	24 11 2005
Version	11

Copyright of copyright owner required for any other use. For inspection purposes only.

EPA Export 25-07-2013:17:59:48

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

Tier 3 -Groundwater

ENVIRONMENT AGENCY

Input Parameters (using pull down menu)	Variable	Value	Unit	Sours.
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	9.80E-03	fraction	
Hydraulic conductivity of aquifer	K	7.00E+00	m/d	
Distance to compliance point	x	1.50E+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	13.510	m	*see options*
Transverse dispersivity	az	1.351	m	*see options*
Vertical dispersivity	ay	0.135	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	0.00E+00 l/kg
Entry for ionic organic chemicals (option)		
Sorption coefficient for ionised species	$K_{oc\,a}$	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		1.35E+01	m
Transverse dispersivity	az		1.35E+00	m
Vertical dispersivity	ay		1.35E-01	m

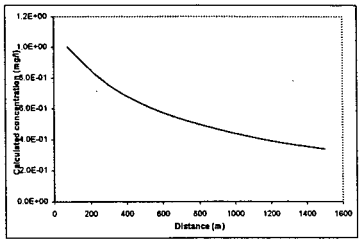
For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report $ax = 0.83(\log_{10}x)^{2.414}$; az = ax/10, ay = az/100 are assumed

Calculated Parameters	Variable		
Groundwater flow velocity	v	3.77E-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	3.77E-01	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	3.39E-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	3.04E+00	
Attenuation factor (two way vertical dispersion, C_0/C_{ED})	AF	5.90E+00	

Remedial Targets

Remedial Target Ogata Banks	LTC3	6.59E+00	mg/l	For comparison with measured groundwater concentration.
Distance to compliance point		**1500**	**m**	
Concentration of contaminant at compliance point after	$C_{ED}/C0$	**3.39E-01** **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.



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
76.0	1.0E+00
150.0	9.1E-01
225.0	8.2E-01
300.0	7.5E-01
376.0	7.0E-01
450.0	6.5E-01
526.0	6.1E-01
600.0	6.7E-01
676.0	5.4E-01
760.0	5.1E-01
825.0	4.9E-01
900.0	4.7E-01
976.0	4.5E-01
1060.0	4.3E-01
1125.0	4.1E-01
1200.0	3.9E-01
1275.0	3.8E-01
1350.0	3.6E-01
1426.0	3.5E-01
1500.0	3.4E-01

Site being assessed:	Bless Area 1 Res
Completed by:	AJ
Date:	24 11 2005
Version:	11

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 25-07-2013:17:59:48

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

				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	9.80E-03	fraction	
Hydraulic conductivity of aquifer	K	7.00E+00	m/d	
Distance to compliance point	x	1.50E+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	1.38E+02	l/kg	*see options*
Longitudinal dispersivity	ax	13.510	m	*see options*
Transverse dispersivity	az	1.351	m	*see options*
Vertical dispersivity	ay	0.135	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	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		1.35E+01	m
Transverse dispersivity	az		1.35E+00	m
Vertical dispersivity	ay		1.35E-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 = az/100 are assumed

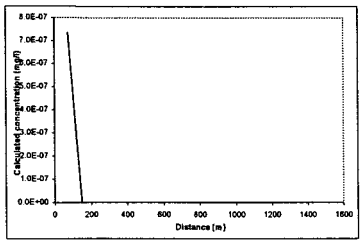
Calculated Parameters | Variable

Groundwater flow velocity	v	3.77E-01	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	2.92E-04	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	2.00E-119	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	1.03E-119	mg/l
Attenuation factor (one way vertical dispersion, C_0/C_{ED})	AF	3.00E+118	
Attenuation factor (two way vertical dispersion, C_0/C_{ED})	AF	5.82E+118	

Remedial Targets

Remedial Target Ogata Banks	LTC3	1.99E+113	mg/l	For comparison with measured groundwater concentration.
Distance to compliance point		1500	m	
Concentration of contaminant at compliance point after	$C_{ED}/C0$	2.00E-119	mg/l	Ogata Banks
		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.

Site being assessed:	Bloss Area 1 Res
Completed by:	AJ
Date:	24 11 2005
Version:	11

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration
	mg/l
75.0	7.4E-07
150.0	8.4E-13
225.0	9.6E-19
300.0	1.1E-24
375.0	1.3E-30
450.0	1.5E-36
525.0	1.8E-42
600.0	2.1E-48
675.0	2.5E-54
750.0	3.0E-60
825.0	3.5E-66
900.0	4.3E-72
975.0	5.2E-78
1050.0	6.3E-84
1125.0	7.6E-90
1200.0	9.2E-96
1275.0	1.1E-101
1350.0	1.4E-107
1425.0	1.8E-113
1500.0	2.0E-119

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 25-07-2013:17:59:48

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

Tier 3 -Groundwater

ENVIRONMENT AGENCY

Input Parameters(using cull 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	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	9.80E-03	fraction	
Hydraulic conductivity of aquifer	K	7.00E+00	m/d	
Distance to compliance point	x	1.50E+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	9.55E+00	l/kg	*see options*
Longitudinal dispersivity	ax	13.510	m	*see options*
Transverse dispersivity	az	1.351	m	*see options*
Vertical dispersivity	ay	0.135	m	*see options*

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

Calculate for non-polar organic chemicals

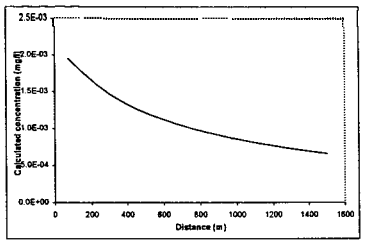
Entry if specify partition coefficient (option)
Soil water partition coefficient | Kd | | l/kg
Entry for non-polar organic chemicals (option)
Fraction of organic carbon in aquifer | foc | 1.00E+00 | fraction
Organic carbon partition coefficient | Koc | 9.55E+00 | l/kg
Entry for ionic organic chemicals (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		1.35E+01	m
Transverse dispersivity	az		1.35E+00	m
Vertical dispersivity	ay		1.35E-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
76.0	1.9E-03
160.0	1.8E-03
225.0	1.6E-03
3W.0	1.5E-03
376.0	1.4E-03
450.0	1.3E-03
525.0	1.2E-03
600.0	1.1E-03
176.0	1.1E-03
750.0	1.0E-03
825.0	9.5E-04
900.0	9.1E-04
976.0	8.7E-04
1050.0	8.3E-04
1125.0	7.9E-04
1200.0	7.6E-04
1276.0	7.3E-04
1350.0	7.1E-M
1426.0	6.8E-04

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 Area 1 Res
Completed by:	AJ
Date:	24 11 2005
Version:	11

Calculated Parameters | Variable

Groundwater flow velocity	v	3.77E-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	4.18E-03	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	6.58E-04	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	3.39E-04	mg/l
Attenuation factor (one way vertical dispersion, C_0/C_{ED})	AF	3.04E+00	
Attenuation factor (two way vertical dispersion, C_0/C_{ED})	AF	5.90E+00	

Remedial Targets

Remedial Target Ogata Banks	LTC3	3.04E-02	mg/l	For comparison with measured groundwater concentration.
Distance to compliance point		1500	m	
Concentration of contaminant at compliance point	$C_{ED}/C0$	6.58E-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.

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 25-07-2013:17:59:48

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	1.06E+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	9.80E-03	fraction	
Hydraulic conductivity of aquifer	K	7.00E+00	m/d	
Distance to compliance point	x	1.50E+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	13.510	m	*see options*
Transverse dispersivity	az	1.351	m	*see options*
Vertical dispersivity	ay	0.135	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/kd

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 | $K_{oc\ a}$ | | l/kd

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		1.35E+01	m
Transverse dispersivity	az		1.35E+00	m
Vertical dispersivity	ay		1.35E-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 = az/100 are assumed

Calculated Parameters | Variable

Groundwater flow velocity	v	3.77E-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	3.77E-01	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	1.61E-01	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	8.31E-02	mg/l
Attenuation factor (one way vertical dispersion, C_0/C_{ED})	AF	3.04E+00	
Attenuation factor (two way vertical dispersion, C_0/C_{ED})	AF	5.90E+00	

Remedial Targets

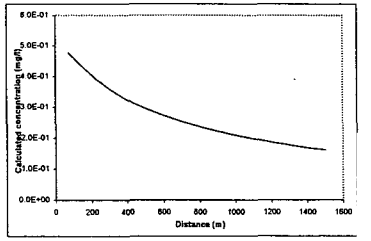
Remedial Target	LTCS	3.04E+00	mg/l

For comparison with measured groundwater concentration.

Ogata Banks

Distance to compliance point		1500	m	
Concentration of contaminant at compliance point	$C_{ED}/C0$	1.61E-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.



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
75.0	4.8E-01
150.0	4.3E-01
225.0	3.9E-01
300.0	3.6E-01
375.0	3.3E-01
450.0	3.1E-01
525.0	2.9E-01
600.0	2.8E-01
760.0	2.4E-01
900.0	2.2E-01
975.0	2.1E-01
1050.0	2.0E-01
1200.0	1.9E-01
1275.0	1.8E-01
1350.0	1.7E-01
1426.0	1.7E-01
I W . O	1.6E-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 Res
Completed by:	AJ
Date:	24 11 2005
Version:	11

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 25-07-2013:17:59:48

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 '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		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		9.90E+99	days	
Calculated decay rate	λ	7.00E-101	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	SI	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	i	9.80E-03	fraction	
Hydraulic conductivity of aquifer	K	7.00E+00	m/d	
Distance to compliance point	x	1.50E+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	13.510	m	*see options*
Transverse dispersivity	az	1.351	m	*see options*
Vertical dispersivity	ay	0.135	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	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		1.35E+01	m
Transverse dispersivity	az		1.35E+00	m
Vertical dispersivity	ay		1.35E-01	m

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

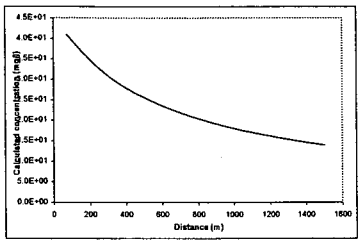
Xu & Eckstein (1995) report ax = $0.83(\log_{10}x)^{2.414}$: az = ax/10, ay = az/100 are assumed

Calculated Parameters	Variable		
Groundwater flow velocity	v	3.77E-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	3.77E-01	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	1.38E+01	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	7.12E+00	mg/l
Attenuation factor (one way vertical dispersion, C_0/C_{ED})	AF	3.04E+00	
Attenuation factor (two way vertical dispersion, C_0/C_{ED})	AF	5.90E+00	

Remedial Targets

Remedial Target	LTC3	8.09E+02	mg/l	For comparison with measured groundwater concentration.
Ogata Banks				
Distance to compliance point		1500	m	
Concentration of contaminant at compliance point	$C_{ED}/C0$	1.38E+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.



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.

Site being assessed:	Bless Area 1 Res
Completed by	AJ
Date:	24/11.2005
Version:	11

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration
	mg/l
75.0	4.1E+01
150.0	3.7E+01
225.0	3.4E+01
300.0	3.1E+01
375.0	2.8E+01
450.0	2.7E+01
525.0	2.5E+01
600.0	2.3E+01
675.0	2.2E+01
750.0	2.1E+01
825.0	2.0E+01
900.0	1.9E+01
975.0	1.8E+01
1050.0	1.7E+01
1125.0	1.7E+01
1200.0	1.6E+01
1275.0	1.5E+01
1350.0	1.5E+01
1425.0	1.4E+01
1500.0	1.4E+01

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 25-07-2013:17:59:49

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		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	1.87E-01	fraction	
Hydraulic gradient	i	9.80E-03	fraction	
Hydraulic conductivity of aquifer	K	7.00E+00	m/d	
Distance to compliance point	x	1.50E+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	2.14E-01	l/kg	*see options*
Longitudinal dispersivity	ax	13510	m	*see options*
Transverse dispersivity	az		m	*see options*
Vertical dispersivity	ay	0135	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		1.35E+01	m
Transverse dispersivity	az		1.35E+00	m
Vertical dispersivity	ay		1.35E-01	m

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

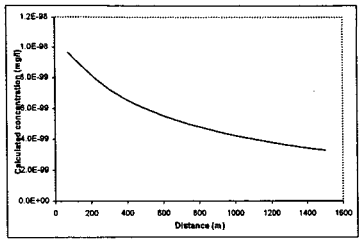
Xu & Eckstein (1995) report $ax = 0.83(\log_{10}x)^{2.414}$; az = ax/10, ay = ax/100 are assumed

Calculated Parameters	Variable		
Groundwater flow velocity	v	3.77E-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	1.26E-01	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	3.26E-99	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	1.68E-99	mg/l
Attenuation factor (one way vertical dispersion, C_0/C_{ED})	AF	3.04E+00	
Attenuation factor (two way vertical dispersion, C_0/C_{ED})	AF	5.90E+00	

Remedial Targets

Remedial Target	LTC3	3.04E-03	mg/l	For comparison with measured groundwater concentration.
Ogata Banks				
Distance to compliance point		1500	m	
Concentration of contaminant at compliance point	$C_{ED}/C0$	3.26E-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 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 Area 1 Res
Completed by:	AJ
Date:	24 11 2005
Version:	1.1

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration
	mg/l
76.0	9.6E-99
IW.O	8.7E-M
225.0	7.9E-99
300.0	7.3E-99
376.0	6.7E-99
450.0	6.3E-99
626.0	5.9E-99
506.0	5.8E-99
750.0	4.9E-99
825.0	4.7E-99
900.0	4.5E-99
975.0	4.3E-99
1050.0	4.1E-99
1125.0	3.9E-99
1200.0	3.8E-99
1275.0	3.6E-99
1350.0	3.5E-99
1425.0	3.4E-99
1500.0	3.3E-99

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 25-07-2013:17:59:49

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 C8-C10		
Target Concentration	C_T	7.14E-04	mg/l	

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	$K_{HC,n}$		l/kg
Sorption coefficient for ionised species	$K_{HC,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		

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	1.62E-01	fraction	
Hydraulic gradient	i	9.80E-03	fraction	
Hydraulic conductivity of aquifer	K	7.00E+00	m/d	
Distance to compliance point	x	1.50E+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	13.510	m	*see options*
Transverse dispersivity	az	1.351	m	*see options*
Vertical dispersivity	ay	0.135	m	*see options*

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		1.35E+01	m
Transverse dispersivity	az		1.35E+00	m
Vertical dispersivity	ay		1.35E-01	m

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

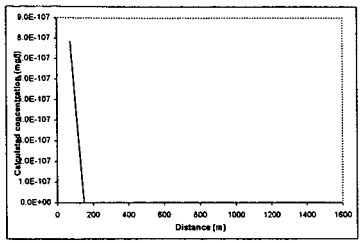
Xu & Eckstein (1995) report $ax = 0.83(\log_{10}x)^{2.414}$; az = ax/10, ay = ax/100 are assumed

Calculated Parameters	Variable		
Groundwater flow velocity	v	3.77E-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	3.51E-04	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{EO}	5.47E-261	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{EO}	2.82E-261	mg/l
Attenuation factor (one way vertical dispersion, C_0/C_{EO})	AF	1.81E+162	
Attenuation factor (two way vertical dispersion, C_0/C_{EO})	AF	3.51E+162	

Remedial Targets

Remedial Target Ogata Banks	LTC3	1.29E+159	mg/l	For comparison with measured groundwater concentration.
Distance to compliance point		1500	m	
Concentration of contaminant at compliance point after	$C_{EO}/C0$	5.47E-261 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.



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
76.0	7.9E-107
160.0	5.8E-115
225.0	4.3E-123
300.0	3.2E-131
376.0	2.4E-139
450.0	1.8E-147
525.0	1.4E-155
600.0	1.1E-163
676.0	8.3E-172
760.0	6.4E-180
826.0	5.0E-188
900.0	3.9E-196
176.0	3.0E-204
1060.0	2.3E-212
1125.0	1.8E-220
1200.0	1.4E-228
1276.0	1.1E-236
1160.0	8.8E-245
1426.0	7.0E-253
1500.0	5.5E-261

Site being assessed:	Bless Area 1 Res
Completed by:	AJ
Date:	24 11 2005
Version	11

For inspection purposes only.
Consent or copyright owner required for any other use.

EPA Export 25-07-2013:17:59:49

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

				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	9.80E-03	fraction	
Hydraulic conductivity of aquifer	K	7.00E+00	m/d	
Distance to compliance point	x	1.50E+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	13.510	m	*see options*
Transverse dispersivity	az	1.351	m	*see options*
Vertical dispersivity	ay	0.135	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+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		1.35E+01	m
Transverse dispersivity	az		1.35E+00	m
Vertical dispersivity	ay		1.35E-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

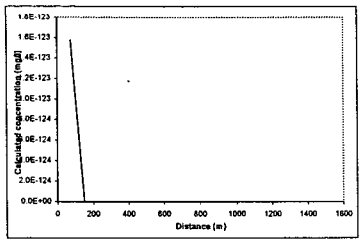
Calculated Parameters | Variable

Groundwater flow velocity	v	3.77E-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	4.43E-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		1600	m	
Concentration of contaminant at compliance point after	$C_{ED}/C0$	#NUM! 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.



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.

Site being assessed	Bloss Area 1 Res
Completed by:	AJ
Date:	24.11.2005
Version	11

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration
	mg/l
75.0	1.6E-123
150.0	2.4E-148
225.0	3.5E-173
300.0	5.2E-198
376.0	7.9E-223
450.0	1.2E-247
525.0	1.9E-272
600.0	2.9E-297
676.0	0.0E+00
750.0	0.0E+00
825.0	0.0E+00
900.0	#NUM!
975.0	#NUM!
1050.0	#NUM!
1126.0	#NUM!
1200.0	#NUM!
1275.0	#NUM!
1350.0	#NUM!
1126.0	#NUM!
1500.0	#NUM!

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 25-07-2013:17:59:49

EPA Export 25-07-2013:17:59:49

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	1.06E+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	9.80E-03	fraction	
Hydraulic conductivity of aquifer	K	7.00E+00	m/d	
Distance to compliance point	x	1.50E+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	13.510	m	*see options*
Transverse dispersivity	az	1.351	m	*see options*
Vertical dispersivity	ay	0.135	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	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		1.35E+01	m
Transverse dispersivity	az		1.35E+00	m
Vertical dispersivity	ay		1.35E-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

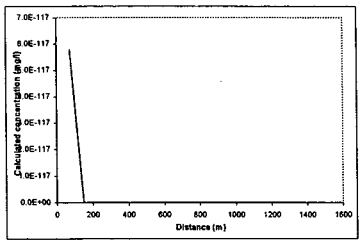
Calculated Parameters | Variable

Groundwater flow velocity	v	3.77E-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	2.22E-06	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{e0}	#NUM!	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{e0}	#NUM!	mg/l
Attenuation factor (one way vertical dispersion, C_0/C_{e0})	AF	#NUM!	
Attenuation factor (two way vertical dispersion, C_0/C_{e0})	AF	#NUM!	

Remedial Targets

Remedial Target Ogata Banks	LTC3	#NUM!	mg/l	For comparison with measured groundwater concentration.
Distance to compliance point		1500	m	
Concentration of contaminant at compliance point	$C_{xt}/C0$	#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.

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:	Bloss Area 1 Res
Completed by:	AJ
Date:	24 11 2005
Version:	11

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration
	mg/l
75.0	5.8E-117
150.0	9.0E-232
225.0	#NUM!
300.0	#NUM!
375.0	#NUM!
450.0	#NUM!
525.0	#NUM!
600.0	#NUM!
675.0	#NUM!
750.0	#NUM!
825.0	#NUM!
900.0	#NUM!
975.0	#NUM!
1050.0	#NUM!
1125.0	#NUM!
1200.0	#NUM!
1275.0	#NUM!
1350.0	#NUM!
1425.0	#NUM!
1500.0	#NUM!

For inspection purposes only. Consent of copyright owner required for any other use.

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

				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	9.80E-03	fraction	
Hydraulic conductivity of aquifer	K	7.00E+00	m/d	
Distance to compliance point	x	1.50E+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	13.510	m	*see options*
Transverse dispersivity	az	1.351	m	*see options*
Vertical dispersivity	ay	0.135	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 ionised species — $K_{w,n}$ — l/kg

Sorption coefficient for ionised species — $K_{w,i}$ — 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		1.35E+01	m
Transverse dispersivity	az		1.35E+00	m
Vertical dispersivity	ay		1.35E-01	m

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

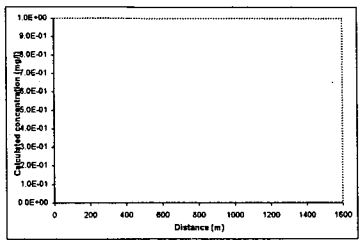
Xu & Eckstein (1995) report $ax = 0.83(\log_{10}x)^{2.414}$; az = ax/10, ay = ax/100 are assumed

Calculated Parameters	Variable		
Groundwater flow velocity	v	3.77E-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	1.76E-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 Ogata Banks	LTC3	#NUM!	mg/l	For comparison with measured groundwater concentration.
Distance to compliance point		**1500**	**m**	
Concentration of contaminant at compliance point after	$C_{ED}/C0$	**#NUM!** **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.



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.

Site being assessed:	Bless Area 1 Res
Completed by:	AJ
Date:	24 11 2005
Version:	11

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration
	mg/l
75.0	#NUM!
150.0	#NUM!
225.0	#NUM!
300.0	#NUM!
375.0	#NUM!
450.0	#NUM!
525.0	#NUM!
600.0	#NUM!
675.0	#NUM!
750.0	#NUM!
825.0	#NUM!
900.0	#NUM!
975.0	#NUM!
1050.0	#NUM!
1125.0	#NUM!
1200.0	#NUM!
1275.0	#NUM!
1350.0	#NUM!
1425.0	#NUM!
1500.0	#NUM!

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 25-07-2013:17:59:49

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	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	9.80E-03	fraction	
Hydraulic conductivity of aquifer	K	7.00E+00	m/d	
Distance to compliance point	x	1.50E+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	13.510	m	*see options*
Transverse dispersivity	az	1.351	m	*see options*
Vertical dispersivity	ay	0.135	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_{wr}	l/kg
Sorption coefficient for ionised species	K_{wi}	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		1.35E+01	m
Transverse dispersivity	az		1.35E+00	m
Vertical dispersivity	ay		1.35E-01	m

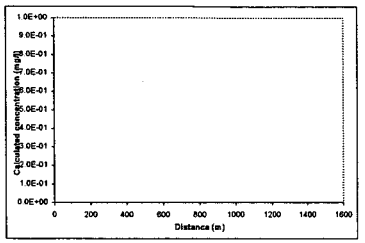
For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report ax = $0.83(\log_{10}x)^{2.414}$; az = ax/10, ay = ax/100 are assumed

Calculated Parameters	Variable		
Groundwater flow velocity	v	3.77E-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	1.76E-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 Ogata Banks	LTC3	#NUM!	mg/l	For comparison with measured groundwater concentration.
Distance to compliance point		**1500**	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.

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 Area 1 Res
Completed by:	AJ
Date:	24 11 2005
Version:	11

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration
	mg/l
75.0	#NUM!
150.0	#NUM!
225.0	#NUM!
300.0	#NUM!
375.0	#NUM!
450.0	#NUM!
525.0	#NUM!
600.0	#NUM!
676.0	#NUM!
750.0	#NUM!
825.0	#NUM!
900.0	#NUM!
976.0	#NUM!
1050.0	#NUM!
1125.0	#NUM!
1200.0	#NUM!
1276.0	#NUM!
1350.0	#NUM!
1425.0	#NUM!
1500.0	#NUM!

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 25-07-2013:17:59:49

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	9.80E-03	fraction	
Hydraulic conductivity of aquifer	K	7.00E+00	m/d	
Distance to compliance point	x	1.50E+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	13.510	m	*see options*
Transverse dispersivity	az	1.351	m	*see options*
Vertical dispersivity	ay	0.135	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	5.00E-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		1.35E+01	m
Transverse dispersivity	az		1.35E+00	m
Vertical dispersivity	ay		1.35E-01	m

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

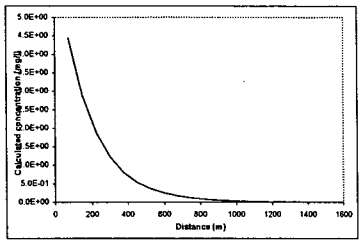
Xu & Eckstein (1995) report ax = $0.83(\log_{10}x)^{2.414}$; az = ax/10, ay = ax/100 are assumed

Calculated Parameters	Variable		
Groundwater flow velocity	v	3.77E-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	6.65E-02	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	2.51E-03	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	1.29E-03	mg/l
Attenuation factor (one way vertical dispersion, C_0/C_{ED})	AF	2.55E+03	
Attenuation factor (two way vertical dispersion, C_0/C_{ED})	AF	4.96E+03	

Remedial Targets

Remedial Target	LTCS	3.07E+02	mg/l	For comparison with measured groundwater concentration.
Ogata Banks				
Distance to compliance point		1600	m	
Concentration of contaminant at compliance point	$C_{ED}/C0$	2.51E-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.E+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 at 9.0E+99.

Site being assessed:	Bless Area 1 Res
Completed by:	AJ
Date:	24 11 2005
Version:	11

Calculated concentrations for distance-concentration graph

Ogata Banks solution sheet

Distance	Concentration
	mg/l
75.0	4.5E+00
150.0	2.9E+00
225.0	1.9E+00
300.0	1.2E+00
375.0	8.1E-01
450.0	5.4E-01
525.0	I.SE-01
600.0	2.4E-01
675.0	1.6E-01
750.0	1.1E-01
825.0	7.5E-02
900.0	5.1E-02
975.0	3.5E-02
1050.0	2.4E-02
1125.0	1.6E-02
1200.0	1.1E-02
1275.0	7.7E-03
1350.0	5.3E-03
1426.0	3.6E-03
16W.0	2.5E-03

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 25-07-2013:17:59:49

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 25-07-2013:17:59:49

RBD 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

				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	7.00E+00	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*

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

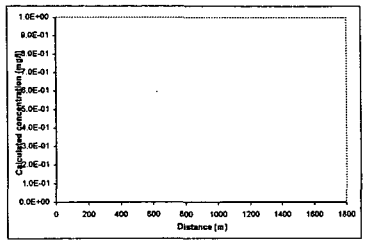
Xu & Eckstein (1995) report $ax = 0.83(\log_{10}x)^{2.414}$; az = ax/10, ay = ax/100 are assumed

Calculated Parameters	Variable		
Groundwater flow velocity	v	3.92E-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	1.83E-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 Ogata Banks	LTC3	#NUM!	mg/l	For comparison with measured groundwater concentration.
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.



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.

Site being assessed:	Bloss Area 4 Res
Completed by:	AJ
Date:	24 11 2005
Version:	11

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!

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 25-07-2013:17:59:49

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

				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	1.62E-01	fraction	
Hydraulic gradient	i	1.02E-02	fraction	
Hydraulic conductivity of aquifer	K	7.00E+00	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*

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

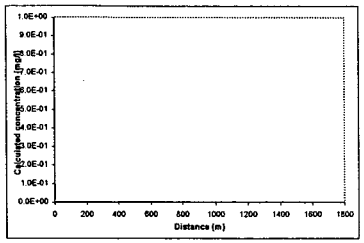
For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report $ax = 0.83(\log_{10}x)^{2.414}$; az = ax/10, ay = ax/100 are assumed

Calculated Parameters	Variable		
Groundwater flow velocity	v	3.92E-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	1.83E-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		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.



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
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!
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
Completed by:	AJ
Date:	24.11.2005
Version	11

For inspection purposes only.
Consent or copyright owner required for any other use.

EPA Export 25-07-2013:17:59:49

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: Ammoniacal Nitrogen as N

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	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	7.00E+00	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*

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 $K_{sr,n}$: l/kg

Sorption coefficient for ionised species $K_{sr,i}$: 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

Calculated Parameters | Variable

Groundwater flow velocity	v	3.92E-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	6.92E-02	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	1.04E-02	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	5.80E-03	mg/l
Attenuation factor (one way vertical dispersion, C_0/C_{ED})	AF	5.28E+03	
Attenuation factor (two way vertical dispersion, C_0/C_{ED})	AF	9.49E+03	

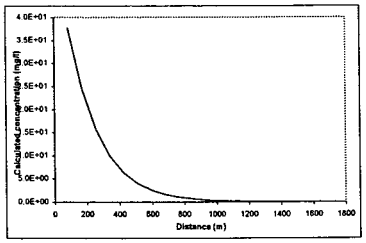
Remedial Targets

Remedial Target LTC3 6.33E+02 mg/l — For comparison with measured groundwater concentration.

Ogata Banks

Distance to compliance point		1700	m	
Concentration of contaminant at compliance point	$C_{ED}/C0$	1.04E-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.



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 Res
Completed by	AJ
Date	24 11 2005
Version	11

Calculated concentrations for distance-concentration graph

Spreadsheet calculation sheet

Distance	Concentration
	mg/l
85.0	3.8E+01
255.0	2.5E+01
340.0	9.9E+00
426.0	6.3E+00
610.0	4.0E+00
595.0	2.5E+00
680.0	1.5E+00
850.0	1.3E+00
935.0	4.4E-01
1020.0	2.9E-01
1105.0	1.9E-01
1190.0	8.2E-02
1160.0	5.4E-02
1445.0	3.6E-02
1530.0	2.4E-02
1616.0	1.6E-02
1700.0	1.0E-02

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 25-07-2013:17:59:49

Tier 3 Groundwater
Site Name:

	Distance to compliance point (m)		1700								
	Groundwater velocity (m/d)		0.51153846								
	Groundwater travel time (d)		3323.30827	If data entry error						If data entry error	If groundwater fails at tier 3
Contaminant	Maximum groundwater concentration at source (mg/l)[2]	Acceptable concentration (screening) water (mg/l)	Retardation factor	Contaminant velocity (m/d)	Contaminant travel time (d)	Contaminant travel time (yr)	Half life (d)	Attenuation Factor (AF)	Tier 3 Groundwater RTV (mg/l)	Tier 3 Groundwater Hazard Index	
Total Cyanide		0.01	7.4195E+10	6.89447E-12	2.46575E+14	675,546,576,317.69	29.1666667	#NUM!	#NUM!	#NUM!	
Flouride		1	1	0.511538462	3323.308271	9.10	9.9E+99	3.452683033	3.45E+00	0.00E+00	
Sulphide		0.00025	1	0.511538462	3323.308271	9.10	9.9E+99	3.452683033	8.63E-04	0.00E+00	
Ammoniacal Nitrogen as N		0.12	5.67032967	0.090213178	18844.25349	51.63	2190	1027.70665	1.23E+02	0.00E+00	
Arsenic		0.01	1098.43178	0.000465699	3650427.426	10,001.17	9.9E+99	3.452683033	3.45E-02	0.00E+00	
Nickel		0.02	1	0.511538462	3323.308271	9.10	9.9E+99	3.452683033	6.91E-02	0.00E+00	
Strontium		1	1	0.511538462	3323.308271	9.10	9.9E+99	3.452683033	3.45E+00	0.00E+00	
Aliphatic C8-C10		0.000714	1073.22063	0.000476639	3566642.991	9,771.62	1825	8.5485E+151	6.10E+148	0.00E+00	
Aliphatic C10-C12		0.0007141	8517.951191	6.00542E-05	28307777.641	77,555.56	1825	#NUM!	#NUM!	#NUM!	
Aliphatic C12-C16		0.0007141	169936.5181	3.01017E-06	564751434.11	1,547,264.20	1825	#NUM!	#NUM!	#NUM!	
Aliphatic C16-C21		0.0007141	21393615.11	2.39108E-08	710975781221	194,787,885.27	3650	#NUM!	#NUM!	#NUM!	
Aliphatic C21-C35		0.000714	21393615.11	2.39108E-08	71097578122	194,787,885.27	3650	#NUM!	#NUM!	#NUM!	
Aromatic C8-C10		0.000714	54.7383291	0.00934516	181912.3417	498.39	1825	7.41809E+21	5.30E+18	0.00E+00	
Aromatic C10-C12		0.000714	86.1695119	0.005936421	286367.8516	784.57	1825	3.7638E+30	2.69E+27	0.00E+00	
Aromatic C12-C16		0.000714	170.935518	0.002992581	568071.4191	1,556.36	1825	1.46421E+49	1.05E+46	0.00E+00	
Aromatic C16-C21		0.000714	538.383291	0.000950138	1789213.643	4,901.96	3650	1.3141E+66	9.38E+62	0.00E+00	
Aromatic C21-C35		0.000714	4269.58721	0.00011981	14189154.48	38,874.40	3650	2.8902E+223	2.06E+220	0.00E+00	
								3.26278E+79	1.63E+76	0.00E+00	

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 25-07-2013:17:59:49

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

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	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	7.00E+00	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*

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		1.41E+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

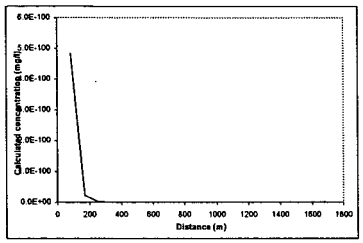
Calculated Parameters | Variable

Groundwater flow velocity	v	3.92E-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	7.17E-03	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	2.17E-125	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	1.21E-125	mg/l
Attenuation factor (one way vertical dispersion, C_0/C_{ED})	AF	4.56E+26	
Attenuation factor (two way vertical dispersion, C_0/C_{ED})	AF	8.19E+26	

Remedial Targets

Remedial Target Ogata Banks	LTC3	3.25E+23	mg/l	For comparison with measured groundwater concentration.
Distance to compliance point		1700	m	
Concentration of contaminant at compliance point after	$C_{ED}/C0$	2.17E-126 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.



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.

Site being assessed:	Bless Area 4 Res
Completed by	AJ
Date:	24 11 2005
Version:	11

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration
	mg/l
85.0	4.8E-100
170.0	2.3E-101
255.0	1.0E-102
340.0	4.6E-104
426.0	2.1E-105
610.0	9.4E-107
696.0	4.3E-108
680.0	2.0E-109
765.0	9.0E-111
850.0	4.2E-112
956.0	1.9E-113
1020.0	9.0E-116
1105.0	4.2E-116
IIW.O	2.0E-117
1275.0	9.2E-119
1360.0	4.3E-120
1445.0	2.0E-121
1530.0	9.7E-123
1016.0	4.6E-124
1700.0	2.2E-125

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 25-07-2013:17:59:50

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	p	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	7.00E+00	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*

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

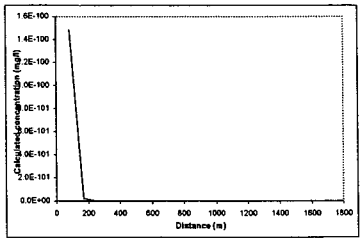
For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report ax = $0.83(\log_{10}x)^{2.414}$; az = ax/10, ay = ax/100 are assumed

Calculated Parameters	Variable		
Groundwater flow velocity	v	3.92E-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	4.55E-03	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{FD}	1.21E-135	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{FD}	6.76E-136	mg/l
Attenuation factor (one way vertical dispersion, C_0/C_{FD})	AF	8.15E+36	
Attenuation factor (two way vertical dispersion, C_0/C_{FD})	AF	1.47E+37	

Remedial Targets

Remedial Target Ogata Banks	LTC3	5.82E+33	mg/l	For comparison with measured groundwater concentration.
Distance to compliance point		1700	m	
Concentration of contaminant at compliance point after	$C_{FD}/C0$	1.21E-135 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.



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
86.0	1.6E-100
170.0	2.1E-102
266.0	3.0E-104
340.0	4.1E-106
426.0	6.7E-108
510.0	7.9E-110
595.0	1.1E-111
680.0	1.6E-113
766.0	2.2E-115
850.0	3.1E-117
935.0	4.4E-119
1020.0	6.3E-121
1106.0	9.1E-123
1190.0	1.9E-125
1380.0	2.7E-128
1445.0	4.0E-130
1530.0	5.7E-132
1616.0	8.3E-134
1700.0	1.2E-135

Site being assessed	Bloss Area 4 Res
Completed by	AJ
Date	24 11 2005
Version	11

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 25-07-2013:17:59:50

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

	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	n	1.82E-01	fraction	
Hydraulic gradient	i	1.02E-02	fraction	
Hydraulic conductivity of aquifer	K	7.00E+00	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*

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+09	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,s}$		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		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

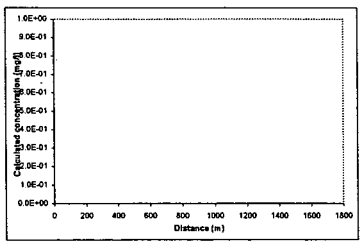
Calculated Parameters

	Variable		
Groundwater flow velocity	v	3.92E-01	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	5.29E-12	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.



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.

Site being assessed:	Bless Area 4 Res
Completed by:	AJ
Date:	24 11 2005
Version.	11

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!

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 25-07-2013:17:59:50

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 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	7.00E+00	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*

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

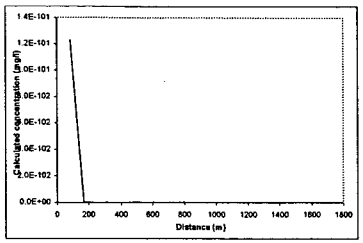
For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report ax = $0.83(\log_{10}x)^{2.414}$; az = ax/10, ay = az/100 are assumed

Calculated Parameters	Variable		
Groundwater flow velocity	v	3.92E-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	2.30E-03	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	2.76E-157	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	1.53E-157	mg/l
Attenuation factor (one way vertical dispersion, C_0/C_{ED})	AF	3.59E+58	
Attenuation factor (two way vertical dispersion, C_0/C_{ED})	AF	6.46E+58	

Remedial Targets

Remedial Target	LTC3	2.58E+55	mg/l	For comparison with measured groundwater concentration.
Ogata Banks				
Distance to compliance point		1700	m	
Concentration of contaminant at compliance point after	$C_{ED}/C0$	2.76E-157 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.



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	Bloss Area 4 Res
Completed by	AJ
Date	24.11.2005
Version	11

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration
	mg/l
85.0	1.2E-101
170.0	1.5E-104
255.0	1.7E-107
340.0	1.9E-110
426.0	2.2E-113
510.0	2.5E-116
595.0	2.9E-119
680.0	3.4E-122
716.0	4.0E-125
866.0	6.5E-131
1020.0	8.5E-134
1190.0	9.2E-140
1276.0	1.1E-142
1360.0	1.3E-145
1445.0	1.5E-148
1530.0	1.9E-151
1598.0	2.8E-153

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 25-07-2013:17:59:50

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

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	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	7.00E+00	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*	

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

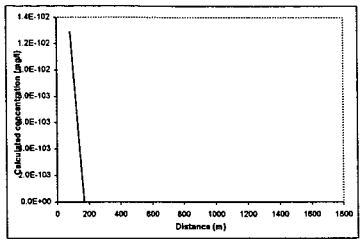
Xu & Eckstein (1995) report $ax = 0.83(\log_{10}x)^{2.414}$; az = ax/10, ay = az/100 are assumed

Calculated Parameters	Variable		
Groundwater flow velocity	v	3.92E-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	7.29E-04	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	7.11E-177	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	3.96E-177	mg/l
Attenuation factor (one way vertical dispersion, C_0/C_{ED})	AF	1.39E+78	
Attenuation factor (two way vertical dispersion, C_0/C_{ED})	AF	2.50E+78	

Remedial Targets

Remedial Target Ogata Banks	LTC3	8.94E+74	mg/l	For comparison with measured groundwater concentration.
Distance to compliance point		1700	m	
Concentration of contaminant at compliance point after	$C_{ED}/C0$	7.11E-177 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.



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:	Bloss Area 4 Res
Completed by	AJ
Date:	24 11 2005
Version	11

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration
	mg/l
85.0	1.3E-102
170.0	1.6E-106
255.0	1.9E-110
340.0	2.3E-114
426.0	2.8E-118
510.0	3.4E-122
596.0	4.1E-126
680.0	5.0E-130
765.0	6.1E-134
850.0	7.5E-138
1020.0	1.2E-145
1106.0	1.4E-149
1190.0	1.8E-153
1276.0	2.2E-157
1445.0	2.8E-165
1530.0	4.5E-169
1615.0	5.6E-173
1700.0	7.1E-177

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 25-07-2013:17:59:50

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

Tier 3 - Groundwater

ENVIRONMENT AGENCY

Input Parameters (using pull down menu)	Variable	Value	Unit	Sours.
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

				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	7.00E+00	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*

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

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		1.41E+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

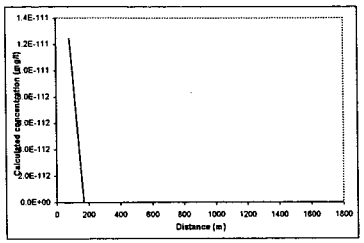
Calculated Parameters

	Variable		
Groundwater flow velocity	v	3.92E-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	9.19E-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		1700	m	
Concentration of contaminant at compliance point after	$C_{ED}/C0$	#NUM!	mg/l	Ogata Banks
		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
85.0	1.2E-111
170.0	1.5E-124
255.0	1.7E-137
340.0	2.0E-150
425.0	2.3E-163
510.0	2.7E-176
595.0	3.2E-189
680.0	3.8E-202
765.0	4.5E-215
850.0	5.3E-228
935.0	6.4E-241
1020.0	7.6E-254
1105.0	9.1E-267
1190.0	1.1E-279
1275.0	1.3E-292
1360.0	1.6E-305
1445.0	0.0E+00
1530.0	0.0E+00
1615.0	0.0E+00
1700.0	#NUM!

Site being assessed	Bloss Area 4 Res
Completed by	AJ
Date	24 11 2005
Version	11

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 25-07-2013:17:59:50

EPA Export 25-07-2013:17:59:50

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	p	1.70E+00	g/cm^3	
Effective porosity of aquifer		1.82E-01	fracion	
Hydraulic gradient		1.02E-02	fraction	
Hydraulic conductivity of aquifer	K	7.00E+00	m/d	
Distance to compliance point		1.70E+03	m	
Distance (lateral) to compliance point perpendicular to flow direction		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*

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

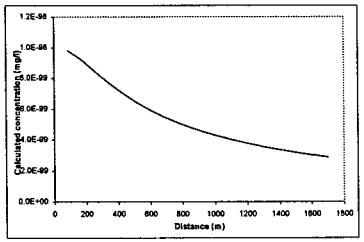
Calculated Parameters | Variable

Groundwater flow velocity	v	3.92E-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	3.57E-04	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 Ogata Banks	LTC3	3.45E-02	mg/l	For comparison with measured groundwater concentration.
Distance to compliance point		1700	m	
Concentration of contaminant at compliance point after	$C_{ED}/C0$	2.87E-99 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.



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.

Site being assessed	Bloss Area 4 Res
Completed by	AJ
Date:	24.11.2005
Version:	11

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration
m	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

For inspection purposes only. Consult of copyright owner required for any other use.

ENVIRONMENT AGENCY

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

Date of Workbook Issue: April 2002

This worksheet has been produced in combination with the document 'Methodology for the Derivation of Remedial Targets for Soil and Groundwater to Protect Water Resources' - Environment Agency R&D Publication 20, (1999).

Users of this worksheet should always refer to the User Manual, to R&D Publication 20 and to relevant guidance on UK legislation and policy, in order to understand how this procedure should be applied in an appropriate context.

© Environment Agency, 2002. (Produced by the Agency's National Groundwater and Contaminated Land Centre and Enviros Aspinwall)

This calculation of equations in this worksheet has been independently checked by Entec (UK) Ltd on behalf of the NGWCLC.

All rights reserved. You will not modify, reverse compile or otherwise dis-assemble the worksheet.

Liability: The Environment Agency does not promise that the worksheet will provide any particular facilities or functions. You must ensure that the worksheet meets your needs and you remain solely responsible for the competent use of the worksheet. You are entirely responsible for the consequences of any use of the worksheet and the Agency provides no warranty about the fitness for purpose or performance of any part of the worksheet. We do not promise that the media will always be free from defects, computer viruses, software locks or other similar code or that the operation of the worksheet will be uninterrupted or error free. You should carry out all necessary virus checks prior to installing on your computing system.

IMPORTANT: To enable MS Excel worksheet, click Tools, Add-Ins, Analysis Tool Pak and Analysis Tool Pak-VBA (to calculate error fu

For inspection purposes only.
Consent of copyright owner required for any other use.

Details to be **completed** for each assessment

Site Name:	**Bless Area 4 Res**		
Site Address:			
Completed by:	AJ		
Date:	**24/1**112005	**Version:**	**11**
Contaminant	**Fluoride**		
Target Concentration (C_T)	**1 mg/l**	**Origin of C_T:**	**EPA 2003**

This worksheet can be used to determine remedial targets for soils (Worksheets Tier 1 Soil, Tier 2 Soil and Tier 3 Soil) or to determine remedial targets for groundwater (Tier 3 Groundwater). For Tier 3, parameter values must be entered separately dependent on whether the assessment is for soil or groundwater. For soil, remedial targets are calculated as either mg/kg (for comparision with soil measurements) or mg/l (for comparison with leaching tests or pore water concentrations).
Site details entered on this page are automatically copied to Tier 1, 2 and 3 Worksheets.
Worksheet options are identified by brown background and employ a pull-down menu or require a "0", "1" or "2" to be entered. Data entry are identified as blue backgrc
Data origin / justification should be noted in cells coloured yellow and fully documented in subsequent reports.
It is recommended that a copy of the original worksheet is saved (all data fields in the original copy are blank).

The worksheet also calculates a number of frequently used hydrogeological equations.

EPA Export 25-07-2013:17:59:50

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

				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	..	1.82E-01	fraction	
Hydraulic gradient	i	1.02E-02	fraction	
Hydraulic conductivity of aquifer	K	7.00E+00	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*

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 = az/100 are assumed

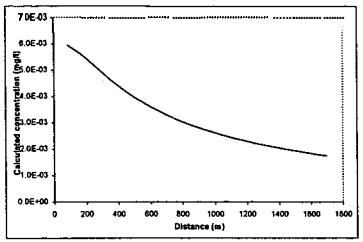
Calculated Parameters | Variable

Groundwater flow velocity	v	3.92E-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	3.92E-01	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_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	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 after	$C_{ED}/C0$	1.74E-03 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.



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:	Bloss Area 4 Res
Completed by:	AJ
Date	24 11 2005
Version	11

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**
426.0	4.3E-03
510.0	**3.9E-03**
696.0	3.6E-03
680.0	**3.3E-03**
850.0	**2.9E-03**
935.0	**2.7E-03**
1020.0	**2.5E-03**
1190.0	**2.3E-03**
1275.0	2.2E-W
1300.0	2.1E-03
1445.0	**2.0E-03**
1530.0	**1.9E-03**
1615.0	**1.8E-03**
1700.0	1.7E-W

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 25-07-2013:17:59:50

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

Tier 3 - Groundwater

ENVIRONMENT AGENCY

Input Parameters (using pull down menu) | Variable | Value | Unit | Sours.

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	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	7.00E+00	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*

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 $ax = 0.83(\log_{10}x)^{2.414}$; sz = ax/10, ay = az/100 are assumed

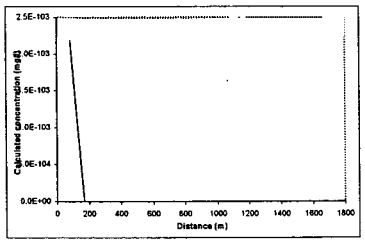
Calculated Parameters | Variable

Groundwater flow velocity	v	3.92E-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	1.98E-01	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	2.68E-192	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	1.49E-192	mg/l
Attenuation factor (one way vertical dispersion, C_0/C_{ED})	AF	3.70E+93	
Attenuation factor (two way vertical dispersion, C_0/C_{ED})	AF	6.65E+93	

Remedial Targets

Remedial Target Ogata Banks	LTC3	1.85E+00	mg/l	For comparison with measured groundwater concentration.
Distance to compliance point		1700	m	
Concentration of contaminant at compliance point after	$C_{ED}/C0$	2.68E-192 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.



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
85.0	2.7E-03 mg/l
170.0	4.6E-108
255.0	9.4E-113
340.0	1.9E-117
426.0	3.9E-122
510.0	8.0E-127
595.0	1.6E-131
680.0	3.4E-136
706.0	7.0E-141
850.0	1.5E-145
935.0	3.1E-150
1020.0	6.4E-155
1105.0	1.4E-159
1190.0	2.9E-164
1271.0	6.1E-169
1360.0	1.3E-173
1445.0	2.7E-178
1530.0	5.9E-183
1011.0	1.3E-187
1700.0	2.7E-192

Site being assessed:	Bloss Area 4 Res
Completed by:	AJ
Date:	24 11 2005
Version	11

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 25-07-2013:17:59:50

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	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	7.00E+00	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*

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

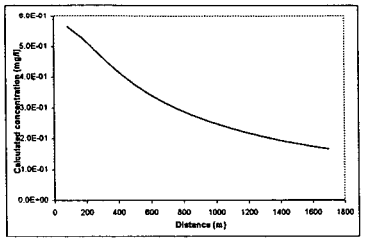
Xu & Eckstein (1995) report $ax = 0.83(\log_{10}x)^{2.414}$; az = ax/10, ay = ax/100 are assumed

Calculated Parameters	Variable		
Groundwater flow velocity	v	3.92E-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	3.92E-01	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{z0}	1.65E-01	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{z0}	9.18E-02	mg/l
Attenuation factor (one way vertical dispersion, C_0/C_{z0})	AF	3.45E+00	
Attenuation factor (two way vertical dispersion, C_0/C_{z0})	AF	6.21E+00	

Remedial Targets

Remedial Target Ogata Banks	LTC3	3.45E+00	mg/l	For comparison with measured groundwater concentration.
Distance to compliance point		1700	m	
Concentration of contaminant at compliance point	$C_{z0}/C0$	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.



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	5.5E-01
255.0	5.9E-01
340.0	4.4E-01
425.0	4.1E-01
610.0	3.7E-01
595.0	3.4E-01
680.0	3.2E-01
706.0	3.0E-01
850.0	2.8E-01
932000	2.6E-01
1105.0	2.3E-01
1275.0	2.2E-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	Bloss Area 4 Res
Completed by:	AJ
Date:	24 11 2005
Version:	11

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 25-07-2013:17:59:50

Simple hydrogeological calculations

(These are not specific to, or required in, the Remedial Targets Methodology)

Parameter	svmbol		unit	justification
Hydraulic conductivity	K	8.10E-05	mls	
Hydraulic gradient	i	9.80E-03	unitless	
Effective porosity of aquifer	n	1.82E-01	fraction	
Thickness of saturated aquifer	b	2.10E+01	m	
Width of aquifer perpendicular to flow	w	8.00E+01	m	
Distance to receptor	x	1.70E+03	m	
Density of stratum	ρ	1.70E+00	g/cm^3	
Soil-water partition co-efficient	Kd	0.00E+00	l/kg	
Retardation factor of pollutant	R	1		

Groundwater flow velocity	v(GW)	4.36E-06	m/s	3.77E-01	m/day	1.38E+02	m/year
Time for groundwater to reach receptor	t(GW)	3.90E+08	seconds	4.51E+03	days	1.24E+01	years
Rate of groundwater flow through aquifer	Q	1.33E-03	m^3/s	1.15E+02	m^3/day	4.21E+04	$m^3/year$

Contaminant flow velocity	v(contam)	4.36E-06	m/s	3.77E-01	m/day	1.38E+02	m/year
Time for contaminant to reach receptor	t(contam)	3.90E+08	seconds	4.51E+03	days	1.24E+01	years

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 25-07-2013:17:59:50

R&D Publication20 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

				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	7.00E+00	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*

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		1.41E+01	m
Transverse dispersivity	az		1.41E+00	m
Vertical dispersivity	ay		1.41E-01	m

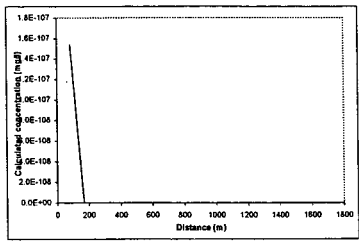
For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report $ax = 0.83(\log_{10}x)^{2.414}$; az = ax/10, ay = az/100 are assumed

Calculated Parameters	Variable		
Groundwater flow velocity	v	3.92E-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	3.66E-04	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	2.38E-275	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	1.32E-275	mg/l
Attenuation factor (one way vertical dispersion, C_0/C_{ED})	AF	4.16E+176	
Attenuation factor (two way vertical dispersion, C_0/C_{ED})	AF	7.48E+176	

Remedial Targets

Remedial Target Ogata Banks	LTC3	2.97E+173	mg/l	For comparison with measured groundwater concentration.
Distance to compliance point		1700	m	
Concentration of contaminant at compliance point after	$C_{ED}/C0$	2.38E-275 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.



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

Site being assessed	Bloss Area 4 Res
Completed by	AJ
Date:	24 11 2005
Version	11

Calculated concentrations for distance-concentration graph

Ogata Banks

Distance	Calc Concentration
	mg/l
64.0	1.5E-107
250.0	3.3E-125
385.0	6.7E-143
510.0	9.7E-152
595.0	1.4E-160
680.0	2.0E-169
765.0	3.0E-178
935.0	6.4E-196
1020.0	9.5E-205
1190.0	2.1E-222
1276.0	3.1E-231
1360.0	4.7E-240
1445.0	7.0E-249
1530.0	1.0E-257
1616.0	1.6E-266
1700.0	2.4E-275

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 25-07-2013:17:59:50

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

				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	7.00E+00	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*

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		1.41E+01	m
Transverse dispersivity	az		1.41E+00	m
Vertical dispersivity	ay		1.41E-01	m

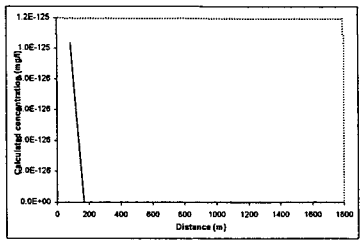
For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report $ax = 0.83(\log_{10}x)^{2.414}$; az = ax/10, ay = ax/100 are assumed

Calculated Parameters	Variable		
Groundwater flow velocity	v	3.92E-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	4.61E-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		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.



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	Bloss Area 4 Res
Completed by:	AJ
Date:	24 11 2005
Version:	11

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration
	mg/l
85.0	1.0E-125
170.0	1.0E-152
255.0	1.0E-179
340.0	9.6E-207
426.0	9.3E-234
610.0	WE-161
696.0	8.7E-288
680.0	0.0E+00
765.0	0.0E+00
850.0	0.0E+00
935.0	RMUHI
1020.0	#NUM!
1105.0	RMUHI
1190.0	#NUM!
1276.0	#NUM!
1360.0	#NUM!
1445.0	#NUM!
1530.0	#NUM!
1616.0	RMUHI
1700.0	#NUM!

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 25-07-2013:17:59:51

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_o	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	7.00E+00	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	ay	0.141	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	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		1.41E+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 = az/100 are assumed

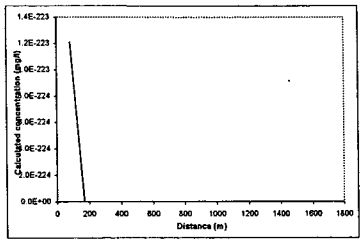
Calculated Parameters | Variable

Groundwater flow velocity	v	3.92E-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	2.31E-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_{ES}	#NUM!	mg/l
Attenuation factor (one way vertical dispersion, C_o/C_{ED})	AF	#NUM!	
Attenuation factor (two way vertical dispersion, C_o/C_{ES})	AF	#NUM!	

Remedial Targets

Remedial Target Ogata Banks	LTC3	#NUM!	mg/l	For comparison with measured groundwater concentration.
Distance to compliance point		1700	m	
Concentration of contaminant at compliance point	$C_{ES}/C0$	#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.

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
Completed by	AJ
Date.	24 11 2005
Version:	11

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration
	mg/l
85.0	1.2E-223
170.0	0.0E+00
255.0	#NUM!
340.0	#NUM!
425.0	#NUM!
510.0	#NUM!
595.0	#NUM!
680.0	#NUM!
716.0	#NUM!
860.0	#NUM!
935.0	#NUM!
1020.0	#NUM!
1106.0	#NUM!
1190.0	#NUM!
1276.0	#NUM!
1360.0	#NUM!
1445.0	#NUM!
1530.0	#NUM!
1615.0	#NUM!
1700.0	#NUM!

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 25-07-2013:17:59:51

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 25-07-2013:17:59:51

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

				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	7.00E+00	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*

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 ionised species $K_{oc\,n}$: [redacted] l/kg
Sorption coefficient for ionised species $K_{oc\,i}$: [redacted] 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]	1.11E+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

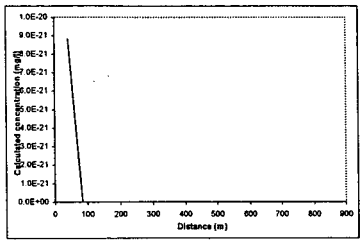
Calculated Parameters | Variable

Groundwater flow velocity	v	2.69E-01	m/d
Retardation factor	Rf	6.52E+03	fraction
Decay rate used	λ	3.80E-04	d^{-1}
Rate of contaminant flow due to retardation	u	3.16E-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		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.



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	Blossington area 6
Completed by	Anna Jeffcoat
Date:	23 11 2005
Version:	11

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration
	mg/l
42.6	8.8E-21
85.0	3.7E-39
127.5	1.5E-57
170.0	6.2E-76
212.6	2.6E-94
255.1	1.0E-112
297.6	4.1E-131
340.0	1.7E-149
382.6	6.7E-168
426.0	2.7E-186
467.5	1.1E-204
510.0	4.5E-223
552.6	1.8E-241
596.0	7.4E-260
637.5	3.0E-278
680.0	
722.5	#NUM!
765.0	#NUM!
807.5	#NUM!
850.0	#NUM!

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 25-07-2013:17:59:51

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	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	7.00E+00	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*

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 ionised 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

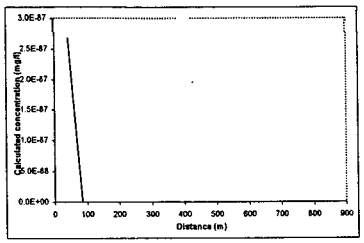
For calculated value, assumes ax = 0.1 * x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report $ax = 0.83(\log_{10}x)^{2.414}$; az = ax/10, ay = ax/100 are assumed

Calculated Parameters	Variable		
Groundwater flow velocity	v	2.69E-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	1.58E-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_D/C_{ED})	AF	#NUM!	
Attenuation factor (two way vertical dispersion, C_D/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.



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
Completed by	Anna Jeffcoat
Date	23 11 2005
Version	11

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration
	mg/l
42.5	2.7E-87
66.0	3.4E-172
127.6	4.2E-257
170.0	#NUM!
255.0	#NUM!
297.5	#NUM!
340.0	#NUM!
382.5	#NUM!
425.0	#NUM!
510.0	#NUM!
552.5	#NUM!
595.0	#NUM!
637.5	#NUM!
680.0	#NUM!
722.5	#NUM!
765.0	#NUM!
807.6	#NUM!
850.0	#NUM!

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 25-07-2013:17:59:51

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	6.00E+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	7.00E+00	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*

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 — $K_{sc,n}$ — [redacted] l/kg

Sorption coefficient for ionised species — $K_{sc,i}$ — [redacted] 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]	1.11E+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

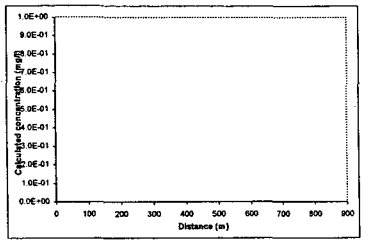
Xu & Eckstein (1995) report $ax = 0.83(\log_{10}x)^{2.414}$; az = ax/10, ay = ax/100 are assumed

Calculated Parameters	Variable		
Groundwater flow velocity	v	2.69E-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	1.26E-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	LTCS	#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}/C_0		#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
42.5	**#NUM!**
85.0	**#NUM!**
127.5	**#NUM!**
170.0	#NUM!
212.5	**#NUM!**
255.0	#NUM!
297.5	**#NUM!**
340.0	**#NUM!**
382.5	#NUM!
426.0	#NUM!
467.5	**#NUM!**
610.0	#NUM!
552.5	**#NUM!**
696.0	#NUM!
637.5	**#NUM!**
680.0	**#NUM!**
722.5	**#NUM!**
716.0	#NUM!
107.6	#NUM!
850.0	**#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:	Blessington area 6
Completed by	Anna Jeffcoat
Date:	23.11.2005
Version:	11

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 25-07-2013:17:59:51

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		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	7.00E-03	fraction	
Hydraulic conductivity of aquifer	K	7.00E+00	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*

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 ionised 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		1.11E+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

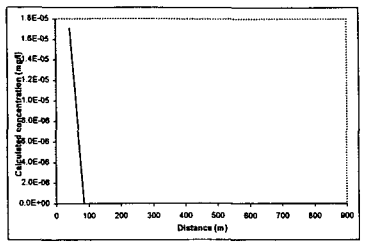
Calculated Parameters | Variable

Groundwater flow velocity	v	2.69E-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	1.98E-03	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	1.91E-64	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	1.83E-64	mg/l
Attenuation factor (one way vertical dispersion, C_0/C_{ED})	AF	1.11E+62	
Attenuation factor (two way vertical dispersion, C_0/C_{ED})	AF	1.16E+62	

Remedial Targets

Remedial Target Ogata Banks	LTC3	7.94E-06	mg/l	For comparison with measured groundwater concentration.
Distance to compliance point		850	m	
Concentration of contaminant at compliance point	$C_{ED}/C0$	1.91E-64	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.

Site being assessed	Blessington area 6
Completed by:	Anna Jeffcoat
Date:	23 11 2005
Version	11

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration
	mg/l
42.5	1.7E-05
85.0	1.4E-08
127.6	1.1E-11
170.0	8.7E-15
212.6	6.8E-18
266.0	5.3E-21
297.6	4.2E-24
340.0	3.3E-27
382.5	2.6E-30
426.0	2.0E-33
467.5	1.6E-36
610.0	1.3E-39
662.6	9.9E-43
695.8	6.1E-49
880.0	4.9E-52
722.6	3.8E-55
765.0	3.0E-58
807.5	2.4E-61
850.0	1.9E-64

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 25-07-2013:17:59:51

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: Ammoniacal 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	4.00E-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	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	7.00E+00	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	2.69E-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	4.75E-02	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	1.28E-03	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	1.23E-03	mg/l
Attenuation factor (one way vertical dispersion, C_0/C_{ED})	AF	3.12E+02	
Attenuation factor (two way vertical dispersion, C_0/C_{ED})	AF	3.25E+02	

Remedial Targets

Remedial Target Ogata Banks	LTC3	3.74E+01	mg/l	For comparison with measured groundwater concentration.
Distance to compliance point		850	m	
Concentration of contaminant at compliance point	$C_{ED}/C0$	1.28E-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

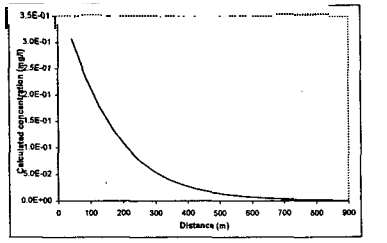
Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd		l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	1.00E+00	fraction
Organic carbon partition coefficient	Koc	5.00E-01	l/kg
Entry for ionic organic chemicals (option)			
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		1.11E+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	3.1E-01
85.0	2.3E-01
127.5	1.8E-01
170.0	1.3E-01
212.5	9.9E-02
255.0	7.4E-02
297.5	5.6E-02
340.0	4.1E-02
382.5	3.1E-02
425.0	2.3E-02
467.5	1.7E-02
510.0	1.3E-02
552.5	9.6E-03
595.0	7.1E-03
637.5	5.4E-03
680.0	4.0E-03
722.5	3.0E-03
765.0	2.3E-03
807.5	1.7E-03
850.0	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:	Blessington area 6
Completed by:	Anna Jeffcoat
Date:	23.11.2005
Version:	11

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 25-07-2013:17:59:51

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_o	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	7.00E+00	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*

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 retated 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

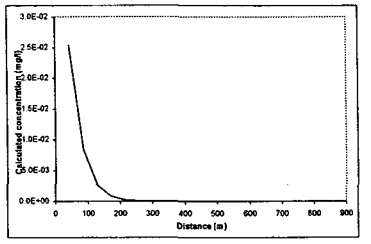
For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report ax = $0.83(\log_{10}x)^{2.414}$; az = ax/10, ay = ax/100 are assumed

Calculated Parameters	Variable		
Groundwater flow velocity	v	2.69E-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	2.83E-02	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	1.21E-11	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	1.16E-11	mg/l
Attenuation factor (one way vertical dispersion, C_O/C_{ED})	AF	6.34E+09	
Attenuation factor (two way vertical dispersion, C_O/C_{ED})	AF	6.62E+09	

Remedial Targets

Remedial Target	LTCS	4.53E+08	mg/l	For comparison with measured groundwater concentration.
Ogata Banks				
Distance to compliance point		850	m	
Concentration of contaminant at compliance point	$C_{ED}/C0$	1.21E-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.



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	2.5E-02
127.5	8.3E-03
212.5	2.8E-04
255.0	9.9E-05
340.0	9.4E-06
382.5	3.0E-06
426.0	9.7E-07
467.5	3.1E-07
6t0.0	1.0E-07
595.0	3.3E-08
UI.6	3.4E-09
680.0	3.6E-09
166.0	1.2E-10
807.5	3.7E-11
850.0	1.2E-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:	Bicsington
Completed by:	AJ
Date:	23 11 2005
Version:	11

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 25-07-2013:17:59:51

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 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_o	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	7.00E+00	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*

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 ionised species	$K_{ow,n}$		l/kg
Sorption coefficient for ionised species	$K_{ow,i}$		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

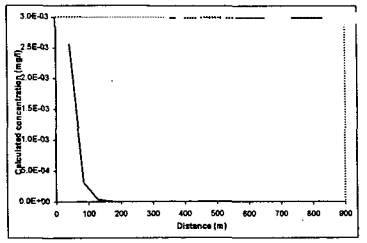
For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x.
Xu & Eckstein (1995) report $ax = 0.83(\log_{10}p)^{2.414}$; az = ax/10, ay = ax/100 are assumed

Calculated Parameters	Variable		
Groundwater flow velocity	v	*2.89E-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	4.92E-03	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	5.96E-21	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	5.71E-21	mg/l
Attenuation factor (one way vertical dispersion, C_o/C_{ED})	AF	3.58E+18	
Attenuation factor (two way vertical dispersion, C_o/C_{ED})	AF	3.71E+18	

Remedial Targets

Remedial Target Ogata Banks	LTC3	2.56E+15	mg/l	For comparison with measured groundwater concentration.
Distance to compliance point		**850**	m	
Concentration of contaminant at compliance point after	$C_{ED}/C0$	**5.96E-21** **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.



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
Completed by	Anna Jeffcoat
Date	23 11 2005
Version	11

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration
	mg/l
42.5	2.6E-03
85.0	3.1E-04
127.6	3.7E-05
170.0	4.3E-06
212.5	5.1E-07
255.0	6.0E-08
297.5	7.0E-09
340.0	8.2E-10
382.5	9.6E-11
467.5	1.3E-12
510.0	1.5E-13
552.5	1.8E-14
595.0	2.2E-15
722.6	3.6E-18
765.0	4.2E-19
807.5	5.0E-20
850.0	6.0E-21

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 25-07-2013:17:59:51

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	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	1.62E-01	fraction	
Hydraulic gradient	i	7.00E-03	fraction	
Hydraulic conductivity of aquifer	K	7.00E+00	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	$K_{ow,n}$		l/kg
Sorption coefficient for ionised species	$K_{ow,i}$		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 = az/100 are assumed

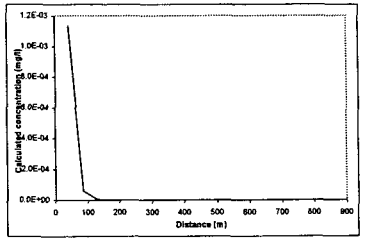
Calculated Parameters | Variable

Groundwater flow velocity	v	2.69E-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	3.12E-03	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	5.18E-28	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	4.96E-28	mg/l
Attenuation factor (one way vertical dispersion, C_0/C_{ED})	AF	4.10E+25	
Attenuation factor (two way vertical dispersion, C_0/C_{ED})	AF	4.27E+25	

Remedial Targets

Remedial Target	LTC3	2.92E+22	mg/l	For comparison with measured groundwater concentration.
Ogata Banks				
Distance to compliance point		850	m	
Concentration of contaminant at compliance point	$C_{ED}/C0$	5.18E-28	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.

Site being assessed:	Bessington area 6
Completed by:	Anna Jeffcoat
Date:	23 11 2005
Version:	11

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration
	mg/l
425.0	6.1E-06
127.6	3.2E-06
170.0	1.7E-07
232.6	8.7E-09
266.0	4.6E-10
237.6	2.4E-11
340.5	**6.1E-13**
426.0	3.3E-15
467.5	1.7E-16
610.0	**9.1E-18**
552.5	**4.7E-19**
696.0	**2.5E-20**
637.5	1.3E-21
680.0	6.8E-23
722.6	3.6E-24
765.0	1.9E-25
807.5	9.8E-27
850.0	5.2E-28

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 25-07-2013:17:59:51

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 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	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	7.00E+00	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*

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		1.11E+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 = az/100 are assumed

Calculated Parameters | Variable

Groundwater flow velocity	v	2.69E-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	1.58E-03	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	7.69E-43	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	7.37E-43	mg/l
Attenuation factor (one way vertical dispersion, C_0/C_{ED})	AF	2.76E+40	
Attenuation factor (two way vertical dispersion, C_0/C_{ED})	AF	2.87E+40	

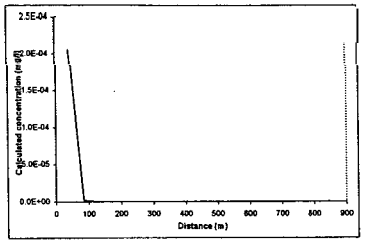
Remedial Targets

Remedial Target | LTC3 | 1.97E+37 | mg/l — For comparison with measured groundwater concentration.

Ogata Banks

Distance to compliance point		**850**	**m**	
Concentration of contaminant at compliance point	$C_{ED}/C0$	**7.69E-43**	**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

Distance-Concentration sheet

Distance	Concentration
42.6	2.7E-04
96.0	2.0E-06
170.6	1.9E-08
258.6	1.8E-10
297.6	1.5E-16
340.6	1.4E-28
425.0	1.3E-22
467.5	1.2E-24
610.0	1.2E-26
662.6	1.1E-28
696.0	1.0E-30
680.6	9.3E-35
722.5	8.9E-37
765.0	8.5E-39
907.6	8.1E-41
850.0	7.7E-43

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
Completed by	Anna Jeffcoat
Date	23 11 2005
Version	11

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 25-07-2013:17:59:51

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	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	7.00E+00	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*

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	$K_{w,e}$		l/kg
Sorption coefficient for ionised species	$K_{w,i}$		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		1.11E+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

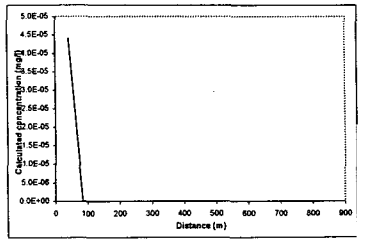
Xu & Eckstein (1995) report $ax = 0.83(\log_{10}x)^{2.414}$; az = ax/10, ay = az/100 are assumed

Calculated Parameters	Variable		
Groundwater flow velocity	v	2.69E-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	5.00E-04	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	3.26E-56	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	3.12E-56	mg/l
Attenuation factor (one way vertical dispersion, C_0/C_{ED})	AF	6.51E+53	
Attenuation factor (two way vertical dispersion, C_0/C_{ED})	AF	6.79E+53	

Remedial Targets

Remedial Target	LTCS	4.85E+50	mg/l	For comparison with measured groundwater concentration.
Ogata Banks				
Distance to compliance point		850	m	
Concentration of contaminant at compliance point	$C_{ED}/C0$	3.26E-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.



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 shouk 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
Completed by:	Anna Jeffcoat
Date:	23 11 2005
Version:	11

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration
	mg/l
42.6	4.4E-05
127.5	9.2E-09
170.0	3.6E-13
255.0	7.8E-16
297.5	3.2E-21
340.0	6.4E-24
382.5	1.3E-26
425.0	2.6E-29
610.0	1.1E-34
552.5	2.2E-37
595.0	4.5E-40
637.5	9.2E-43
680.0	1.9E-45
722.6	3.8E-48
71.0	7.8E-51
807.5	1.6E-53
850.0	3.3E-56

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 25-07-2013:17:59:51

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		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

				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	1.62E-01	fraction	
Hydraulic gradient	*i*	7.00E-03	*fraction*	
Hydraulic conductivity of aquifer	K	7.00E+00	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*

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 — $K_{sor,n}$ — l/kg

Sorption coefficient for ionised species — $K_{sor,i}$ — 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		1.11E+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

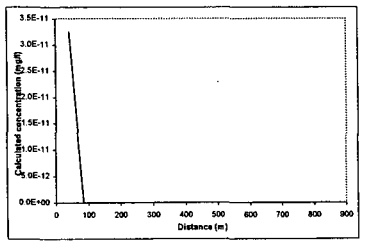
Groundwater flow velocity	v	2.69E-01	m/d
Retardation factor	Rf	4.27E+03	fraction
Decay rate used	λ	1.90E-04	d^{-1}
Rate of contaminant flow due to retardation	u	6.31E-05	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	7.31E-179	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	7.01E-179	mg/l
Attenuation factor (one way vertical dispersion, C_0/C_{ED})	AF	2.90E+176	
Attenuation factor (two way vertical dispersion, C_0/C_{ED})	AF	3.02E+176	

Remedial Targets

Remedial Target	LTCS	2.07E+173	mg/l	For comparison with measured groundwater concentration.
Ogata Banks				
Distance to compliance point		850	m	
Concentration of contaminant at compliance point	$C_{ED}/C0$	*7.31E-179*	*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
42.5	3.3E-11
85.0	5.0E-20
127.5	7.6E-29
170.0	1.1E-37
212.5	1.7E-46
255.0	2.5E-55
297.5	3.8E-64
340.0	5.6E-73
382.5	8.4E-82
425.0	1.3E-90
467.5	1.9E-99
510.0	2.8E-108
552.5	4.2E-117
595.0	6.3E-126
637.5	9.5E-135
680.0	1.4E-143
722.5	2.1E-152
765.0	3.2E-161
807.5	4.9E-170
850.0	7.3E-179

Site being assessed	Blessington
Completed by:	AJ
Date:	23 11 2005
Version	11

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 25-07-2013:17:59:51

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

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

	Variable	Value	Unit	Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	1.40E-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	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	7.00E+00	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*

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): 2

specify dispersivity (1), or calc after Xu & Eckstein (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

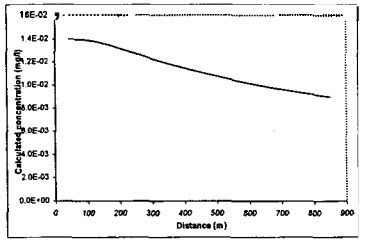
Xu & Eckstein (1995) report $ax = 0.83(\log_{10}x)^{2.414}$; az = ax/10, ay = az/100 are assumed

Calculated Parameters	Variable		
Groundwater flow velocity	v	2.69E-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	2.45E-04	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	9.00E-03	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	8.62E-03	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 Ogata Banks	LTC3	1.56E-02	mg/l	For comparison with measured groundwater concentration.
Distance to compliance point		850	m	
Concentration of contaminant at compliance point	$C_{ED}/C0$	9.00E-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



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
42.6	1.4E-02
86.0	1.4E-02
127.6	1.3E-02
212.6	1.3E-02
255.5	1.3E-02
340.0	1.2E-02
382.5	1.2102
425.0	1.1E-02
610.0	1.1E-02
552.5	1.0E-02
595.0	1.0E-02
637.5	1.0E-02
680.0	9.8E-03
722.5	9.5E-03
786.0	9.4E-03
807.6	9.2E-03
850.0	9.0E-03

Site being assessed	Blessington area 6
Completed by	Anna Jeffcoat
Date	23/11/2005
Version	11

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 25-07-2013:17:59:51

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		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	2.12E-01	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	7.00E+00	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

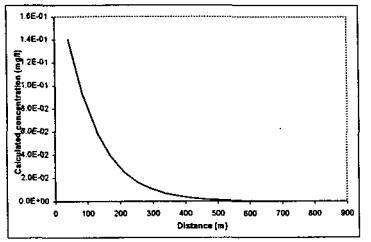
For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report $ax = 0.83(\log_{10}x)^{2.414}$; az = ax/10, ay = ax/100 are assumed

Calculated Parameters	Variable		
Groundwater flow velocity	v	2.69E-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	8.98E-02	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	3.65E-05	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	3.50E-05	mg/l
Attenuation factor (one way vertical dispersion, C_0/C_{ED})	AF	5.80E+03	
Attenuation factor (two way vertical dispersion, C_0/C_{ED})	AF	6.05E+03	

Remedial Targets

Remedial Target Ogata Banks	LTC3	6.99E+00	mg/l	For comparison with measured groundwater concentration.
Distance to compliance point		**850**	m	
Concentration of contaminant at compliance point after	$C_{ED}/C0$	**3.66E-05** **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.



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.

Site being assessed:	Blessington
Completed by:	AJ
Date:	23.11.2005
Version:	11

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration
	mg/l
42.6	1.4E-01
85.0	9.3E-02
127.6	6.1E-02
170.0	3.9E-02
212.5	2.5E-02
255.0	1.6E-02
297.6	6.5E-03
340.1	4.2E-03
382.6	2.8E-03
425.1	1.8E-03
467.6	1.2E-03
510.0	12EQI
552.5	7.6E.M
595.0	4.9E-04
637.5	3.2E-04
680.0	2.1E-04
722.6	8.8E-05
765.1	5.9E-05
807.6	3.7E-05
850.0	2.4E-05

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 25-07-2013:17:59:51

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

				Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	2.70E+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	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	7.00E+00	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		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 ionised 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

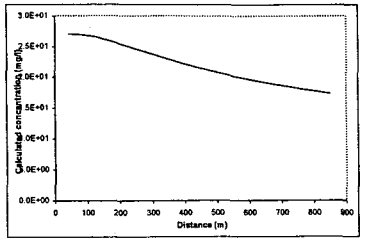
Calculated Parameters | Variable

Groundwater flow velocity	v	*2.69E-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	2.69E-01	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	1.73E+01	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	1.66E+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	

Remedial Targets

Remedial Target Ogata Banks	LTC3	1.56E+00	mg/l	For comparison with measured groundwater concentration.
Distance to compliance point		850	m	
Concentration of contaminant at compliance point	$C_{ED}/C0$	1.73E+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.



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
426	2.7E+01
[illegible]	2.7E+01
170.0	2.6E+01
212.5	2.5E+01
297.5	2.4E+01
340.0	2.3E+01
382.5	2.2E+01
425.0	2.2E+01
467.5	2.1E+01
510.0	2.1E+01
552.5	2.0E+01
595.0	2.0E+01
637.5	1.9E+01
680.0	1.9E+01
765.0	1.8E+01
807.5	1.8E+01
850.0	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:	Blessington area 5
Completed by:	Anna Jeffcoat
Date:	23 11 2005
Version:	11

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 25-07-2013:17:59:51

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		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	3.30E-02	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	7.00E+00	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	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 — 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

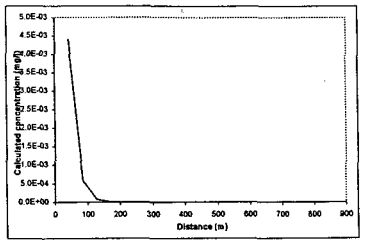
Calculated Parameters | Variable

Groundwater flow velocity	v	2.69E-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	3.20E-02	m/d
Contaminant concentration at distance x, *assuming one-way vertical dispersion*	C_{ED}	7.11E-20	*mg/l*
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	6.81E-20	mg/l
Attenuation factor (one way vertical dispersion, C_0/C_{ED})	AF	4.64E+17	
Attenuation factor (two way vertical dispersion, C_0/C_{ED})	AF	4.85E+17	

Remedial Targets

Remedial Target	LTC3	4.64E+14	mg/l	For comparison with measured groundwater concentration.
Ogata Banks				
Distance to compliance point		850	m	
Concentration of contaminant at compliance point	$C_{ED}/C0$	7.11E-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.



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	4.4E-03
85.0	5.9E-04
127.6	7.8E-05
170.0	1.0E-05
212.5	1.3E-06
255.0	1.7E-07
297.5	2.2E-08
340.0	2.9E-09
382.5	3.7E-10
426.0	4.9E-11
467.5	6.3E-12
510.0	8.3E-13
552.6	1.1E-13
595.0	1.4E-14
637.5	1.8E-15
680.0	2.4E-16
722.5	3.2E-17
765.0	4.1E-18
807.6	5.4E-19
850.0	7.1E-20

Site being assessed:	Blessington
Completed by:	AJ
Date:	23.11.2005
Version:	11

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 25-07-2013:17:59:51

ENVIRONMENT AGENCY

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

Date of Workbook Issue: April 2002

This worksheet has been produced in combination with the document 'Methodology for the Derivation of Remedial Targets for Soil and Groundwater to Protect Water Resources' - Environment Agency R&D Publication 20, (1999).

Users of this worksheet should always refer to the User Manual, to R&D Publication 20 and to relevant guidance on UK legislation and policy, in order to understand how this procedure should be applied in an appropriate context.

© Environment Agency, 2002. (Produced by the Agency's National Groundwater and Contaminated Land Centre and Enviros Aspinwall)

This calculation of equations in this worksheet has been independently checked by Entec (UK) Ltd on behalf of the NGWCLC.

All rights reserved. You will not modify, reverse compile or otherwise dis-assemble the worksheet.

Liability: The Environment Agency does not promise that the worksheet will provide any particular facilities or functions. You must ensure that the worksheet meets your needs and you remain solely responsible for the competent use of the worksheet. You are entirely responsible for the consequences of any use of the worksheet and the Agency provides no warranty about the fitness for purpose or performance of any part of the worksheet. We do not promise that the media will always be free from defects, computer viruses, software locks or other similar code or that the operation of the worksheet will be uninterrupted or error free. You should carry out all necessary virus checks prior to installing on your computing system.

IMPORTANT: To enable MS Excel worksheet, click Tools, Add -Ins, Analysis Tool Pak and Analysis Tool Pak-VBA (to calculate error fi

For inspection purposes only.
Consent of copyright owner required for any other use.

(Details to be completed for each assessment

Site Name:	**Blessington Appeal**		
Site Address:	**Area 6 Res**		
Completed by:	**Anna Jeffcoat**		
Date:	**25-Nov-05**	**Version:**	**11**
Contaminant	**Chloroethane**		
Target Concentration (C_T)	**0.001 mg/l**	**Origin of C_T:**	**from Benzene 98/83/EC**

This worksheet can be used to determine remedial targets for soils (Worksheets Tier 1 Soil, Tier 2 Soil and Tier 3 Soil) or to determine remedial targets for groundwater (Tier 3 Groundwater). For Tier 3, parameter values must be entered separately dependent on whether the assessment is for soil or groundwater. For soil, remedial targets are calculated as either mg/kg (for comparision with soil measurements) or mg/l (for comparison with leaching tests or pore water concentrations).
Site details entered on this page are automatically copied to Tier 1, 2 and 3 Worksheets.
Worksheet options are identified by brown background and employ a pull-down menu or require a "0", "1" or "2" to be entered. Data entry are identified as blue backgrc
Data origin / justification should be noted in cells coloured yellow and fully documented in subsequent reports.
It is recommended that a copy of the original worksheet is saved (all data fields in the original copy are blank).

The worksheet also calculates a number of frequently used hydrogeological equations.

EPA Export 25-07-2013:17:59:51

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		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	1.32E+00	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	7.00E+00	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*

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	$K_{sr,s}$		l/kg
Sorption coefficient for ionised species	$K_{sr,i}$		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

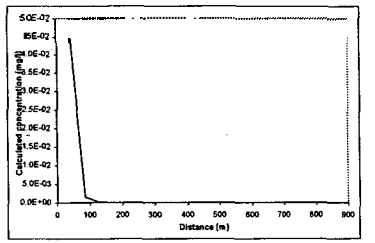
Calculated Parameters | Variable

Groundwater flow velocity	v	2.69E-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	2.02E-02	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	3.20E-30	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	3.07E-30	mg/l
Attenuation factor (one way vertical dispersion, C_0/C_{ED})	AF	4.12E+29	
Attenuation factor (two way vertical dispersion, C_0/C_{ED})	AF	4.30E+29	

Remedial Targets

Remedial Target Ogata Banks	LTC3	4.12E+27	mg/l	For comparison with measured groundwater concentration.
Distance to compliance point		850	m	
Concentration of contaminant at compliance point	$C_{ED}/C0$	3.20E-30	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.

Site being assessed	Blessington
Completed by	AJ
Date	23.11.2005
Version	11

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration
	mg/l
42.5	4.5E-02
85.0	1.5E-03
127.6	5.0E-05
170.0	1.7E-06
212.5	5.4E-08
255.0	1.8E-09
297.6	5.8E-11
340.0	1.9E-12
382.5	6.3E-14
425.0	2.0E-15
510.0	2.2E-18
552.5	7.4E-20
595.0	2.4E-21
637.6	8.0E-23
680.0	LIE-24
722.5	8.8E-26
765.0	2.9E-27
807.5	9.6E-29
850.0	3.2E-30

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 25-07-2013:17:59:51

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: 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	8.80E-02	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	1.62E-01	fraction	
Hydraulic gradient	i	7.00E-03	fraction	
Hydraulic conductivity of aquifer	K	7.00E+00	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: [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

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]	1.11E+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

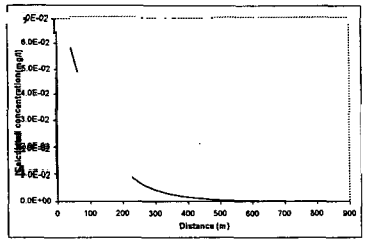
Calculated Parameters | Variable

Groundwater flow velocity	v	2.69E-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	8.98E-02	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	1.52E-05	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	1.45E-05	mg/l
Attenuation factor (one way vertical dispersion, C_0/C_{ED})	AF	5.80E+03	
Attenuation factor (two way vertical dispersion, C_0/C_{ED})	AF	6.05E+03	

Remedial Targets

Remedial Target Ogata Banks	LTCS	5.90E+01	mg/l	For comparison with measured groundwater concentration.
Distance to compliance point		850	m	
Concentration of contaminant at compliance point	$C_{ED}/C0$	1.52E-05	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
88.5	**3.9E-02**
127.6	2.5E-02
170.0	1.0E-02
212.5	**1.1E-02**
266.0	**6.8E-03**
297.5	**4.4E-03**
340.0	**2.8E-03**
382.5	**1.8E-03**
425.0	**1.2E-03**
467.5	7.6E-M
610.0	4.8E-M
552.5	**3.1E-04**
595.0	**2.0E-04**
637.5	1.JE-M
680.0	**8.5E-05**
722.5	**5.5E-05**
765.0	**3.6E-05**
807.5	**2.3E-05**
850.0	**1.5E-05**

Site being assessed:	Blessington
Completed by	AJ
Date	23 11 2005
Version	11

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 25-07-2013:17:59:51

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

	Variable	Value	Unit	Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	1.27E-01	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	7.00E+00	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*

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	$K_{ex,n}$		l/kg
Sorption coefficient for ionised species	$K_{ex,i}$		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

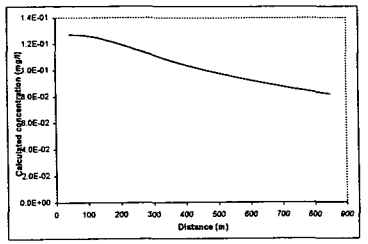
Xu & Eckstein (1995) report $ax = 0.83(\log_{10}x)^{2.414}$; az = ax/10, ay = ax/100 are assumed

Calculated Parameters	Variable		
Groundwater *flow velocity*	v	*2.69E-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	3.20E-03	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	8.16E-02	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	7.82E-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-03	mg/l	For comparison with measured groundwater concentration.
Ogata Banks				
Distance to compliance point		850	m	
Concentration of contaminant at compliance point	$C_{ED}/C0$	8.16E-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.



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

From Calculation sheet

Distance	Concentration
	mg/l
42.6	1.3E-01
85.0	1.3E-01
127.5	**1.2E-01**
170.0	1.2E-01
255.0	**1.2E-01**
297.5	**1.1E-01**
340.0	**1.1E-01**
382.6	1.1E-01
425.0	1.0E-01
467.5	1.0E-01
510.0	**9.7E-02**
552.5	9.5E-02
595.5	**9.3E-02**
680.0	8.9E-02
722.5	8.7E-02
765.0	**8.5E-02**
850.0	
	8.2E-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	Blessington
Completed by:	AJ
Date:	23 11 2005
Version	1

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 25-07-2013:17:59:52

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

				Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_o	4.67E-01	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	7.00E+00	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	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	7.24E+00	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for ionised 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

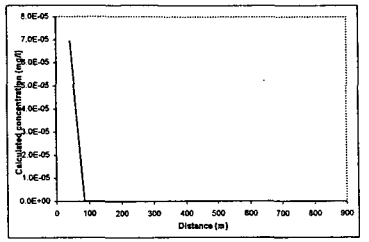
Calculated Parameters | Variable

Groundwater flow velocity	v	2.69E-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	3.92E-03	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{EO}	8.73E-78	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{EO}	8.36E-78	mg/l
Attenuation factor (one way vertical dispersion, C_O/C_{EO})	AF	5.35E+76	
Attenuation factor (two way vertical dispersion, C_O/C_{EO})	AF	5.58E+76	

Remedial Targets

Remedial Target Ogata Banks	LTC3	8.35E+73	mg/l	For comparison with measured groundwater concentration.
Distance to compliance point		850	m	
Concentration of contaminant at compliance point	$C_{EO}/C0$	8.73E-78	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.

Site being assessed:	Blessington
Completed by:	AJ
Date:	23 11 2005
Version:	11

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration
	mg/l
42.6	7.0E-05
85.0	1.0E-08
127.5	1.5E-12
170.0	2.2E-16
212.5	3.2E-20
255.0	4.6E-24
297.5	6.7E-28
382.5	1.4E-35
425.5	2.9E-43
510.0	4.3E-47
595.5	9.0E-55
637.6	1.3E-58
680.0	1.9E-62
722.5	2.8E-66
765.0	4.1E-70
807.5	6.0E-74
850.0	8.7E-78

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 25-07-2013:17:59:52

EPA Export 25-07-2013:17:59:52

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	4.00E-02	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	7.00E+00	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*

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		1.11E+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

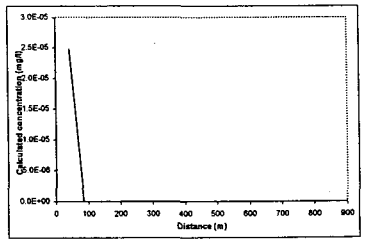
Xu & Eckstein (1995) report $ax = 0.83(\log_{10}x)^{2.414}$; az = ax/10, ay = ax/100 are assumed

Calculated Parameters	Variable		
Groundwater flow velocity	v	2.69E-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	1.36E-01	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{z0}	1.88E-66	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{z0}	1.80E-66	mg/l
Attenuation factor (one way vertical dispersion, C_0/C_{z0})	AF	2.13E+64	
Attenuation factor (two way vertical dispersion, C_0/C_{z0})	AF	2.22E+64	

Remedial Targets

Remedial Target Ogata Banks	LTCS	1.00E+01	mg/l	For comparison with measured groundwater concentration.
Distance to compliance point		850	m	
Concentration of contaminant at compliance point	$C_{z0}/C0$	1.88E-66	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
42.5	2.5E-05
85.0	1.5E-08
127.5	9.4E-12
170.0	5.7E-15
212.5	3.5E-18
255.0	2.1E-21
297.5	1.3E-24
340.0	7.6E-28
382.5	4.6E-31
425.0	2.8E-34
467.5	1.7E-37
510.0	1.0E-40
552.5	6.1E-44
595.0	3.7E-47
637.5	2.3E-50
680.0	1.4E-53
722.5	8.3E-57
765.0	5.1E-60
807.5	3.1E-63
850.0	1.9E-66

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:	Blessington
Completed by:	AJ
Date:	23 11 2005
Version:	11

Consent of copyright owner required for any other use.
For inspection purposes only.

R&D Publication20 Remedial Targets Worksheet, Release 2.2a

Tier 3 - Groundwater

ENVIRONMENT AGENCY

Input Parameters (using pulldown 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_o	5.60E-02	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	7.00E+00	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

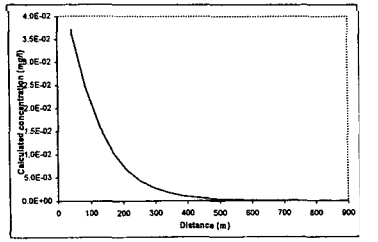
Calculated Parameters

	Variable		
Groundwater flow velocity	v	2.69E-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	8.98E-02	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	9.65E-06	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	9.25E-06	mg/l
Attenuation factor (one way vertical dispersion, C_O/C_{ED})	AF	5.80E+03	
Attenuation factor (two way vertical dispersion, C_O/C_{ED})	AF	6.05E+03	

Remedial Targets

Remedial Target	LTCS	5.90E+00	mg/l	For comparison with measured groundwater concentration.
Ogata Banks				
Distance to compliance point		850	m	
Concentration of contaminant at compliance point	$C_{ED}/C0$	9.65E-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



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	3.7E-02
85.0	2.6E-02
127.6	1.6E-02
210.6	6.9E-03
255.0	4.3E-03
297.5	2.8E-03
340.0	1.8E-03
382.5	1.1E-03
425.0	7.4E-04
461.6	4.8E-04
610.0	3.1E-04
552.5	2.0E-04
636.0	1.3E-04
680.9	8.4E-05
722.5	3.6E-05
765.0	2.3E-05
807.5	1.5E-05
850.0	9.7E-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
Completed by:	AJ
Date:	23 11 2005
Version:	11

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 25-07-2013:17:59:52

R&D Publication20 Remedial Targets Worksheet, Release 2.2a

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	8.90E-02	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	7.00E+00	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 [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		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 = az/100 are assumed

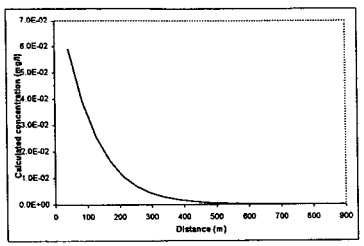
Calculated Parameters | Variable

Groundwater flow velocity	v	2.69E-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	8.99E-02	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	1.54E-05	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	1.47E-05	mg/l
Attenuation factor (one way vertical dispersion, C_0/C_{ED})	AF	5.80E+03	
Attenuation factor (two way vertical dispersion, C_0/C_{ED})	AF	6.05E+03	

Remedial Targets

Remedial Target Ogata Banks	LTC3	8.90E-03	mg/l	For comparison with measured groundwater concentration.
Distance to compliance point		850	m	
Concentration of contaminant at compliance point	$C_{ED}/C0$	1.64E-05	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.

Site being assessed:	Blessington
Completed by	AJ
Date	23 11 2005
Version	11

Calculated concentrations for distance-concentration graph

Ogata Banks
Distance | Calculated concentration

Distance	mg/l
42.6	5.9E-02
86.0	3.9E-02
129.6	1.8E-02
258.6	6.9E-03
343.8	6.6E-03
382.5	1.8E-03
425.0	1.2E-03
467.5	7.0E-M
510.0	4.9E-04
662.6	3.2E-04
595.0	2.1E-04
630.8	8.6E-05
722.5	5.6E-05
765.0	3.6E-05
807.5	2.4E-05
850.0	1.5E-05

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 25-07-2013:17:59:52

Simple hydrogeological calculations

(These are not specific to, or required in, the Remedial Targets Methodology)

Parameter	symbol		unit	justification
Hydraulic conductivity	K	8.10E-05	m/s	
Hydraulic gradient	i	7.00E-03	unitless	
Effective porosity of aquifer	n	1.82E-01	fraction	
Thickness of saturated aquifer	b	5.60E+01	m	
Width of aquifer perpendicular to flow	w	8.00E+01	m	
Distance to receptor	x	8.50E+02	m	
Density of stratum	ρ	1.70E+00	g/cm^3	
Soil-water partition co-efficient	Kd	9.55E+00	l/kg	
Retardation factor of pollutant	R	90.20236264		

Groundwater flow velocity	v(GW)	3.12E-06	m/s	2.69E-01	m/day	9.82E+01	m/year
Time for groundwater to reach receptor	t(GW)	2.73E+08	seconds	3.16E+03	days	8.65E+00	years
Rate of groundwater flow through aquifer	Q	2.54E-03	m^3/s	2.19E+02	m^3/day	8.01E+04	m^3/year
Contaminant flow velocity	v(contam)	3.45E-08	m/s	2.98E-03	m/day	1.09E+00	m/year
Time for contaminant to reach receptor	t(contam)	2.46E+10	seconds	2.85E+05	days	7.80E+02	years

Consent of copyright owner required for any other use.
For inspection purposes only.

EPA Export 25-07-2013:17:59:52

Simple hydrogeological calculations

(These are not specific to, or required in, the Remedial Targets Methodology)

Parameter	symbol		unit	justification
Hydraulic conductivity	K	8.10E-05	mls	
Hydraulic gradient	i	7.00E-03	unitless	
Effective porosity of aquifer	n	1.82E-01	fraction	
Thickness of saturated aquifer	b	5.60E+01	m	
Width of aquifer perpendicular to flow	w	8.00E+01	m	
Distance to receptor	x	8.50E+02	m	
Density of stratum	ρ	1.70E+00	g/cm^3	
Soil-water partition co-efficient	Kd	0.00E+00	l/kg	
Retardation factor of pollutant	R	1		

Groundwater flow velocity	v(GW)	3.12E-06	m/s	2.69E-01	m/day	9.82E+01	m/year
Time for groundwater to reach receptor	t(GW)	2.73E+08	seconds				
Rate of groundwater flow through aquifer	Q	2.54E-03	m^3/s	2.19E+02	m^3/day	8.01E+04	$m^3/year$
Contaminant flow velocity	v(contam)	3.12E-06	m/s	2.69E-01	m/day	9.82E+01	m/year
Time for contaminant to reach receptor	t(contam)	2.73E+08	seconds	3.16E+03	days	8.65E+00	years

Consent of copyright owner required for any other use.
For inspection purposes only.

EPA Export 25-07-2013:17:59:52

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 | 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	4.61E-01	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	7.00E+00	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*

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 | $K_{ac\,a}$ | | l/kg
Sorption coefficient for ionised species | $K_{ac\,i}$ | | 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 = az/100 are assumed

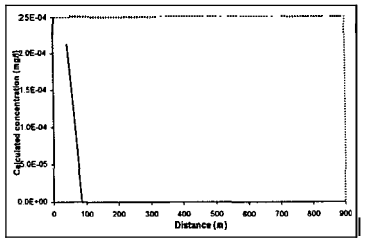
Calculated Parameters | Variable

Groundwater flow velocity	v	2.69E-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	6.07E-03	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	5.89E-68	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	5.64E-68	mg/l
Attenuation factor (one way vertical dispersion, C_0/C_{ED})	AF	7.83E+66	
Attenuation factor (two way vertical dispersion, C_0/C_{ED})	AF	8.17E+66	

Remedial Targets

Remedial Target Ogata Banks	LTC3	3.92E+65	mg/l	For comparison with measured groundwater concentration.
Distance to compliance point		850	m	
Concentration of contaminant at compliance point after	$C_{ED}/C0$	5.89E-68	mg/l	Ogata Banks
		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
42.5	2 mg/l
85.0	9.8E-08
129.0	8.8E-14
212.6	9.1E-18
255.0	4.1E-21
297.6	1.8E-24
340.0	8.2E-28
382.5	3.7E-31
425.0	1.7E-34
487.6	7.5E-38
510.0	3.4E-41
662.6	1.5E-44
696.0	6.8E-48
017.6	3.1E-51
680.0	1.4E-54
722.5	6.3E-58
766.0	2.9E-61
807.6	1.3E-64
850.0	5.9E-68

Site being assessed:	Blessington
Completed by:	AJ
Date:	23.11.2005
Version	1.1

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 25-07-2013:17:59:52

Simple hydrogeological calculations

(These are not specific to, or required in, the Remedial Targets Methodology)

Parameter	symbol		unit	justification
Hydraulic conductivity	K	8.10E-05	m/s	
Hydraulic gradient	i	7.00E-03	unitless	
Effective porosity of aquifer	n	1.82E-01	fraction	
Thickness of saturated aquifer	b	5.60E+01	m	
Width of aquifer perpendicular to flow	w	8.00E+01	m	
Distance to receptor	x	8.50E+02	m	
Density of stratum	ρ	1.70E+00	g/cm^3	
Soil-water partition co-efficient	Kd	0.00E+00	l/kg	
Retardation factor of pollutant	R	1		

Groundwater flow velocity	v(GW)	3.12E-06	m/s	2.69E-01	m/day	9.82E+01	m/year
Time for groundwater to reach receptor	t(GW)	2.73E+08	seconds	3.16E+03	days	8.65E+00	years
Rate of groundwater flow through aquifer	Q	2.54E-03	m^3/s	2.19E+02	m^3/day	8.01E+04	m^3/year
*Contaminant flow velocity	v(contam)	3.12E-06	m/s	2.69E-01	m/day	9.82E+01	m/year
Time for contaminant to reach receptor	t(contam)	2.73E+08	seconds	3.16E+03	days	8.65E+00	years

Consent of copyright owner required for any other use.
For inspection purposes only.

EPA Export 25-07-2013:17:59:52

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 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

				Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	9.60E-02	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	7.00E+00	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 — [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

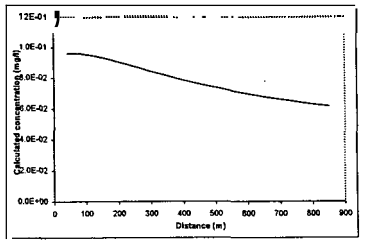
Xu & Eckstein (1995) report $ax = 0.83(\log_{10}x)^{2.414}$; az = ax/10, ay = ax/100 are assumed

Calculated Parameters	Variable		
Groundwater flow velocity	v	2.69E-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	8.99E-02	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	6.17E-02	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	5.91E-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-03	mg/l	For comparison with measured groundwater concentration.
Ogata Banks				
Distance to compliance point		850	m	
Concentration of contaminant at compliance point	$C_{ED}/C0$	6.17E-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.



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

Site being assessed	Blessington
Completed by	AJ
Date	23.11.2005
Version	11

Calculated concentrations for distance-concentration graph

Ogata Banks Biotransic Concentration

	mg/l
42.6	9.6E-02
[redacted]	9.6E-02
110.0	9.2E-02
212.6	9.0E-02
255.0	8.7E-02
297.6	8.4E-02
340.0	8.2E-02
382.5	8.0E-02
425.0	7.7E-02
467.6	7.6E-02
510.0	7.3E-02
662.6	7.2E-02
595.0	1.0E-02
637.5	6.8E-02
[redacted]	6.6E-02
765.0	6.4E-02
807.5	0.0E-02
850.0	6.2E-02

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 25-07-2013:17:59:52

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		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	1.40E-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	7.00E+00	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 ionised 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

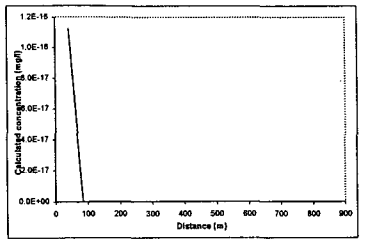
Calculated Parameters	Variable		
Groundwater flow velocity	v	2.69E-01	m/d
Retardation factor	Rf	9.35E+01	fraction
Decay rate used	λ	2.38E-02	d^{-1}
Rate of contaminant flow due to retardation	u	2.88E-03	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	#NUM!	mg/l
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
Ogata Banks				
Distance to compliance point			850	m
Concentration of contaminant at compliance point	$C_{ED}/C0$		#NUM!	mg/l
after			9.9E+99	**days**

For comparison with measured groundwater concentration.

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
42.5	1.7E-16
85.0	9.0E-32
127.6	7.2E-47
170.1	6.8E-62
212.6	
255.0	3.4E-92
297.6	2.7E-107
340.0	2.1E-122
382.6	1.6E-137
426.0	1.3E-152
467.5	1.0E-167
510.0	7.9E-183
552.6	6.2E-198
595.0	4.8E-213
637.5	3.8E-228
680.0	3.0E-243
722.6	2.4E-258
765.0	1.9E-273
807.6	#NUM!
850.0	#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	Blessington area 6
Completed by:	Anna Jeffcoat
Date:	23 11 2005
Version	11

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 25-07-2013:17:59:52

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		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	2.60E-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		1.82E-01	fraction	
Hydraulic gradient	i	7.00E-03	fraction	
Hydraulic conductivity of aquifer	K	7.00E+00	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	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	$K_{oc\,s}$	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

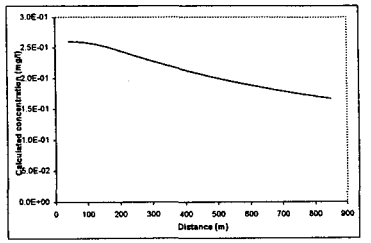
Calculated Parameters

	Variable		
Groundwater flow velocity	v	2.69E-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	2.69E-01	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{E0}	1.67E-01	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	1.60E-01	mg/l
Attenuation factor (one way vertical dispersion, C_0/C_{E0})	AF	1.56E+00	
Attenuation factor (two way vertical dispersion, C_0/C_{ED})	AF	1.62E+00	

Remedial Targets

Remedial Target Ogata Banks	LTC3	1.56E-01	mg/l	For comparison with measured groundwater concentration.
Distance to compliance point		850	m	
Concentration of contaminant at compliance point	$C_{ED}/C0$	1.67E-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



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

Site being assessed:	Blessington area 6
Completed by:	Anna Jeffcoat
Date:	23 11 2005
Version:	11

Calculated concentrations for distance-concentration graph

Ogata Banks calculation sheet

Distance	Concentration
42.6	2.mg/l1
85.0	2.6E-01
127.6	2.6E-01
170.0	2.5E-01
212.6	2.4E-01
255.0	2.4E-01
340.0	2.3E-01
385.0	2.2E-01
U7.6	2.0E-01
610.0	2.0E-01
662.6	1.9E-01
696.0	1.9E-01
637.5	1.9E-01
680.0	1.8E-M
722.6	1.8E-01
765.0	1.7E-01
607.6	1.7E-01
850.0	1.7E-01

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 25-07-2013:17:59:52

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 of parameter value

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

Initial contaminant concentration in groundwater at plume core	C_o	1.04E-01	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	7.00E+00	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*

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

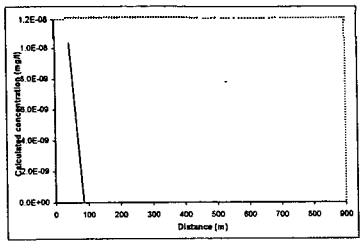
Calculated Parameters | Variable

Groundwater flow velocity	v	2.69E-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	9.73E-04	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	6.47E-142	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	6.20E-142	mg/l
Attenuation factor (one way vertical dispersion, C_O/C_{ED})	AF	1.61E+140	
Attenuation factor (two way vertical dispersion, C_O/C_{ED})	AF	1.68E+140	

Remedial Targets

Remedial Target LTC3		1.61E+139	mg/l	For comparison with measured groundwater concentration.
Ogata Banks				
Distance to compliance point		**850**	**m**	
Concentration of contaminant at compliance point	$C_{ED}/C0$	**6.47E-142**	**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.

Site being assessed:	Blessington
Completed by:	AJ
Date:	23 11 2005
Version	11

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration
	mg/l
42.6	1.0E-08
85.0	1.0E-15
127.6	9.8E-32
212.5	9.6E-37
255.0	9.3E-44
297.5	9.0E-51
340.0	8.5E-58
382.6	8.5E-65
426.0	8.3E-72
467.5	8.0E-79
510.0	7.8E-86
552.5	7.6E-93
595.0	7.4E-100
680.0	7.1E-114
722.5	6.9E-121
807.6	6.6E-135
850.0	6.5E-142

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 25-07-2013:17:59:52

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

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

					Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	2.39E-01	mg/l		
Half life for degradation of contaminant in water	$t_{1/2}$	3.80E+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	7.00E+00	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*	

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	$K_{w,n}$		l/kg
Sorption coefficient for ionised species	$K_{w,i}$		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

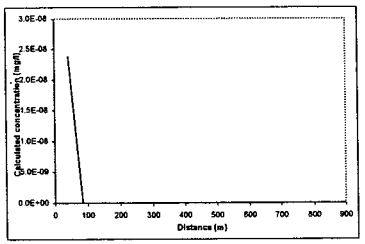
Calculated Parameters | Variable

Groundwater flow velocity	v	2.69E-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	9.73E-04	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	1.49E-141	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	1.42E-141	mg/l
Attenuation factor (one way vertical dispersion, C_0/C_{ED})	AF	1.61E+140	
Attenuation factor (two way vertical dispersion, C_0/C_{ED})	AF	1.68E+140	

Remedial Targets

Remedial Target Ogata Banks	LTCS	1.61E+139	mg/l	For comparison with measured groundwater concentration.	
Distance to compliance point		850	m		
Concentration of contaminant at compliance point after	$C_{ED}/C0$	1.49E-141 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.



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
88.6	2.4E-15
111.6	LIE-22
170.0	2.3E-29
212.6	2.2E-36
255.0	2.1E-43
297.6	2.1E-50
340.0	2.0E-57
382.6	2.0E-64
425.0	1.9E-76
510.0	1.8E-85
552.6	1.7E-92
595.0	1.7E-99
637.5	1.7E-106
((10.0	1.6E-113
722.6	1.6E-120
765.0	1.5E-127
865.0	1.5E-134

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
Completed by:	AJ
Date:	23 11 2005
Version	11

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 25-07-2013:17:59:52

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

EMU'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_o	2.10E-01	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	7.00E+00	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*

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

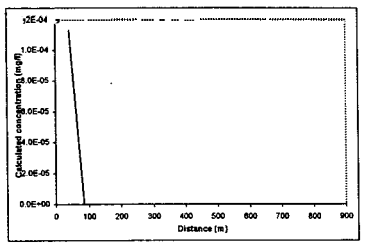
For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report ax = $0.83(\log_{10}x)^{2.414}$; az = ax/10, ay = ax/100 are assumed

Calculated Parameters	Variable		
Groundwater flow velocity	v	2.69E-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	3.66E-03	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	5.77E-67	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	5.53E-67	mg/l
Attenuation factor (one way vertical dispersion, C_O/C_{ED})	AF	3.64E+65	
Attenuation factor (two way vertical dispersion, C_O/C_{ED})	AF	3.79E+65	

Remedial Targets

Remedial Target Ogata Banks	LTCS	3.84E+63	mg/l	For comparison with measured groundwater concentration.
Distance to compliance point		850	m	
Concentration of contaminant at compliance point	$C_{ED}/C0$	5.77E-67	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.E+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

Site being assessed:	Blessington
Completed by:	AJ
Date:	23 11 2005
Version	11

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration
	mg/l
42.6	1.1E-04
85.0	6.1E-08
127.6	3.2E-11
110.0	1.7E-14
2126	8.9E-18
266.0	4.7E-21
340.8	1.3E-27
382.6	3.5E-34
481.6	1.8E-37
510.0	9.7E-41
552.6	5.1E-44
595.0	2.7E-47
637.5	1.4E-50
680.0	7.4E-54
722.5	3.9E-57
706.0	2.1E-60
807.5	1.1E-63
850.0	5.8E-67

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 25-07-2013:17:59:52

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

				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	7.00E+00	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*

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	$K_{wc\,n}$		l/kg
Sorption coefficient for ionised species	$K_{wc\,i}$		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

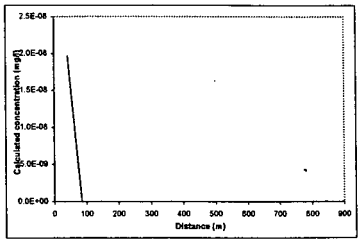
Xu & Eckstein (1995) report $ax = 0.83(\log_{10}x)^{2.414}$; az = ax/10, ay = ax/100 are assumed

Calculated Parameters	Variable		
Groundwater flow velocity	v	2.69E-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	2.51E-04	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	3.05E-123	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}	2.92E-123	mg/l
Attenuation factor (one way vertical dispersion, C_0/C_{ED})	AF	6.95E+120	
Attenuation factor (two way vertical dispersion, C_0/C_{ED})	AF	7.25E+120	

Remedial Targets

Remedial Target Ogata Banks	LTC3	4.96E+117	mg/l	For comparison with measured groundwater concentration.
Distance to compliance point		**850**	**m**	
Concentration of contaminant at compliance point	$C_{ED}/C0$	**3.05E-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.



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+9

Calculated concentrations for distance-concentration graph

Ogata Banks

Distance	Concentration
	mg/l
42.5	**2.0E-08**
85.0	**1.8E-14**
127.6	1.7E-20
170.0	**1.5E-26**
212.5	**1.4E-32**
255.0	**1.2E-38**
297.6	1.1E-44
340.0	**1.0E-50**
382.5	**9.0E-57**
425.0	**8.1E-63**
487.6	7.3E-69
510.0	**6.6E-75**
552.5	**6.0E-81**
595.0	**5.4E-87**
637.5	4.9E-93
680.0	**4.5E-99**
722.5	**4.1E-105**
716.0	3.7E-111
807.5	3.4E-117
850.0	**3.1E-123**

Site being assessed:	Blessington area 6
Completed by	Anna Jeffcoat
Date:	23 11 2005
Version	11

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 25-07-2013:17:59:52