

Appendices D - E



Appendix D. Model Input Values and Model Runs

D.1. Model Inputs

RTM Worksheet - Site Specific Assessment Chemical Parameter Inputs



Site Information									
Site Name: NGET Tottenham									
Site Address:									
Contaminant	Total Ammonium	Total Cyanide	Chloride	Naphthalene	Anthracene	Fluoranthene	Benzo(a)pyrene	Ethylbenzene	Phenol
Target Concentration (mg/L), C_T	0.26	0.05	250	0.001	0.00001	0.0000063	0.00000017	0.3	0.0077
Target Concentration Reference	Lowest of DWS/EQS	Lowest of DWS/EQS	Lowest of DWS/EQS	Lowest of DWS/EQS	Lowest of DWS/EQS	Lowest of DWS/EQS	Lowest of DWS/EQS	Lowest of DWS/EQS	Lowest of DWS/EQS
Kd Derivation Option	User Defined	User Defined	User Defined	Calculate	Calculate	Calculate	Calculate	Calculate	Calculate
Henry's Law Constant	0.0000781	4.18E-11	#N/A	0.225	0.0016	0.000417	0.0000186	0.358	0.0000262
Henry's Law Constant Reference No.	81	#N/A	#N/A	83	83	83	83	83	86
Henry's Law Constant Reference	Transport of Ammonium in aquifers: retardation and degradation (Erskine, QJEG 00, 2000)	#N/A	#N/A	TPH Criteria Working Group Series, Volume 3: Selection of Representative TPH Fractions based on Fate and Transport Considerations	TPH Criteria Working Group Series, Volume 3: Selection of Representative TPH Fractions based on Fate and Transport Considerations	TPH Criteria Working Group Series, Volume 3: Selection of Representative TPH Fractions based on Fate and Transport Considerations	TPH Criteria Working Group Series, Volume 3: Selection of Representative TPH Fractions based on Fate and Transport Considerations	TPH Criteria Working Group Series, Volume 3: Selection of Representative TPH Fractions based on Fate and Transport Considerations	Environment Agency, 2008 (Martin, I & Cowie, C). Compilation of data for priority organic pollutants for derivation of soil guideline values. Science report SC050021/SR7
Soil/Water Partition Coefficient (Kd)	1	9.9	1						
Soil/Water Partition Coefficient	96	96	#N/A						
Soil/Water Partition Coefficient Reference	#N/A	#N/A	#N/A						
Organic Carbon Partition Coefficient				81.2	7690	27800	131000	537	83
Organic Carbon Partition Coefficient				83	83	83	83	83	86
Organic Carbon Partition Coefficient Reference				TPH Criteria Working Group Series, Volume 3: Selection of Representative TPH Fractions based on Fate and Transport Considerations	TPH Criteria Working Group Series, Volume 3: Selection of Representative TPH Fractions based on Fate and Transport Considerations	TPH Criteria Working Group Series, Volume 3: Selection of Representative TPH Fractions based on Fate and Transport Considerations	TPH Criteria Working Group Series, Volume 3: Selection of Representative TPH Fractions based on Fate and Transport Considerations	TPH Criteria Working Group Series, Volume 3: Selection of Representative TPH Fractions based on Fate and Transport Considerations	Environment Agency, 2008 (Martin, I & Cowie, C). Compilation of data for priority organic pollutants for derivation of soil guideline values. Science report
Half-life (days)	2190	365	9E+99	350	920	880	4500	200	100
Half-life Reference No.	81	90	#N/A	77	79	79	76	77	79
Half-life Reference	Transport of Ammonium in aquifers: retardation and degradation (Erskine, QJEG 00, 2000)	The Chemistry and Treatment of Cyanidation Wastes. Adrian Smith and Terry Mudder. Mining Journal Books Limited, London, p293.	#N/A	The Effects of Contaminant Concentration on the Potential for Natural Attenuation R & D Technical Report P2-228/TR	Howard, P. H., Boethling, R. S., Jarvis, W. F., Meylan, W. M. & Michalenko, E. M. (1991) Handbook of environmental degradation rates. Chelsea, michigan. Lewis Publishers.	Howard, P. H., Boethling, R. S., Jarvis, W. F., Meylan, W. M. & Michalenko, E. M. (1991) Handbook of environmental degradation rates. Chelsea, michigan. Lewis Publishers.	Polycyclic Aromatic Hydrocarbons (PAH): Priorities for Environmental Quality Standard Development R & D Technical Report P45	The Effects of Contaminant Concentration on the Potential for Natural Attenuation R & D Technical Report P2-228/TR	Howard, P. H., Boethling, R. S., Jarvis, W. F., Meylan, W. M. & Michalenko, E. M. (1991) Handbook of environmental degradation rates. Chelsea, michigan. Lewis Publishers.

Numerical references within this summary table reference the RTM worksheets

RTM Worksheet - Site Specific Assessment Physical Paramter Inputs

Site Information			
Site Name: NGET Tottenham			
Site Address:			
Site Parameters	Units	Inputs	Source of data
Level 1 Soil Source			
1.1 Water filled soil porosity	fraction	0.37	Conservative value estimated from average site moisture content values
1.2 Air filled soil porosity	fraction	0.19	Conservative value estimated from average site moisture content values
1.3 Bulk density of soil zone material	g/cm3	1.6	Conservative Estimate for Made Ground
1.4 Fraction organic carbon (in soil)	frac.	0.08	Average from uncontaminated site samples
Level 2 Soil Source			
2.1 Infiltration	m/d	0.00073973	Effective rainfall calculated from EA effective infiltration mapping and 80% hardstanding cover of site
2.2 Area of contaminant source	m2	12500	Length x width of site (50x250)
2.3 Length of contaminant source in direction of groundwater flow	m	50	Approximate lenght of site in direction of GW flow (north/south)
2.4 Saturated aquifer thickness	m	2.54	Average thickness of Kempton Park Gravel based on BH logs + WP data
2.5 Hydraulic Conductivity of aquifer in which dilution occurs	m/d	10	WP 2013 value for KPG
2.6 Hydraulic gradient of water table	-	0.002	Based on average of site-specific GW measurements (SSE groundwater flow) - 0.0005 - 0.002 between site and off site locations near Pymmes brook. On site locations suggest 0.004-0.005 though site orientation/shape not ideal for calcaultions
2.7 Width of contaminant source perpendicular to groundwater flow	m	250	Approximate site area perpendicular to GW flow (north-east/south-west)
2.8 Calculated / Specified Mixing	-	Calculate	default condition
2.9 Enter mixing zone (specified only) - Must be less than saturated thickness	m		
Level 3			
3.1 Analytical solution	-	Ogata Banks	
3.2 Approach for simulating degradation of pollutants:	-	Apply degradation rate to dissolved pollutants only	
Level 3 Soil Source			
3.4 Bulk density of aquifer materials	g/cm3	1.8	Literature estimate for RTD
3.5 Effective porosity of aquifer	fraction	0.2	Literature estimate for RTD
3.6 Distance to compliance point	m	30	Default for aquifer protection
3.7 Distance (lateral) to compliance point perpendicular to flow direction	m	0	default condition
3.8 Distance (depth) to compliance point perpendicular to flow direction	m	0	default condition
3.9 Time since pollutant entered groundwater	d	9.99E+99	steady state
3.10 Fraction organic carbon (in aquifer)	frac.	0.004	Average of unsaturated samples
3.11 Dispersivity options	-	User defined values for dispersivity	
3.12 Longitudinal dispersivity	m	3	10% of pathway
3.13 Transverse dispersivity	m	0.3	1% of pathway
3.14 Vertical dispersivity	m	1E-99	No dispersivity
Level 3 Groundwater Source			
3.1 Choose analytical solution	-	Ogata Banks	
3.2 Approach for simulating vertical dispersion	-	Simulate vertical dispersion in 1 direction	
3.3 Approach for simulating degradation of pollutants:	-	Apply degradation rate to dissolved pollutants only	
3.4 Use the calculated value of Sy from Level 2 Soil		Yes	
3.4 Width of plume in aquifer at source (perpendicular to flow)	m	250	
3.5 Plume thickness at source	m		

D.2. Model Runs



Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

This worksheet has been produced in combination with the document 'Remedial Targets Methodology: Hydrogeological risk assessment for land contamination (Environment Agency 2006).

Users of this worksheet should always refer to the User Manual to the Remedial Targets Methodology and to relevant guidance on UK legislation and policy, in order to understand how this procedure should be applied in an appropriate context.

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

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

<u>Details to be completed for each assessment</u>			
Site Name:	NGET Tottenham		
Site Address:			
Completed by:	M Craske	Version:	x.xx
Date:	27-Oct-23		
Contaminant	Anthracene		
Target Concentration (C_T)	0.000559009	mg/l	Origin of C_T: Lowest of DWS/EQS

This worksheet can be used to determine remedial targets for soils (Worksheets Level 1 Soil, Level 2 and Level 3 Soil) or to determine remedial targets for groundwater (Level 3 Groundwater). For Level 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 comparison 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 Level 1, 2 and 3 Worksheets.

Worksheet options are identified by brown background and employ a pull-down menus. Data entry are identified as blue background.

Data origin / justification should be noted in cells coloured yellow and fully documented in subsequent reports.

Data carried forward from an earlier worksheet are identified by a light green background

It is recommended that a copy of the original worksheet is saved (all data fields in the original copy are blank).

The spreadsheet also includes a porosity calculation worksheet, a soil impact calculation worksheet and a worksheet that performs some simple hydrogeological calculations.

Level 1 - Soil

Select the method of calculating the soil water
Partition Co-efficient by using the pull down menu
below

Calculate for non-polar organic chemicals

Contaminant	Anthracene
Target concentration	0.000559009 mg/l

Input Parameters

Standard entry

Water filled soil porosity	θ_w	$3.70E-01$	fraction	Conservative value estimated from average site mo
Air filled soil porosity	θ_a	$1.90E-01$	fraction	Conservative value estimated from average site mo
Bulk density of soil zone material	ρ	$1.60E+00$	g/cm ³	Conservative Estimate for Made Ground
Henry's Law constant	H	$1.60E-03$	dimensionless	83

This sheet calculates the Level 1 remedial target for soils(mg/kg) based on a selected target concentration and theoretical calculation of soil water partitioning. Three options are included for determinina the partition coefficient. The measured soil concentration as mg/kg should be compared with the Level 1 remedial target to determine the need for further action.

Entry if specify partition coefficient (option)

Soil water partition coefficient	Kd		l/kg	$3.10E+01$
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Entry for non-polar organic chemicals (option)

Fraction of organic carbon (in soil)	foc	$8.00E-02$	fraction	Average from uncontaminated site samples
Organic carbon partition coefficient	Koc	$7.69E+03$	l/kg	83

Entry for ionic organic chemicals (option)

Sorption coefficient for neutral species	$K_{oc,n}$		l/kg	
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg	
pH value	pH		pH units	
Acid dissociation constant	pKa			
Fraction of organic carbon (in soil)	foc		fraction	

Soil water partition coefficient used in Level Assessment	Kd	$6.15E+02$	l/kg	Calculated value
---	----	------------	------	------------------

Level 1 Remedial Target

Level 1 Remedial Target	$3.44E-01$	mg/kg	(for comparison with soil analyses)
	or		
	0.000559009	mg/l	(for comparison with leachate test results)

Site being assessed:	NGET Tottenham
Completed by:	M Craske
Date:	27-Oct-23
Version:	x.xx



Level 2 - Soil

Contaminant
Target concentration

C_T

Anthracene
0.000559009

mg/l

from Level 1
from Level 1

This sheet calculates the Level 2 remedial target for soils (mg/kg) or for pore water (mg/l).

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 2 remedial target to determine the need for further action. Equations presented in 'Hydrogeological risk assessment for land contamination' (Environment Agency 2006)

Input Parameters

Variable

Value

Unit

Source of parameter value

Standard entry

Infiltration
Area of contaminant source

Inf
A

7.40E-04
1.25E+04

m/d
m²

ted from EA effective infiltration mapping and 80% ha
Length x width of site (50x250)

Not used in calculation

Entry for groundwater flow below site

Length of contaminant source in direction of groundwater flow
Saturated aquifer thickness
Hydraulic Conductivity of aquifer in which dilution occurs
Hydraulic gradient of water table
Width of contaminant source perpendicular to groundwater flow
Background concentration of contaminant in groundwater beneath site

L
da
K
i
w
Cu

5.00E+01
2.54E+00
1.00E+01
2.00E-03
2.50E+02
0.00E+00

m
m
m/d
fraction
m
mg/l

oximate lenght of site in direction of GW flow (north/s
thickness of Kempton Park Gravel based on BH logs +
WP 2013 value for KPG
between site and off site locations near Pymmes brook
ate site area perpendicular to GW flow (north-east/so

Not used in calculation

Define mixing zone depth by specifying or calculating depth (using pull down list)

Enter mixing zone thickness
Calculated mixing zone thickness

Mz
Mz

Calculate
2.54E+00

m
m

default condition

Calculated Parameters

Dilution Factor	DF	2.37E+00
Level 2 Remedial Target		1.33E-03 or 8.17E-01
		mg/l mg/kg

For comparison with measured pore water concentration. This assumes Level 1 Remedial Target is based on Target Concentrati

For comparison with measured soil concentration. This assumes Level 1
Remedial Target calculated from soil-water

Additional option

Calculation of impact on receptor

Concentration of contaminant in contaminated discharge (entering receptor)

Cc

0.00E+00

mg/l

Calculated concentration within receptor (dilution only)

0.00E+00

mg/l

0

Site being assessed: NGET Tottenham
Completed by: M Craske
Date: 27-Oct-23
Version: x.xx

Remedial Targets Worksheet , Release 3.2

Level 3 - Soil

See Note



Input Parameters	Variable	Value	Unit	Source
Contaminant		Anthracene		from Level 1
Target Concentration	C _T	0.00001	mg/l	from Level 1
Dilution Factor	DF	2.37E+00		from Level 2

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

Ogata Banks	Equations in HRA publication
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Select nature of decay rate (click on brown cell below, then on pull-down menu)

Approach for simulating degradation of pollutants: Apply degradation rate to dissolved pollutants only

Variable	Value	Unit	Source of parameter value
Soil leachate concentration as mg/l			
Enter source concentration	0.1	mg/l	
Enter soil leachate concentration			
Half life for degradation of contaminant in water	t _{1/2}	9.20E+02 days	79
Calculated decay rate	λ	7.53E-04 days ⁻¹	calculated
Width of plume in aquifer at source	Sz	2.50E+02 m	from Level 2
Plume thickness in aquifer at source	Sy	2.54E+00 m	from Level 2
Bulk density of aquifer materials	ρ	1.80E+00 g/cm ³	Literature estimate for RTD
Effective porosity of aquifer	n	2.00E-01 fraction	Literature estimate for RTD
Hydraulic gradient	i	3.46E-03 fraction	from Level 2 (adjusted)
Hydraulic conductivity of saturated aquifer	K	1.00E+01 m/d	from Level 2
Distance (lateral) to compliance point perpendicular to flow direction	x	3.00E+01 m	Default for aquifer protection
Distance (depth) to compliance point perpendicular to flow direction	z		default condition
Time since pollutant entered groundwater	y		default condition
Time since pollutant entered groundwater	t	9.99E+99 days	time variant options only
Parameters values determined from options			
Partition coefficient	Kd	3.08E+01 l/kg	see options
Longitudinal dispersivity	ax	3.000 m	see options
Transverse dispersivity	az	0.300 m	see options
Vertical dispersivity	ay	0.000 m	see options

Parameter values should be checked against Level 1 and 2

Calculated Parameters

Variable			
Groundwater flow velocity	v	1.73E-01 m/d	
Retardation factor	Rf	2.78E+02 fraction	
Decay rate used	λ	2.71E-06 d ⁻¹	
Hydraulic gradient used in aquifer flow down-gradient	i	3.46E-03 fraction	
Rate of contaminant flow due to retardation	u	6.22E-04 m/d	
Ratio of Compliance Point to Source Concentration	C _{ED} /C ₀	8.79E-01 fraction	
Attenuation factor (C ₀ /C _{ED})	AF	1.14E+00 fraction	
Soil leachate concentration	Co	1.00E-01	

Remedial Targets

Level 3 Remedial Target	2.70E-05	mg/l	For comparison with measured pore water concentration.
Ogata Banks	or		This assumes Level 1 Remedial Target is based on Target Concentration.
	1.66E-02	mg/kg	For comparison with measured soil concentration. This
Distance to compliance point	30	m	assumes Level 1 Remedial Target calculated from soil-water partitioning equation.
Ratio of Compliance Point to Source Concentration	C _{ED} /C ₀	8.79E-01	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

Enter method of defining partition co-efficient (using pull down list)

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 4.00E-03 fraction

Organic carbon partition coefficient Koc 7.69E+03 l/kg

Entry for ionic organic chemicals (option)

Sorption coefficient for related species K_{oc,n} l/kg

Sorption coefficient for ionised species K_{oc,i} l/kg

pH value pH

Acid dissociation constant pKa

Fraction of organic carbon in aquifer foc fraction

Soil water partition coefficient Kd 3.08E+01 l/kg

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

User defined values for dispersivity

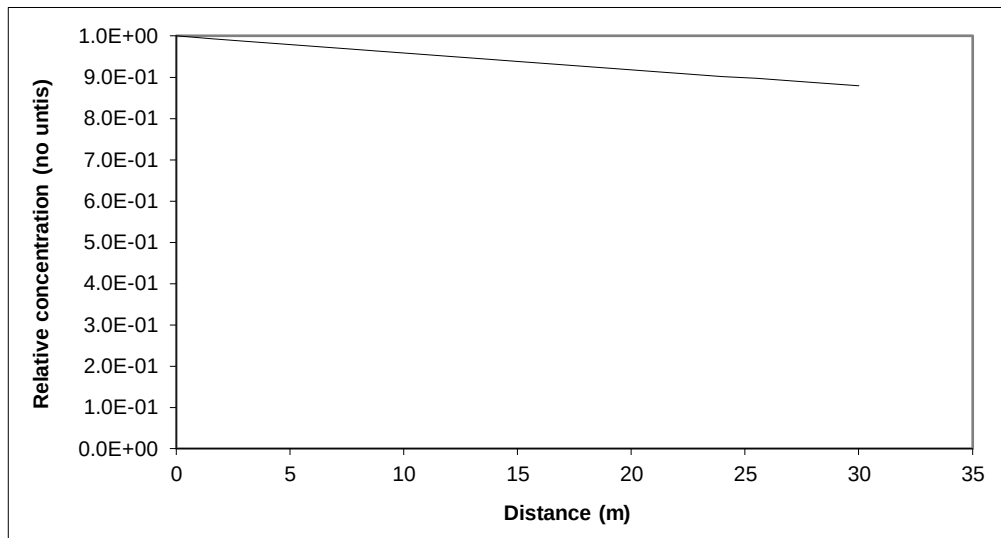
	Enter value	Calc value	Xu & Eckstein	
Longitudinal dispersivity	ax	3.00E+00	3.00E+00	2.13E+00 m
Transverse dispersivity	az	3.00E-01	3.00E-01	2.13E-01 m
Vertical dispersivity	ay	1.00E-99	3.00E-02	2.13E-02 m

Note values of dispersivity must be > 0

Xu & Eckstein (1995) report ax = 0.83(log₁₀x)^{2.414} ; az = ax/10, ay = ax/100 are assumed

Note

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



Note: 'Relative concentration' is the ratio of calculated concentration at a given position compared to the source concentration. The calculations assume plume disperses from the top of the aquifer. An alternative solution assuming the centre of the plume is located at the mid-depth of the aquifer is presented in the calculation sheets.

Calculated (relative) concentrations for distance-concentration graph

Ogata Banks

From calculation sheet

Distance	Relative concentration (No units)	Concentration mg/l
0	1.0E+00	4.21E-02
1.5	9.94E-01	4.19E-02
3.0	9.87E-01	4.16E-02
4.5	9.81E-01	4.13E-02
6.0	9.75E-01	4.11E-02
7.5	9.68E-01	4.08E-02
9.0	9.62E-01	4.05E-02
10.5	9.56E-01	4.03E-02
12.0	9.50E-01	4.00E-02
13.5	9.44E-01	3.98E-02
15.0	9.37E-01	3.95E-02
16.5	9.31E-01	3.92E-02
18.0	9.25E-01	3.90E-02
19.5	9.19E-01	3.87E-02
21.0	9.14E-01	3.85E-02
22.5	9.08E-01	3.82E-02
24.0	9.02E-01	3.80E-02
25.5	8.96E-01	3.78E-02
27.0	8.90E-01	3.75E-02
28.5	8.85E-01	3.73E-02
30.0	8.79E-01	3.70E-02

This sheet calculates the Level 3 remedial target for soils(mg/kg) or for pore water (mg/l), based on the distance to the receptor or compliance located down hydraulic gradient of the source Three solution methods are included, the preferred option is Ogata Banks.By setting a long travel time (e.g. 9E99) it will give the steady state solution, which should always be used when calculating remedial targets.

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 3 remedial target to determine the need for further action.

Note if contaminant is not subject to first order degradation, then set half life as 9.9E+99.

Site being assessed:	NGET Tottenham
Completed by:	M Craske
Date:	#####
Version:	x.xx

R&D Publication 20 Remedial Targets Worksheet, Release 3.2

Level 3 - Groundwater

See Note

Input Parameters (using pull down menu)

Contaminant	Anthracene	from Level 1
Target Concentration	C _T 1.00E-05	mg/l from Level 1

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

Ogata Banks	Equations in HRA publication
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Approach for simulating vertical dispersion: Simulate vertical dispersion in 1 direction

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

Approach for simulating degradation of pollutants: Apply degradation rate to dissolved pollutants only

Initial contaminant concentration in groundwater at plume core	C ₀	1.00E+00	mg/l	Source of parameter value
Half life for degradation of contaminant in water	t _{1/2}	9.20E+02	days	Based on site data
Calculated decay rate	λ	7.53E-04	days ⁻¹	
Width of plume in aquifer at source (perpendicular to flow)	Sz	2.50E+02	m	
Plume thickness at source	Sy	2.54E+00	m	
Saturated aquifer thickness	da	2.54E+00	m	Average thickness of Kempton Park Grave
Bulk density of aquifer materials	ρ	1.80E+00	g/cm ³	Literature estimate for RTD
Effective porosity of aquifer	n	2.00E-01	fraction	Literature estimate for RTD
Hydraulic gradient	i	2.00E-03	fraction	Based on average of site-specific GW measurements (SSE groundwater flow) - 0.0005 - 0.002 between
Hydraulic conductivity of aquifer	K	1.00E+01	m/d	WP 2013 value for KPG
Distance to compliance point	x	3.00E+01	m	Longitudinal dispersivity
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	Transverse dispersivity
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	Vertical dispersivity
Time since pollutant entered groundwater	t	9.99E+99	days	Note values of dispersivity must be > 0
Parameters values determined from options				
Partition coefficient	Kd	3.08E+01	l/kg	For calculated value, assumes ax = 0.1 * x, az = 0.01 * x, ay = 0.001 * x
Longitudinal dispersivity	ax	3.00E+00	m	Xu & Eckstein (1995) report ax = 0.83(log ₁₀ x) ^{2.414} ; az = ax/10, ay = ax/100 are assumed
Transverse dispersivity	az	3.00E-01	m	
Vertical dispersivity	ay	1.00E-99	m	

Calculated Parameters

Groundwater flow velocity	v	1.00E-01	m/d
Retardation factor	Rf	2.78E+02	fraction
Decay rate used	λ	2.71E-06	d ⁻¹
Rate of contaminant flow due to retardation	u	3.60E-04	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C _{ED}	8.02E-01	mg/l
Attenuation factor (one way vertical dispersion, CO/CED)	AF	1.25E+00	

Remedial Targets

Remedial Target	1.25E-05	mg/l	For comparison with measured groundwater concentration.
Ogata Banks			
Distance to compliance point	30	m	
Concentration of contaminant at compliance point after	C _{ED} /C ₀	8.02E-01	mg/l
		1.0E+100	days Ogata Banks

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



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

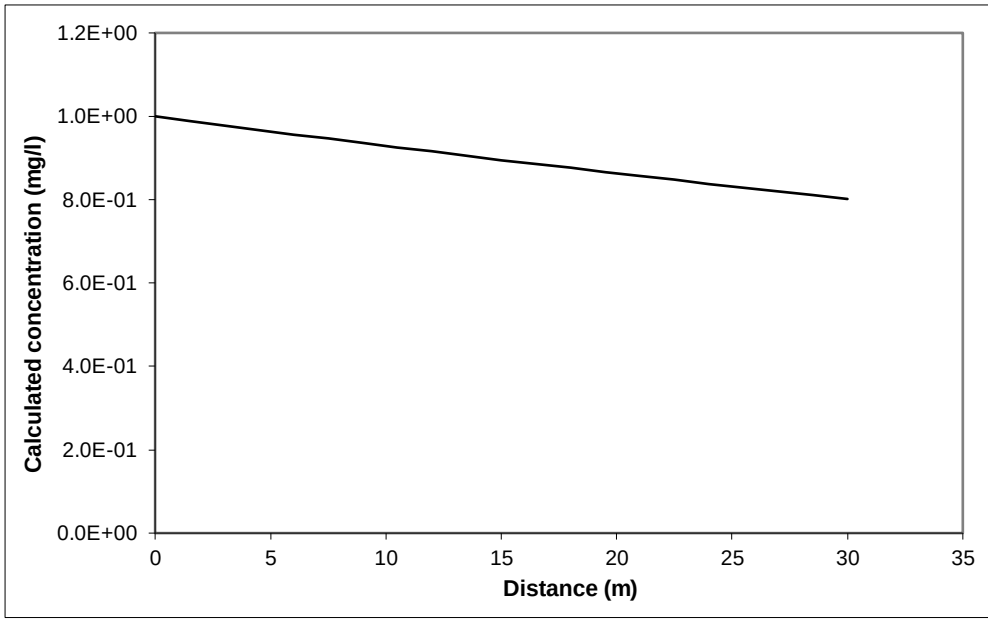
Calculate for non-polar organic chemicals

Entry if specify partition coefficient (option)	Kd		l/kg
Soil water partition coefficient			
Entry for non-polar organic chemicals (option)	foc	4.00E-03	fraction
Fraction of organic carbon in aquifer			
Organic carbon partition coefficient	Koc	7.69E+03	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	K _{oc,n}		l/kg
Sorption coefficient for ionised species	K _{oc,i}		l/kg
pH value	pH		
acid dissociation constant	pKa		
Fraction of organic carbon in aquifer	foc		fraction
Soil water partition coefficient	Kd	3.08E+01	l/kg

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

User defined values for dispersivity

Longitudinal dispersivity	ax	3.00E+00	3.00E+00	2.13E+00	m
Transverse dispersivity	az	3.00E-01	3.00E-01	2.13E-01	m
Vertical dispersivity	ay	1.00E-99	3.00E-02	2.13E-02	
Note values of dispersivity must be > 0					
For calculated value, assumes ax = 0.1 * x, az = 0.01 * x, ay = 0.001 * x					
Xu & Eckstein (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.

Note

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

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

The measured groundwater concentration should be compared with the Level 3 remedial target to determine the need for further action. Note if contaminant is not subject to first order degradation, then set half life as 9.0E+99.

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

Calculated concentrations for distance-concentration graph

Ogata Banks From calculation sheet

Distance	Concentration
	mg/l
0	1.0E+00
1.5	9.89E-01
3.0	9.78E-01
4.5	9.67E-01
6.0	9.57E-01
7.5	9.46E-01
9.0	9.36E-01
10.5	9.26E-01
12.0	9.15E-01
13.5	9.05E-01
15.0	8.95E-01
16.5	8.85E-01
18.0	8.76E-01
19.5	8.66E-01
21.0	8.57E-01
22.5	8.47E-01
24.0	8.38E-01
25.5	8.29E-01
27.0	8.20E-01
28.5	8.11E-01
30.0	8.02E-01



Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

This worksheet has been produced in combination with the document 'Remedial Targets Methodology: Hydrogeological risk assessment for land contamination (Environment Agency 2006).

Users of this worksheet should always refer to the User Manual to the Remedial Targets Methodology and to relevant guidance on UK legislation and policy, in order to understand how this procedure should be applied in an appropriate context.

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

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

Details to be completed for each assessment

Site Name:	NGET Tottenham		
Site Address:			
Completed by:	M Craske	Version:	x.xx
Date:	27-Oct-23		
Contaminant	Anthracene		
Target Concentration (C_T)	0.000559009	mg/l	Origin of C_T: Lowest of DWS/EQS

This worksheet can be used to determine remedial targets for soils (Worksheets Level 1 Soil, Level 2 and Level 3 Soil) or to determine remedial targets for groundwater (Level 3 Groundwater). For Level 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 comparison 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 Level 1, 2 and 3 Worksheets.

Worksheet options are identified by brown background and employ a pull-down menus. Data entry are identified as blue background.

Data origin / justification should be noted in cells coloured yellow and fully documented in subsequent reports.

Data carried forward from an earlier worksheet are identified by a light green background

It is recommended that a copy of the original worksheet is saved (all data fields in the original copy are blank).

The spreadsheet also includes a porosity calculation worksheet, a soil impact calculation worksheet and a worksheet that performs some simple hydrogeological calculations.

Remedial Targets Worksheet , Release 3.2



Level 1 - Soil

Select the method of calculating the soil water
Partition Co-efficient by using the pull down menu
below

Calculate for non-polar organic chemicals

Contaminant	Anthracene
Target concentration	0.000559009 mg/l

Input Parameters

Standard entry

Water filled soil porosity	θ_w	3.70E-01	fraction	Conservative value estimated from average site mo
Air filled soil porosity	θ_a	1.90E-01	fraction	Conservative value estimated from average site mo
Bulk density of soil zone material	ρ	1.60E+00	g/cm ³	Conservative Estimate for Made Ground
Henry's Law constant	H	1.60E-03	dimensionless	83

This sheet calculates the Level 1 remedial target for soils(mg/kg) based on a selected target concentration and theoretical calculation of soil water partitioning. Three options are included for determinina the partition coefficient.
The measured soil concentration as mg/kg should be compared with the Level 1 remedial target to determine the need for further action.

Entry if specify partition coefficient (option)

Soil water partition coefficient	Kd		l/kg	3.10E+01
----------------------------------	----	--	------	----------

Entry for non-polar organic chemicals (option)

Fraction of organic carbon (in soil)	foc	8.00E-02	fraction	Average from uncontaminated site samples
Organic carbon partition coefficient	Koc	7.69E+03	l/kg	83

Entry for ionic organic chemicals (option)

Sorption coefficient for neutral species	$K_{oc,n}$		l/kg	
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg	
pH value	pH		pH units	
Acid dissociation constant	pKa			
Fraction of organic carbon (in soil)	foc		fraction	

Soil water partition coefficient used in Level Assessment	Kd	6.15E+02	l/kg	Calculated value
---	----	----------	------	------------------

Level 1 Remedial Target

Level 1 Remedial Target	3.44E-01	mg/kg	(for comparison with soil analyses)
	or		
	0.000559009	mg/l	(for comparison with leachate test results)

Site being assessed:	NGET Tottenham
Completed by:	M Craske
Date:	27-Oct-23
Version:	x.xx



Level 2 - Soil

Contaminant
Target concentration

C_T

Anthracene
0.000559009

mg/l

from Level 1
from Level 1

This sheet calculates the Level 2 remedial target for soils (mg/kg) or for pore water (mg/l).

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 2 remedial target to determine the need for further action. Equations presented in 'Hydrogeological risk assessment for land contamination' (Environment Agency 2006)

Input Parameters

Variable

Value

Unit

Source of parameter value

Standard entry

Infiltration
Area of contaminant source

Inf
A

7.40E-04
1.25E+04

m/d
m²

ted from EA effective infiltration mapping and 80% ha
Length x width of site (50x250)

Not used in calculation

Entry for groundwater flow below site

Length of contaminant source in direction of groundwater flow
Saturated aquifer thickness
Hydraulic Conductivity of aquifer in which dilution occurs
Hydraulic gradient of water table
Width of contaminant source perpendicular to groundwater flow
Background concentration of contaminant in groundwater beneath site

L
da
K
i
w
Cu

5.00E+01
2.54E+00
1.00E+01
2.00E-03
2.50E+02
0.00E+00

m
m
m/d
fraction
m
mg/l

oximate lenght of site in direction of GW flow (north/s
thickness of Kempton Park Gravel based on BH logs +
WP 2013 value for KPG
between site and off site locations near Pymmes brook
ate site area perpendicular to GW flow (north-east/so

Not used in calculation

Define mixing zone depth by specifying or calculating depth (using pull down list)

Enter mixing zone thickness
Calculated mixing zone thickness

Mz
Mz

Calculate
2.54E+00

m
m

default condition

Calculated Parameters

Dilution Factor	DF	2.37E+00
Level 2 Remedial Target		1.33E-03 or 8.17E-01
		mg/l mg/kg

For comparison with measured pore water concentration. This assumes Level 1 Remedial Target is based on Target Concentrati

For comparison with measured soil concentration. This assumes Level 1
Remedial Target calculated from soil-water

Additional option

Calculation of impact on receptor

Concentration of contaminant in contaminated discharge (entering receptor)

Cc

0.00E+00

mg/l

Calculated concentration within receptor (dilution only)

0.00E+00

mg/l

0

Site being assessed: NGET Tottenham
Completed by: M Craske
Date: 27-Oct-23
Version: x.xx

Remedial Targets Worksheet , Release 3.2

Level 3 - Soil

See Note



Input Parameters	Variable	Value	Unit	Source
Contaminant		Anthracene		from Level 1
Target Concentration	C _T	0.00001	mg/l	from Level 1
Dilution Factor	DF	2.37E+00		from Level 2

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

Ogata Banks	Equations in HRA publication
-------------	------------------------------

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

Approach for simulating degradation of pollutants: Apply degradation rate to dissolved pollutants only

Variable	Value	Unit	Source of parameter value
Soil leachate concentration as mg/l			
Enter source concentration	0.1	mg/l	
Enter soil leachate concentration	9.20E+02	days	
Half life for degradation of contaminant in water	7.53E-04	days ⁻¹	calculated
Calculated decay rate	2.50E+02	m	from Level 2
Width of plume in aquifer at source	2.54E+00	m	from Level 2
Plume thickness in aquifer at source	1.80E+00	g/cm ³	Literature estimate for RTD
Bulk density of aquifer materials	2.00E-01	fraction	Literature estimate for RTD
Effective porosity of aquifer	3.46E-03	fraction	from Level 2 (adjusted)
Hydraulic gradient	1.00E+01	m/d	from Level 2
Hydraulic conductivity of saturated aquifer	3.00E+01	m	Default for aquifer protection
Distance (lateral) to compliance point perpendicular to flow direction		m	default condition
Distance (depth) to compliance point perpendicular to flow direction		m	default condition
Time since pollutant entered groundwater	9.99E+99	days	time variant options only
Parameters values determined from options			
Partition coefficient	Kd	3.08E+01	l/kg see options
Longitudinal dispersivity	ax	3.000	m see options
Transverse dispersivity	az	0.300	m see options
Vertical dispersivity	ay	0.000	m see options

Parameter values should be checked against Level 1 and 2

Calculated Parameters

Variable			
Groundwater flow velocity	v	1.73E-01	m/d
Retardation factor	Rf	2.78E+02	fraction
Decay rate used	λ	2.71E-06	d ⁻¹
Hydraulic gradient used in aquifer flow down-gradient	i	3.46E-03	fraction
Rate of contaminant flow due to retardation	u	6.22E-04	m/d
Ratio of Compliance Point to Source Concentration	C _{ED} /C ₀	8.79E-01	fraction
Attenuation factor (C ₀ /C _{ED})	AF	1.14E+00	fraction
Soil leachate concentration	Co	1.00E-01	

Remedial Targets

Level 3 Remedial Target	2.70E-05	mg/l	For comparison with measured pore water concentration.
Ogata Banks	or		This assumes Level 1 Remedial Target is based on Target Concentration.
	1.66E-02	mg/kg	For comparison with measured soil concentration. This
Distance to compliance point	30	m	assumes Level 1 Remedial Target calculated from soil-water partitioning equation.
Ratio of Compliance Point to Source Concentration	C _{ED} /C ₀	8.79E-01	fraction 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

Enter method of defining partition co-efficient (using pull down list)

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 4.00E-03 fraction

Organic carbon partition coefficient Koc 7.69E+03 l/kg

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

Fraction of organic carbon in aquifer foc fraction

Soil water partition coefficient Kd 3.08E+01 l/kg

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

User defined values for dispersivity

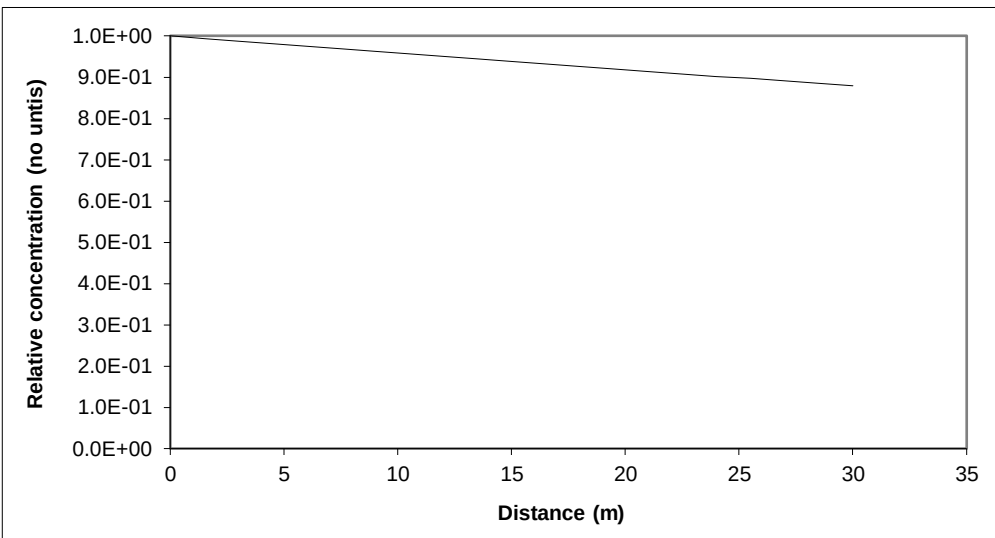
	Enter value	Calc value	Xu & Eckstein	
Longitudinal dispersivity	ax	3.00E+00	3.00E+00	2.13E+00 m
Transverse dispersivity	az	3.00E-01	3.00E-01	2.13E-01 m
Vertical dispersivity	ay	1.00E-99	3.00E-02	2.13E-02 m

Note values of dispersivity must be > 0

Xu & Eckstein (1995) report ax = 0.83(log₁₀x)^{2.414} ; az = ax/10, ay = ax/100 are assumed

Note

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



Note: 'Relative concentration' is the ratio of calculated concentration at a given position compared to the source concentration. The calculations assume plume disperses from the top of the aquifer. An alternative solution assuming the centre of the plume is located at the mid-depth of the aquifer is presented in the calculation sheets.

Calculated (relative) concentrations for distance-concentration graph

Ogata Banks

From calculation sheet

Distance	Relative concentration (No units)	Concentration mg/l
0	1.0E+00	4.21E-02
1.5	9.94E-01	4.19E-02
3.0	9.87E-01	4.16E-02
4.5	9.81E-01	4.13E-02
6.0	9.75E-01	4.11E-02
7.5	9.68E-01	4.08E-02
9.0	9.62E-01	4.05E-02
10.5	9.56E-01	4.03E-02
12.0	9.50E-01	4.00E-02
13.5	9.44E-01	3.98E-02
15.0	9.37E-01	3.95E-02
16.5	9.31E-01	3.92E-02
18.0	9.25E-01	3.90E-02
19.5	9.19E-01	3.87E-02
21.0	9.14E-01	3.85E-02
22.5	9.08E-01	3.82E-02
24.0	9.02E-01	3.80E-02
25.5	8.96E-01	3.78E-02
27.0	8.90E-01	3.75E-02
28.5	8.85E-01	3.73E-02
30.0	8.79E-01	3.70E-02

This sheet calculates the Level 3 remedial target for soils(mg/kg) or for pore water (mg/l), based on the distance to the receptor or compliance located down hydraulic gradient of the source Three solution methods are included, the preferred option is Ogata Banks.By setting a long travel time (e.g. 9E99) it will give the steady state solution, which should always be used when calculating remedial targets.

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 3 remedial target to determine the need for further action.

Note if contaminant is not subject to first order degradation, then set half life as 9.9E+99.

Site being assessed:	NGET Tottenham
Completed by:	M Craske
Date:	#####
Version:	x.xx

R&D Publication 20 Remedial Targets Worksheet, Release 3.2

Level 3 - Groundwater

See Note

Input Parameters (using pull down menu)

Contaminant	Anthracene	from Level 1
Target Concentration	C _T 1.00E-05	mg/l from Level 1

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

Ogata Banks	Equations in HRA publication
-------------	------------------------------

Approach for simulating vertical dispersion: Simulate vertical dispersion in 1 direction

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

Approach for simulating degradation of pollutants: Apply degradation rate to dissolved pollutants only

Initial contaminant concentration in groundwater at plume core	C ₀	1.00E+00	mg/l	Source of parameter value
Half life for degradation of contaminant in water	t _{1/2}	9.20E+02	days	Based on site data
Calculated decay rate	λ	7.53E-04	days ⁻¹	
Width of plume in aquifer at source (perpendicular to flow)	Sz	2.50E+02	m	
Plume thickness at source	Sy	2.54E+00	m	
Saturated aquifer thickness	da	2.54E+00	m	Average thickness of Kempton Park Grave
Bulk density of aquifer materials	ρ	1.80E+00	g/cm ³	Literature estimate for RTD
Effective porosity of aquifer	n	2.00E-01	fraction	Literature estimate for RTD
Hydraulic gradient	i	2.00E-03	fraction	Based on average of site-specific GW measurements (SSE groundwater flow) - 0.0005 - 0.002 between
Hydraulic conductivity of aquifer	K	1.00E+01	m/d	WP 2013 value for KPG
Distance to compliance point	x	3.00E+01	m	Longitudinal dispersivity
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	Transverse dispersivity
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	Vertical dispersivity
Time since pollutant entered groundwater	t	9.99E+99	days	Note values of dispersivity must be > 0
Parameters values determined from options				For calculated value, assumes ax = 0.1 * x, az = 0.01 * x, ay = 0.001 * x
Partition coefficient	Kd	3.08E+01	l/kg	Xu & Eckstein (1995) report ax = 0.83(log ₁₀ x) ^{2.414} ; az = ax/10, ay = ax/100 are assumed
Longitudinal dispersivity	ax	3.00E+00	m	
Transverse dispersivity	az	3.00E-01	m	
Vertical dispersivity	ay	1.00E-99	m	

Calculated Parameters

Groundwater flow velocity	v	1.00E-01	m/d
Retardation factor	Rf	2.78E+02	fraction
Decay rate used	λ	2.71E-06	d ⁻¹
Rate of contaminant flow due to retardation	u	3.60E-04	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C _{ED}	8.02E-01	mg/l
Attenuation factor (one way vertical dispersion, CO/CED)	AF	1.25E+00	

Remedial Targets

Remedial Target	1.25E-05	mg/l	For comparison with measured groundwater concentration.
Ogata Banks			
Distance to compliance point	30	m	
Concentration of contaminant at compliance point after	C _{ED} /C ₀ 8.02E-01	mg/l	Ogata Banks
	1.0E+100	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)

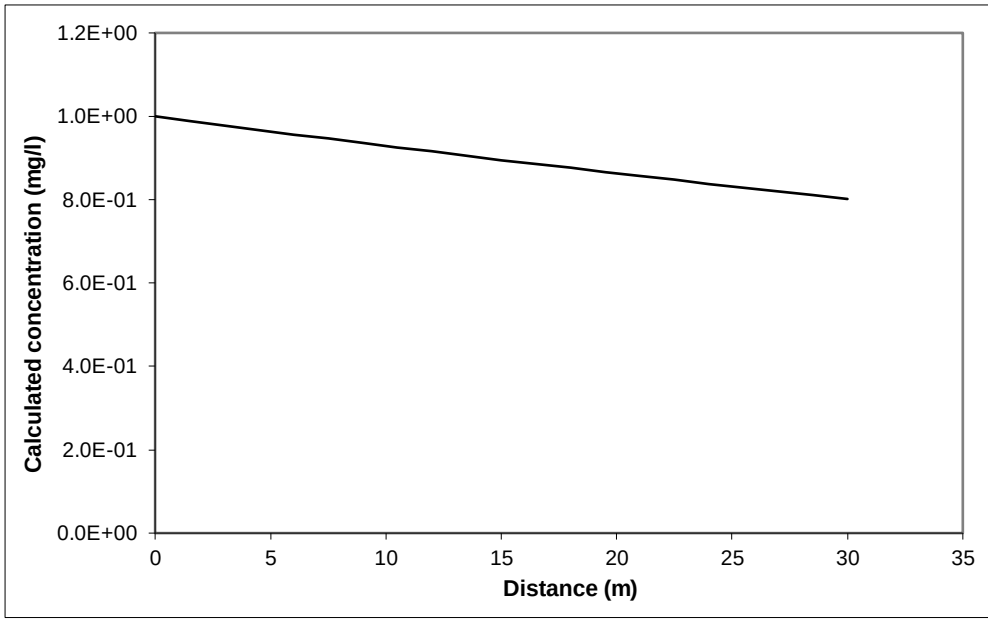
Calculate for non-polar organic chemicals

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	4.00E-03 fraction
Organic carbon partition coefficient	Koc	7.69E+03 l/kg
Entry for ionic organic chemicals (option)		
Sorption coefficient for related species	K _{oc,n}	l/kg
Sorption coefficient for ionised species	K _{oc,i}	l/kg
pH value	pH	
acid dissociation constant	pKa	
Fraction of organic carbon in aquifer	foc	fraction
Soil water partition coefficient	Kd	3.08E+01 l/kg

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

User defined values for dispersivity

Longitudinal dispersivity	ax	3.00E+00	3.00E+00	2.13E+00	m
Transverse dispersivity	az	3.00E-01	3.00E-01	2.13E-01	m
Vertical dispersivity	ay	1.00E-99	3.00E-02	2.13E-02	
Note values of dispersivity must be > 0					
For calculated value, assumes ax = 0.1 * x, az = 0.01 * x, ay = 0.001 * x					
Xu & Eckstein (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.

Note

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

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

The measured groundwater concentration should be compared with the Level 3 remedial target to determine the need for further action. Note if contaminant is not subject to first order degradation, then set half life as 9.0E+99.

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

Calculated concentrations for distance-concentration graph

Ogata Banks From calculation sheet

Distance	Concentration
	mg/l
0	1.0E+00
1.5	9.89E-01
3.0	9.78E-01
4.5	9.67E-01
6.0	9.57E-01
7.5	9.46E-01
9.0	9.36E-01
10.5	9.26E-01
12.0	9.15E-01
13.5	9.05E-01
15.0	8.95E-01
16.5	8.85E-01
18.0	8.76E-01
19.5	8.66E-01
21.0	8.57E-01
22.5	8.47E-01
24.0	8.38E-01
25.5	8.29E-01
27.0	8.20E-01
28.5	8.11E-01
30.0	8.02E-01



Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

This worksheet has been produced in combination with the document 'Remedial Targets Methodology: Hydrogeological risk assessment for land contamination (Environment Agency 2006).

Users of this worksheet should always refer to the User Manual to the Remedial Targets Methodology and to relevant guidance on UK legislation and policy, in order to understand how this procedure should be applied in an appropriate context.

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

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

<u>Details to be completed for each assessment</u>			
Site Name:	NGET Tottenham		
Site Address:			
Completed by:	M Craske	Version:	x.xx
Date:	27-Oct-23		
Contaminant	Benzene		
Target Concentration (C_T)	0.008808843	mg/l	Origin of C_T: Lowest of DWS/EQS

This worksheet can be used to determine remedial targets for soils (Worksheets Level 1 Soil, Level 2 and Level 3 Soil) or to determine remedial targets for groundwater (Level 3 Groundwater). For Level 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 comparison 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 Level 1, 2 and 3 Worksheets.

Worksheet options are identified by brown background and employ a pull-down menus. Data entry are identified as blue background.

Data origin / justification should be noted in cells coloured yellow and fully documented in subsequent reports.

Data carried forward from an earlier worksheet are identified by a light green background

It is recommended that a copy of the original worksheet is saved (all data fields in the original copy are blank).

The spreadsheet also includes a porosity calculation worksheet, a soil impact calculation worksheet and a worksheet that performs some simple hydrogeological calculations.



Level 1 - Soil

Select the method of calculating the soil water
Partition Co-efficient by using the pull down menu
below

Calculate for non-polar organic chemicals

Contaminant	Benzene
Target concentration	0.008808843 mg/l

Input Parameters

Standard entry

Water filled soil porosity	θ_w	3.70E-01	fraction	Conservative value estimated from average site mo
Air filled soil porosity	θ_a	1.90E-01	fraction	Conservative value estimated from average site mo
Bulk density of soil zone material	ρ	1.60E+00	g/cm ³	Conservative Estimate for Made Ground
Henry's Law constant	H	2.25E-01	dimensionless	83

This sheet calculates the Level 1 remedial target for soils(mg/kg) based on a selected target concentration and theoretical calculation of soil water partitioning. Three options are included for determinina the partition coefficient.
The measured soil concentration as mg/kg should be compared with the Level 1 remedial target to determine the need for further action.

Entry if specify partition coefficient (option)

Soil water partition coefficient	Kd		l/kg	3.10E+01
----------------------------------	----	--	------	----------

Entry for non-polar organic chemicals (option)

Fraction of organic carbon (in soil)	foc	8.00E-02	fraction	Average from uncontaminated site samples
Organic carbon partition coefficient	Koc	8.12E+01	l/kg	83

Entry for ionic organic chemicals (option)

Sorption coefficient for neutral species	$K_{oc,n}$		l/kg	
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg	
pH value	pH		pH units	
Acid dissociation constant	pKa			
Fraction of organic carbon (in soil)	foc		fraction	

Soil water partition coefficient used in Level Assessment	Kd	6.50E+00	l/kg	Calculated value
---	----	----------	------	------------------

Level 1 Remedial Target

Level 1 Remedial Target	5.95E-02	mg/kg	(for comparison with soil analyses)
	or		
	0.008808843	mg/l	(for comparison with leachate test results)

Site being assessed:	NGET Tottenham
Completed by:	M Craske
Date:	27-Oct-23
Version:	x.xx



Level 2 - Soil

Contaminant Target concentration C_T Benzene 0.008808843 mg/l from Level 1 from Level 1

This sheet calculates the Level 2 remedial target for soils (mg/kg) or for pore water (mg/l).

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 2 remedial target to determine the need for further action. Equations presented in 'Hydrogeological risk assessment for land contamination' (Environment Agency 2006)

Input Parameters	Variable	Value	Unit	Source of parameter value
Standard entry				
Infiltration	Inf	7.40E-04	m/d	Estimated from EA effective infiltration mapping and 80% ha
Area of contaminant source	A	1.25E+04	m ²	Length x width of site (50x250) Not used in calculation
Entry for groundwater flow below site				
Length of contaminant source in direction of groundwater flow	L	5.00E+01	m	Approximate length of site in direction of GW flow (north/south)
Saturated aquifer thickness	da	2.54E+00	m	Thickness of Kempton Park Gravel based on BH logs +
Hydraulic Conductivity of aquifer in which dilution occurs	K	1.00E+01	m/d	WP 2013 value for KPG
Hydraulic gradient of water table	i	2.00E-03	fraction	Between site and off site locations near Pymmes brook
Width of contaminant source perpendicular to groundwater flow	w	2.50E+02	m	Estimated site area perpendicular to GW flow (north-east/south-west)
Background concentration of contaminant in groundwater beneath site	Cu	0.00E+00	mg/l	Not used in calculation
Define mixing zone depth by specifying or calculating depth (using pull down list)		Calculate		default condition
Enter mixing zone thickness	Mz		m	
Calculated mixing zone thickness	Mz	2.54E+00	m	

Calculated Parameters

Dilution Factor	DF	2.37E+00		
Level 2 Remedial Target		2.09E-02	mg/l	For comparison with measured pore water concentration. This assumes Level 1 Remedial Target is based on Target Concentration
		or		
		1.41E-01	mg/kg	For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water

Additional option

Calculation of impact on receptor

Concentration of contaminant in contaminated discharge (entering receptor)	Cc	0.00E+00	mg/l	
Calculated concentration within receptor (dilution only)		0.00E+00	mg/l	0

Site being assessed:	NGET Tottenham
Completed by:	M Craske
Date:	27-Oct-23
Version:	x.xx

Remedial Targets Worksheet , Release 3.2

Level 3 - Soil

See Note



Input Parameters	Variable	Value	Unit	Source
Contaminant		Benzene		from Level 1
Target Concentration	C _T	0.001	mg/l	from Level 1
Dilution Factor	DF	2.37E+00		from Level 2

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

Ogata Banks	Equations in HRA publication
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Select nature of decay rate (click on brown cell below, then on pull-down menu)

Approach for simulating degradation of pollutants:

Apply degradation rate to dissolved pollutants only

Variable	Value	Unit	Source of parameter value
Soil leachate concentration as mg/l			
Enter source concentration	0.1	mg/l	
Enter soil leachate concentration			
Half life for degradation of contaminant in water	t _{1/2}	3.50E+02 days	77
Calculated decay rate	λ	1.98E-03 days ⁻¹	calculated
Width of plume in aquifer at source	Sz	2.50E+02 m	from Level 2
Plume thickness in aquifer at source	Sy	2.54E+00 m	from Level 2
Bulk density of aquifer materials	ρ	1.80E+00 g/cm ³	Literature estimate for RTD
Effective porosity of aquifer	n	2.00E-01 fraction	Literature estimate for RTD
Hydraulic gradient	i	3.46E-03 fraction	from Level 2 (adjusted)
Hydraulic conductivity of saturated aquifer	K	1.00E+01 m/d	from Level 2
Distance (lateral) to compliance point perpendicular to flow direction	x	3.00E+01 m	Default for aquifer protection
Distance (depth) to compliance point perpendicular to flow direction	z		default condition
Time since pollutant entered groundwater	y		default condition
	t	9.99E+99 days	time variant options only
Parameters values determined from options			
Partition coefficient	Kd	3.25E-01 l/kg	see options
Longitudinal dispersivity	ax	3.000 m	see options
Transverse dispersivity	az	0.300 m	see options
Vertical dispersivity	ay	0.000 m	see options

Parameter values should be checked against Level 1 and 2

Calculated Parameters

Variable			
Groundwater flow velocity	v	1.73E-01 m/d	
Retardation factor	Rf	3.92E+00 fraction	
Decay rate used	λ	5.05E-04 d ⁻¹	
Hydraulic gradient used in aquifer flow down-gradient	i	3.46E-03 fraction	
Rate of contaminant flow due to retardation	u	4.40E-02 m/d	
Ratio of Compliance Point to Source Concentration	C _{ED} /C ₀	7.17E-01 fraction	
Attenuation factor (C ₀ /C _{ED})	AF	1.39E+00 fraction	
Soil leachate concentration	Co	1.00E-01	

Remedial Targets

Level 3 Remedial Target	3.31E-03 mg/l	For comparison with measured pore water concentration.
Ogata Banks	or	This assumes Level 1 Remedial Target is based on Target Concentration.
	2.24E-02 mg/kg	For comparison with measured soil concentration. This
Distance to compliance point	30 m	assumes Level 1 Remedial Target calculated from soil-water partitioning equation.
Ratio of Compliance Point to Source Concentration	C _{ED} /C ₀	7.17E-01 fraction 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

Enter method of defining partition co-efficient (using pull down list)

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 4.00E-03 fraction

Organic carbon partition coefficient Koc 8.12E+01 l/kg

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

Fraction of organic carbon in aquifer foc fraction

Soil water partition coefficient Kd 3.25E-01 l/kg

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

User defined values for dispersivity

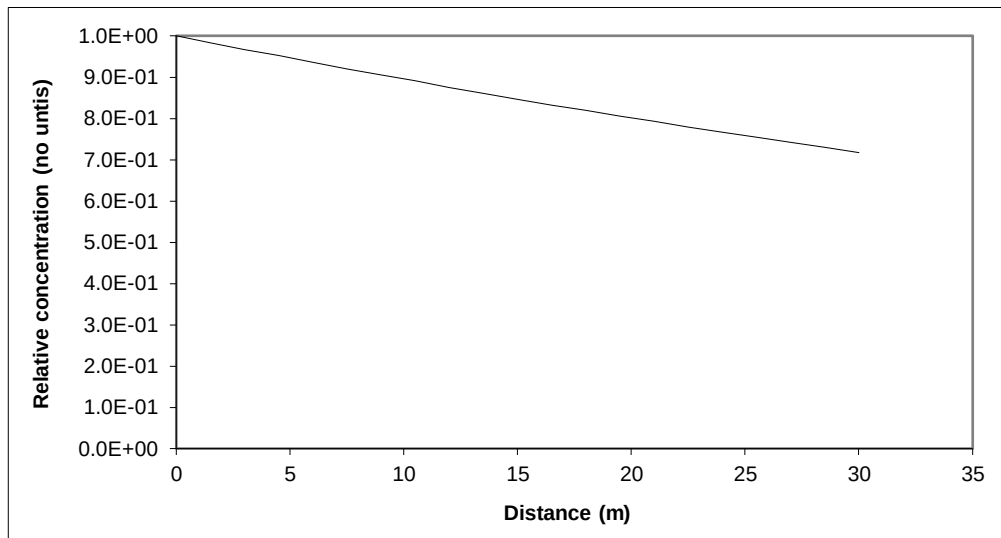
	Enter value	Calc value	Xu & Eckstein	
Longitudinal dispersivity	ax	3.00E+00	3.00E+00	2.13E+00 m
Transverse dispersivity	az	3.00E-01	3.00E-01	2.13E-01 m
Vertical dispersivity	ay	1.00E-99	3.00E-02	2.13E-02 m

Note values of dispersivity must be > 0

Xu & Eckstein (1995) report ax = 0.83(log₁₀x)^{2.414}; az = ax/10, ay = ax/100 are assumed

Note

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



Note: 'Relative concentration' is the ratio of calculated concentration at a given position compared to the source concentration. The calculations assume plume disperses from the top of the aquifer. An alternative solution assuming the centre of the plume is located at the mid-depth of the aquifer is presented in the calculation sheets.

Calculated (relative) concentrations for distance-concentration graph

Ogata Banks

Distance	Relative concentration (No units)	Concentration mg/l
0	1.0E+00	4.21E-02
1.5	9.84E-01	4.14E-02
3.0	9.67E-01	4.08E-02
4.5	9.51E-01	4.01E-02
6.0	9.36E-01	3.94E-02
7.5	9.20E-01	3.88E-02
9.0	9.05E-01	3.81E-02
10.5	8.90E-01	3.75E-02
12.0	8.75E-01	3.69E-02
13.5	8.61E-01	3.63E-02
15.0	8.47E-01	3.57E-02
16.5	8.33E-01	3.51E-02
18.0	8.19E-01	3.45E-02
19.5	8.06E-01	3.39E-02
21.0	7.92E-01	3.34E-02
22.5	7.79E-01	3.28E-02
24.0	7.66E-01	3.23E-02
25.5	7.54E-01	3.18E-02
27.0	7.41E-01	3.12E-02
28.5	7.29E-01	3.07E-02
30.0	7.17E-01	3.02E-02

This sheet calculates the Level 3 remedial target for soils(mg/kg) or for pore water (mg/l), based on the distance to the receptor or compliance located down hydraulic gradient of the source Three solution methods are included, the preferred option is Ogata Banks.By setting a long travel time (e.g. 9E99) it will give the steady state solution, which should always be used when calculating remedial targets.

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 3 remedial target to determine the need for further action.

Note if contaminant is not subject to first order degradation, then set half life as 9.9E+99.

Site being assessed:	NGET Tottenham
Completed by:	M Craske
Date:	#####
Version:	x.xx

R&D Publication 20 Remedial Targets Worksheet, Release 3.2

Level 3 - Groundwater

See Note

Input Parameters (using pull down menu)

Contaminant		Benzene	from Level 1
Target Concentration	C _T	1.00E-03	mg/l from Level 1

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

Ogata Banks	Equations in HRA publication
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Approach for simulating vertical dispersion:

Simulate vertical dispersion in 1 direction

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

Approach for simulating degradation of pollutants:

Apply degradation rate to dissolved pollutants only

Initial contaminant concentration in groundwater at plume core	C ₀	1.00E+00	mg/l	Source of parameter value
Half life for degradation of contaminant in water	t _{1/2}	3.50E+02	days	Based on site data
Calculated decay rate	λ	1.98E-03	days ⁻¹	77
Width of plume in aquifer at source (perpendicular to flow)	Sz	2.50E+02	m	
Plume thickness at source	Sy	2.54E+00	m	
Saturated aquifer thickness	da	2.54E+00	m	Average thickness of Kempton Park Grave
Bulk density of aquifer materials	ρ	1.80E+00	g/cm ³	Literature estimate for RTD
Effective porosity of aquifer	n	2.00E-01	fraction	Literature estimate for RTD
Hydraulic gradient	i	2.00E-03	fraction	Based on average of site-specific GW measurements (SSE groundwater flow) - 0.0005 - 0.002 between
Hydraulic conductivity of aquifer	K	1.00E+01	m/d	WP 2013 value for KPG
Distance to compliance point	x	3.00E+01	m	Longitudinal dispersivity
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	Transverse dispersivity
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	Vertical dispersivity
Time since pollutant entered groundwater	t	9.99E+99	days	Note values of dispersivity must be > 0
Parameters values determined from options				For calculated value, assumes ax = 0.1 * x, az = 0.01 * x, ay = 0.001 * x
Partition coefficient	Kd	3.25E-01	l/kg	Xu & Eckstein (1995) report ax = 0.83(log ₁₀ x) ^{2.414} ; az = ax/10, ay = ax/100 are assumed
Longitudinal dispersivity	ax	3.00E+00	m	
Transverse dispersivity	az	3.00E-01	m	
Vertical dispersivity	ay	1.00E-99	m	

Calculated Parameters

Groundwater flow velocity	v	1.00E-01	m/d
Retardation factor	Rf	3.92E+00	fraction
Decay rate used	λ	5.05E-04	d ⁻¹
Rate of contaminant flow due to retardation	u	2.55E-02	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C _{ED}	5.70E-01	mg/l
Attenuation factor (one way vertical dispersion, CO/CED)	AF	1.76E+00	

Remedial Targets

Remedial Target	1.76E-03	mg/l	For comparison with measured groundwater concentration.
Ogata Banks			
Distance to compliance point	30	m	
Concentration of contaminant at compliance point after	C _{ED} /C ₀	5.70E-01	mg/l
		1.0E+100	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)

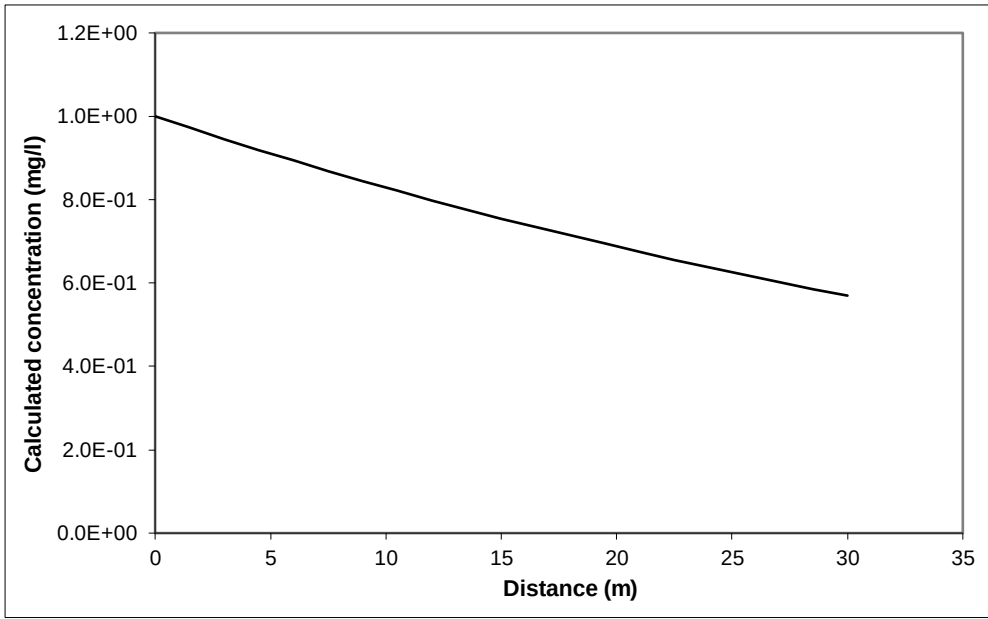
Calculate for non-polar organic chemicals

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	4.00E-03 fraction
Organic carbon partition coefficient	Koc	8.12E+01 l/kg
Entry for ionic organic chemicals (option)		
Sorption coefficient for related species	K _{oc,n}	l/kg
Sorption coefficient for ionised species	K _{oc,i}	l/kg
pH value	pH	
acid dissociation constant	pKa	
Fraction of organic carbon in aquifer	foc	fraction
Soil water partition coefficient	Kd	3.25E-01 l/kg

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

User defined values for dispersivity

Enter value	Calc value	Xu & Eckstein	m
ax	3.00E+00	3.00E+00	2.13E+00 m
az	3.00E-01	3.00E-01	2.13E-01 m
ay	1.00E-99	3.00E-02	2.13E-02 m



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

Note

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

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

The measured groundwater concentration should be compared with the Level 3 remedial target to determine the need for further action. Note if contaminant is not subject to first order degradation, then set half life as 9.0E+99.

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

Site being assessed:	NGET Tottenham
Completed by:	M Craske
Date:	#####
Version:	x.xx

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration
	mg/l
0	1.0E+00
1.5	9.72E-01
3.0	9.45E-01
4.5	9.19E-01
6.0	8.94E-01
7.5	8.69E-01
9.0	8.45E-01
10.5	8.21E-01
12.0	7.99E-01
13.5	7.76E-01
15.0	7.55E-01
16.5	7.34E-01
18.0	7.14E-01
19.5	6.94E-01
21.0	6.75E-01
22.5	6.56E-01
24.0	6.38E-01
25.5	6.20E-01
27.0	6.03E-01
28.5	5.86E-01
30.0	5.70E-01



Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

This worksheet has been produced in combination with the document 'Remedial Targets Methodology: Hydrogeological risk assessment for land contamination (Environment Agency 2006).

Users of this worksheet should always refer to the User Manual to the Remedial Targets Methodology and to relevant guidance on UK legislation and policy, in order to understand how this procedure should be applied in an appropriate context.

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

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

<u>Details to be completed for each assessment</u>			
Site Name:	NGET Tottenham		
Site Address:			
Completed by:	M Craske	Version:	x.xx
Date:	27-Oct-23		
Contaminant	Benzene		
Target Concentration (C_T)	0.008808843	mg/l	Origin of C_T: Lowest of DWS/EQS

This worksheet can be used to determine remedial targets for soils (Worksheets Level 1 Soil, Level 2 and Level 3 Soil) or to determine remedial targets for groundwater (Level 3 Groundwater). For Level 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 comparison 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 Level 1, 2 and 3 Worksheets.

Worksheet options are identified by brown background and employ a pull-down menus. Data entry are identified as blue background.

Data origin / justification should be noted in cells coloured yellow and fully documented in subsequent reports.

Data carried forward from an earlier worksheet are identified by a light green background

It is recommended that a copy of the original worksheet is saved (all data fields in the original copy are blank).

The spreadsheet also includes a porosity calculation worksheet, a soil impact calculation worksheet and a worksheet that performs some simple hydrogeological calculations.

Level 1 - Soil

Select the method of calculating the soil water
Partition Co-efficient by using the pull down menu
below

Calculate for non-polar organic chemicals

Contaminant	Benzene
Target concentration	0.008808843 mg/l

Input Parameters

Standard entry

Water filled soil porosity	θ_w	3.70E-01	fraction	Conservative value estimated from average site mo
Air filled soil porosity	θ_a	1.90E-01	fraction	Conservative value estimated from average site mo
Bulk density of soil zone material	ρ	1.60E+00	g/cm ³	Conservative Estimate for Made Ground
Henry's Law constant	H	2.25E-01	dimensionless	83

Entry if specify partition coefficient (option)

Soil water partition coefficient	Kd		l/kg	3.10E+01
----------------------------------	----	--	------	----------

Entry for non-polar organic chemicals (option)

Fraction of organic carbon (in soil)	foc	8.00E-02	fraction	Average from uncontaminated site samples
Organic carbon partition coefficient	Koc	8.12E+01	l/kg	83

Entry for ionic organic chemicals (option)

Sorption coefficient for neutral species	$K_{oc,n}$		l/kg	
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg	
pH value	pH		pH units	
Acid dissociation constant	pKa			
Fraction of organic carbon (in soil)	foc		fraction	

Soil water partition coefficient used in Level Assessment	Kd	6.50E+00	l/kg	Calculated value
---	----	----------	------	------------------

Level 1 Remedial Target

Level 1 Remedial Target	5.95E-02	mg/kg	(for comparison with soil analyses)
	or		
	0.008808843	mg/l	(for comparison with leachate test results)

Site being assessed:	NGET Tottenham
Completed by:	M Craske
Date:	27-Oct-23
Version:	x.xx



Level 2 - Soil

Contaminant Target concentration C_T Benzene 0.008808843 mg/l from Level 1 from Level 1

This sheet calculates the Level 2 remedial target for soils (mg/kg) or for pore water (mg/l).

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 2 remedial target to determine the need for further action. Equations presented in 'Hydrogeological risk assessment for land contamination' (Environment Agency 2006)

Input Parameters	Variable	Value	Unit	Source of parameter value
Standard entry				
Infiltration	Inf	7.40E-04	m/d	Estimated from EA effective infiltration mapping and 80% ha
Area of contaminant source	A	1.25E+04	m ²	Length x width of site (50x250) Not used in calculation
Entry for groundwater flow below site				
Length of contaminant source in direction of groundwater flow	L	5.00E+01	m	Approximate length of site in direction of GW flow (north/south)
Saturated aquifer thickness	da	2.54E+00	m	Thickness of Kempton Park Gravel based on BH logs +
Hydraulic Conductivity of aquifer in which dilution occurs	K	1.00E+01	m/d	WP 2013 value for KPG
Hydraulic gradient of water table	i	2.00E-03	fraction	Between site and off site locations near Pymmes brook
Width of contaminant source perpendicular to groundwater flow	w	2.50E+02	m	Approximate site area perpendicular to GW flow (north-east/south-west)
Background concentration of contaminant in groundwater beneath site	Cu	0.00E+00	mg/l	Not used in calculation
Define mixing zone depth by specifying or calculating depth (using pull down list)		Calculate		default condition
Enter mixing zone thickness	Mz		m	
Calculated mixing zone thickness	Mz	2.54E+00	m	

Calculated Parameters

Dilution Factor	DF	2.37E+00		
Level 2 Remedial Target		2.09E-02	mg/l	For comparison with measured pore water concentration. This assumes Level 1 Remedial Target is based on Target Concentration
		or		
		1.41E-01	mg/kg	For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water

Additional option

Calculation of impact on receptor

Concentration of contaminant in contaminated discharge (entering receptor)	Cc	0.00E+00	mg/l	
Calculated concentration within receptor (dilution only)		0.00E+00	mg/l	0

Site being assessed:	NGET Tottenham
Completed by:	M Craske
Date:	27-Oct-23
Version:	x.xx

Remedial Targets Worksheet , Release 3.2

Level 3 - Soil

See Note



Input Parameters	Variable	Value	Unit	Source
Contaminant		Benzene		from Level 1
Target Concentration	C _T	0.001	mg/l	from Level 1
Dilution Factor	DF	2.37E+00		from Level 2

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

Ogata Banks	Equations in HRA publication
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Select nature of decay rate (click on brown cell below, then on pull-down menu)

Approach for simulating degradation of pollutants:

Apply degradation rate to dissolved pollutants only

Variable	Value	Unit	Source of parameter value
Soil leachate concentration as mg/l			
Enter source concentration	0.1	mg/l	
Enter soil leachate concentration			
Half life for degradation of contaminant in water	t _{1/2}	3.50E+02 days	77
Calculated decay rate	λ	1.98E-03 days ⁻¹	calculated
Width of plume in aquifer at source	Sz	2.50E+02 m	from Level 2
Plume thickness in aquifer at source	Sy	2.54E+00 m	from Level 2
Bulk density of aquifer materials	ρ	1.80E+00 g/cm ³	Literature estimate for RTD
Effective porosity of aquifer	n	2.00E-01 fraction	Literature estimate for RTD
Hydraulic gradient	i	3.46E-03 fraction	from Level 2 (adjusted)
Hydraulic conductivity of saturated aquifer	K	1.00E+01 m/d	from Level 2
Distance (lateral) to compliance point perpendicular to flow direction	x	3.00E+01 m	Default for aquifer protection
Distance (depth) to compliance point perpendicular to flow direction	z		default condition
Time since pollutant entered groundwater	y		default condition
	t	9.99E+99 days	time variant options only
Parameters values determined from options			
Partition coefficient	Kd	3.25E-01 l/kg	see options
Longitudinal dispersivity	ax	3.000 m	see options
Transverse dispersivity	az	0.300 m	see options
Vertical dispersivity	ay	0.000 m	see options

Parameter values should be checked against Level 1 and 2

Calculated Parameters

Variable			
Groundwater flow velocity	v	1.73E-01 m/d	
Retardation factor	Rf	3.92E+00 fraction	
Decay rate used	λ	5.05E-04 d ⁻¹	
Hydraulic gradient used in aquifer flow down-gradient	i	3.46E-03 fraction	
Rate of contaminant flow due to retardation	u	4.40E-02 m/d	
Ratio of Compliance Point to Source Concentration	C _{ED} /C ₀	7.17E-01 fraction	
Attenuation factor (C ₀ /C _{ED})	AF	1.39E+00 fraction	
Soil leachate concentration	Co	1.00E-01	

Remedial Targets

Level 3 Remedial Target	3.31E-03 mg/l	For comparison with measured pore water concentration.
Ogata Banks	or	This assumes Level 1 Remedial Target is based on Target Concentration.
	2.24E-02 mg/kg	For comparison with measured soil concentration. This
Distance to compliance point	30 m	assumes Level 1 Remedial Target calculated from soil-water partitioning equation.
Ratio of Compliance Point to Source Concentration	C _{ED} /C ₀	7.17E-01 fraction 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

Enter method of defining partition co-efficient (using pull down list)

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 4.00E-03 fraction

Organic carbon partition coefficient Koc 8.12E+01 l/kg

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

Fraction of organic carbon in aquifer foc fraction

Soil water partition coefficient Kd 3.25E-01 l/kg

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

User defined values for dispersivity

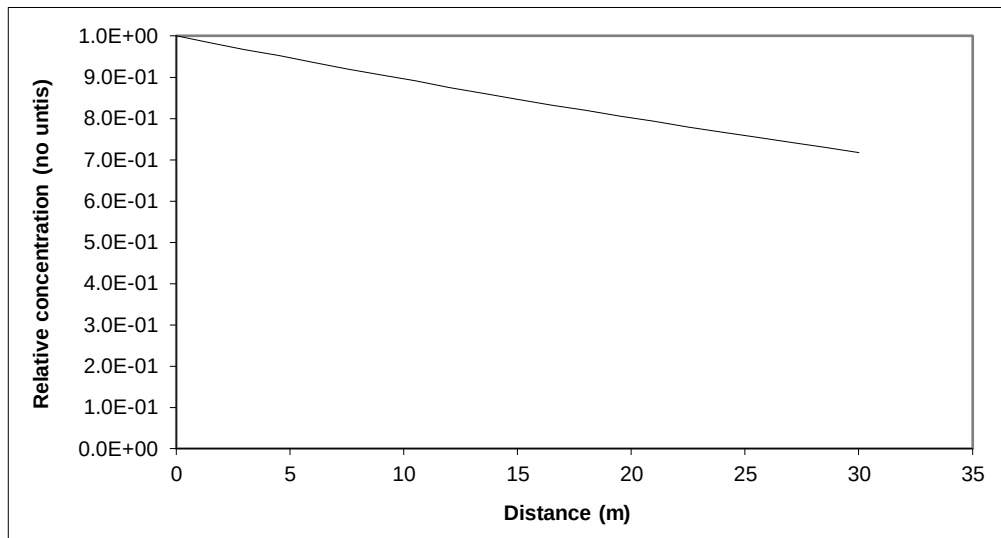
	Enter value	Calc value	Xu & Eckstein	
Longitudinal dispersivity	ax	3.00E+00	3.00E+00	2.13E+00 m
Transverse dispersivity	az	3.00E-01	3.00E-01	2.13E-01 m
Vertical dispersivity	ay	1.00E-99	3.00E-02	2.13E-02 m

Note values of dispersivity must be > 0

Xu & Eckstein (1995) report ax = 0.83(log₁₀x)^{2.414}; az = ax/10, ay = ax/100 are assumed

Note

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



Note: 'Relative concentration' is the ratio of calculated concentration at a given position compared to the source concentration. The calculations assume plume disperses from the top of the aquifer. An alternative solution assuming the centre of the plume is located at the mid-depth of the aquifer is presented in the calculation sheets.

Calculated (relative) concentrations for distance-concentration graph

Ogata Banks

From calculation sheet

Distance	Relative concentration (No units)	Concentration mg/l
0	1.0E+00	4.21E-02
1.5	9.84E-01	4.14E-02
3.0	9.67E-01	4.08E-02
4.5	9.51E-01	4.01E-02
6.0	9.36E-01	3.94E-02
7.5	9.20E-01	3.88E-02
9.0	9.05E-01	3.81E-02
10.5	8.90E-01	3.75E-02
12.0	8.75E-01	3.69E-02
13.5	8.61E-01	3.63E-02
15.0	8.47E-01	3.57E-02
16.5	8.33E-01	3.51E-02
18.0	8.19E-01	3.45E-02
19.5	8.06E-01	3.39E-02
21.0	7.92E-01	3.34E-02
22.5	7.79E-01	3.28E-02
24.0	7.66E-01	3.23E-02
25.5	7.54E-01	3.18E-02
27.0	7.41E-01	3.12E-02
28.5	7.29E-01	3.07E-02
30.0	7.17E-01	3.02E-02

This sheet calculates the Level 3 remedial target for soils(mg/kg) or for pore water (mg/l), based on the distance to the receptor or compliance located down hydraulic gradient of the source Three solution methods are included, the preferred option is Ogata Banks.By setting a long travel time (e.g. 9E99) it will give the steady state solution, which should always be used when calculating remedial targets.

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 3 remedial target to determine the need for further action.

Note if contaminant is not subject to first order degradation, then set half life as 9.9E+99.

Site being assessed:	NGET Tottenham
Completed by:	M Craske
Date:	#####
Version:	x.xx

R&D Publication 20 Remedial Targets Worksheet, Release 3.2

Level 3 - Groundwater

See Note

Input Parameters (using pull down menu)

Contaminant		Benzene	from Level 1
Target Concentration	C _T	1.00E-03	mg/l from Level 1

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

Ogata Banks	Equations in HRA publication
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Approach for simulating vertical dispersion:

Simulate vertical dispersion in 1 direction

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

Approach for simulating degradation of pollutants:

Apply degradation rate to dissolved pollutants only

Initial contaminant concentration in groundwater at plume core	C ₀	1.00E+00	mg/l	Source of parameter value
Half life for degradation of contaminant in water	t _{1/2}	3.50E+02	days	Based on site data
Calculated decay rate	λ	1.98E-03	days ⁻¹	77
Width of plume in aquifer at source (perpendicular to flow)	Sz	2.50E+02	m	
Plume thickness at source	Sy	2.54E+00	m	
Saturated aquifer thickness	da	2.54E+00	m	Average thickness of Kempton Park Grave
Bulk density of aquifer materials	ρ	1.80E+00	g/cm ³	Literature estimate for RTD
Effective porosity of aquifer	n	2.00E-01	fraction	Literature estimate for RTD
Hydraulic gradient	i	2.00E-03	fraction	Based on average of site-specific GW measurements (SSE groundwater flow) - 0.0005 - 0.002 between
Hydraulic conductivity of aquifer	K	1.00E+01	m/d	WP 2013 value for KPG
Distance to compliance point	x	3.00E+01	m	Longitudinal dispersivity
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	Transverse dispersivity
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	Vertical dispersivity
Time since pollutant entered groundwater	t	9.99E+99	days	Note values of dispersivity must be > 0
Parameters values determined from options				For calculated value, assumes ax = 0.1 * x, az = 0.01 * x, ay = 0.001 * x
Partition coefficient	Kd	3.25E-01	l/kg	Xu & Eckstein (1995) report ax = 0.83(log ₁₀ x) ^{2.414} ; az = ax/10, ay = ax/100 are assumed
Longitudinal dispersivity	ax	3.00E+00	m	
Transverse dispersivity	az	3.00E-01	m	
Vertical dispersivity	ay	1.00E-99	m	

Calculated Parameters

Groundwater flow velocity	v	1.00E-01	m/d
Retardation factor	Rf	3.92E+00	fraction
Decay rate used	λ	5.05E-04	d ⁻¹
Rate of contaminant flow due to retardation	u	2.55E-02	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C _{ED}	5.70E-01	mg/l
Attenuation factor (one way vertical dispersion, CO/CED)	AF	1.76E+00	

Remedial Targets

Remedial Target	1.76E-03	mg/l	For comparison with measured groundwater concentration.
Ogata Banks			
Distance to compliance point	30	m	
Concentration of contaminant at compliance point after	C _{ED} /C ₀	5.70E-01	mg/l
		1.0E+100	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)

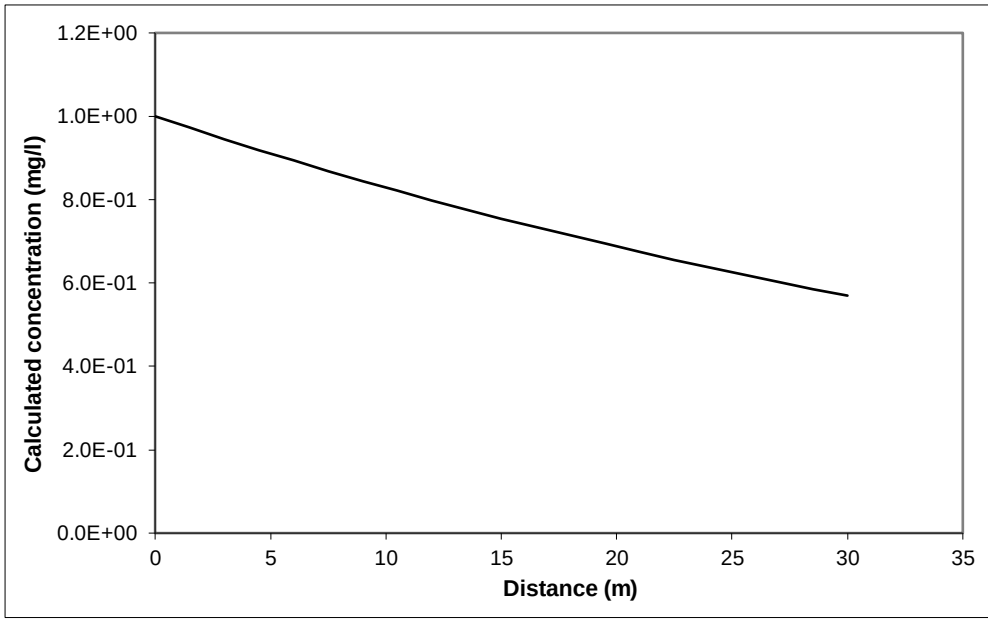
Calculate for non-polar organic chemicals

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	4.00E-03 fraction
Organic carbon partition coefficient	Koc	8.12E+01 l/kg
Entry for ionic organic chemicals (option)		
Sorption coefficient for related species	K _{oc,n}	l/kg
Sorption coefficient for ionised species	K _{oc,i}	l/kg
pH value	pH	
acid dissociation constant	pKa	
Fraction of organic carbon in aquifer	foc	fraction
Soil water partition coefficient	Kd	3.25E-01 l/kg

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

User defined values for dispersivity

Longitudinal dispersivity	ax	3.00E+00	3.00E+00	2.13E+00	m
Transverse dispersivity	az	3.00E-01	3.00E-01	2.13E-01	m
Vertical dispersivity	ay	1.00E-99	3.00E-02	2.13E-02	



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

Note

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

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

The measured groundwater concentration should be compared with the Level 3 remedial target to determine the need for further action. Note if contaminant is not subject to first order degradation, then set half life as 9.0E+99.

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

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration
	mg/l
0	1.0E+00
1.5	9.72E-01
3.0	9.45E-01
4.5	9.19E-01
6.0	8.94E-01
7.5	8.69E-01
9.0	8.45E-01
10.5	8.21E-01
12.0	7.99E-01
13.5	7.76E-01
15.0	7.55E-01
16.5	7.34E-01
18.0	7.14E-01
19.5	6.94E-01
21.0	6.75E-01
22.5	6.56E-01
24.0	6.38E-01
25.5	6.20E-01
27.0	6.03E-01
28.5	5.86E-01
30.0	5.70E-01



Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

This worksheet has been produced in combination with the document 'Remedial Targets Methodology: Hydrogeological risk assessment for land contamination (Environment Agency 2006).

Users of this worksheet should always refer to the User Manual to the Remedial Targets Methodology 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, 2006. (Produced by the Environment Agency's Science Group)

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

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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 functions).

<u>Details to be completed for each assessment</u>			
Site Name:	NGET Tottenham		
Site Address:			
Completed by:	M Craske	Version:	x.xx
Date:	27-Oct-23		
Contaminant	Benzo(a)pyrene		
Target Concentration (C_T)	7.55282E-07	mg/l	Origin of C_T: Lowest of DWS/EQS

This worksheet can be used to determine remedial targets for soils (Worksheets Level 1 Soil, Level 2 and Level 3 Soil) or to determine remedial targets for groundwater (Level 3 Groundwater). For Level 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 comparison 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 Level 1, 2 and 3 Worksheets.

Worksheet options are identified by brown background and employ a pull-down menus. Data entry are identified as blue background.

Data origin / justification should be noted in cells coloured yellow and fully documented in subsequent reports.

Data carried forward from an earlier worksheet are identified by a light green background

It is recommended that a copy of the original worksheet is saved (all data fields in the original copy are blank).

The spreadsheet also includes a porosity calculation worksheet, a soil impact calculation worksheet and a worksheet that performs some simple hydrogeological calculations.

Remedial Targets Worksheet , Release 3.2



Level 1 - Soil

Select the method of calculating the soil water
Partition Co-efficient by using the pull down menu
below

Calculate for non-polar organic chemicals

Contaminant	Benzo(a)pyrene
Target concentration	7.55282E-07 mg/l

Input Parameters

Standard entry

Water filled soil porosity	θ_w	3.70E-01	fraction	Conservative value estimated from average site mo
Air filled soil porosity	θ_a	1.90E-01	fraction	Conservative value estimated from average site mo
Bulk density of soil zone material	ρ	1.60E+00	g/cm ³	Conservative Estimate for Made Ground
Henry's Law constant	H	1.86E-05	dimensionless	83

This sheet calculates the Level 1 remedial target for soils(mg/kg) based on a selected target concentration and theoretical calculation of soil water partitioning. Three options are included for determinina the partition coefficient.
The measured soil concentration as mg/kg should be compared with the Level 1 remedial target to determine the need for further action.

Entry if specify partition coefficient (option)

Soil water partition coefficient	Kd		l/kg	3.10E+01
----------------------------------	----	--	------	----------

Entry for non-polar organic chemicals (option)

Fraction of organic carbon (in soil)	foc	8.00E-02	fraction	Average from uncontaminated site samples
Organic carbon partition coefficient	Koc	1.31E+05	l/kg	83

Entry for ionic organic chemicals (option)

Sorption coefficient for neutral species	$K_{oc,n}$		l/kg	
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg	
pH value	pH		pH units	
Acid dissociation constant	pKa			
Fraction of organic carbon (in soil)	foc		fraction	

Soil water partition coefficient used in Level Assessment	Kd	1.05E+04	l/kg	Calculated value
---	----	----------	------	------------------

Level 1 Remedial Target

Level 1 Remedial Target	7.92E-03	mg/kg	(for comparison with soil analyses)
	or		
	7.55282E-07	mg/l	(for comparison with leachate test results)

Site being assessed:	NGET Tottenham
Completed by:	M Craske
Date:	27-Oct-23
Version:	x.xx



Level 2 - Soil

Contaminant
Target concentration

C_T

Benzo(a)pyrene

7.55282E-07

mg/l

from Level 1

from Level 1

This sheet calculates the Level 2 remedial target for soils (mg/kg) or for pore water (mg/l).

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 2 remedial target to determine the need for further action. Equations presented in 'Hydrogeological risk assessment for land contamination' (Environment Agency 2006)

Input Parameters	Variable	Value	Unit	Source of parameter value
Standard entry				
Infiltration	Inf	7.40E-04	m/d	Estimated from EA effective infiltration mapping and 80% ha
Area of contaminant source	A	1.25E+04	m ²	Length x width of site (50x250) Not used in calculation
Entry for groundwater flow below site				
Length of contaminant source in direction of groundwater flow	L	5.00E+01	m	Approximate length of site in direction of GW flow (north/south)
Saturated aquifer thickness	da	2.54E+00	m	Thickness of Kempton Park Gravel based on BH logs +
Hydraulic Conductivity of aquifer in which dilution occurs	K	1.00E+01	m/d	WP 2013 value for KPG
Hydraulic gradient of water table	i	2.00E-03	fraction	Between site and off site locations near Pymmes brook
Width of contaminant source perpendicular to groundwater flow	w	2.50E+02	m	Approximate site area perpendicular to GW flow (north-east/south-west)
Background concentration of contaminant in groundwater beneath site	Cu	0.00E+00	mg/l	Not used in calculation
Define mixing zone depth by specifying or calculating depth (using pull down list)		Calculate		default condition
Enter mixing zone thickness	Mz		m	
Calculated mixing zone thickness	Mz	2.54E+00	m	

Calculated Parameters

Dilution Factor	DF	2.37E+00		
Level 2 Remedial Target		1.79E-06	mg/l	For comparison with measured pore water concentration. This assumes Level 1 Remedial Target is based on Target Concentration
		or		
		1.88E-02	mg/kg	For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water

Additional option

Calculation of impact on receptor

Concentration of contaminant in contaminated discharge (entering receptor)	Cc	0.00E+00	mg/l	
Calculated concentration within receptor (dilution only)		0.00E+00	mg/l	0

Site being assessed:	NGET Tottenham
Completed by:	M Craske
Date:	27-Oct-23
Version:	x.xx

Remedial Targets Worksheet , Release 3.2

Level 3 - Soil

See Note



Input Parameters	Variable	Value	Unit	Source
Contaminant		Benzo(a)pyrene		from Level 1
Target Concentration	C _T	0.00000017	mg/l	from Level 1
Dilution Factor	DF	2.37E+00		from Level 2

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

Ogata Banks	Equations in HRA publication
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Select nature of decay rate (click on brown cell below, then on pull-down menu)

Approach for simulating degradation of pollutants:

Apply degradation rate to dissolved pollutants only

Variable	Value	Unit	Source of parameter value
Soil leachate concentration as mg/l			
Enter soil leachate concentration	0.1	mg/l	
Half life for degradation of contaminant in water	t _{1/2} 4.50E+03	days	78
Calculated decay rate	λ 1.54E-04	days ⁻¹	calculated
Width of plume in aquifer at source	Sz 2.50E+02	m	from Level 2
Plume thickness in aquifer at source	Sy 2.54E+00	m	from Level 2
Bulk density of aquifer materials	ρ 1.80E+00	g/cm ³	Literature estimate for RTD
Effective porosity of aquifer	n 2.00E-01	fraction	Literature estimate for RTD
Hydraulic gradient	i 3.46E-03	fraction	from Level 2 (adjusted)
Hydraulic conductivity of saturated aquifer	K 1.00E+01	m/d	from Level 2
Distance (lateral) to compliance point perpendicular to flow direction	x 3.00E+01	m	Default for aquifer protection
Distance (depth) to compliance point perpendicular to flow direction	z	m	default condition
Time since pollutant entered groundwater	t 9.99E+99	days	default condition
Parameters values determined from options			
Partition coefficient	Kd 5.24E+02	l/kg	see options
Longitudinal dispersivity	ax 3.000	m	see options
Transverse dispersivity	az 0.300	m	see options
Vertical dispersivity	ay 0.000	m	see options

Parameter values should be checked against Level 1 and 2

Calculated Parameters

Variable			
Groundwater flow velocity	v	1.73E-01	m/d
Retardation factor	Rf	4.72E+03	fraction
Decay rate used	λ	3.27E-08	d ⁻¹
Hydraulic gradient used in aquifer flow down-gradient	i	3.46E-03	fraction
Rate of contaminant flow due to retardation	u	3.66E-05	m/d
Ratio of Compliance Point to Source Concentration	C _{ED} /C ₀	9.74E-01	fraction
Attenuation factor (C ₀ /C _{ED})	AF	1.03E+00	fraction
Soil leachate concentration	Co	1.00E-01	

Remedial Targets

Level 3 Remedial Target	4.14E-07	mg/l	For comparison with measured pore water concentration.
Ogata Banks	or		This assumes Level 1 Remedial Target is based on Target Concentration.
	4.34E-03	mg/kg	For comparison with measured soil concentration. This
Distance to compliance point	30	m	assumes Level 1 Remedial Target calculated from soil-water partitioning equation.
Ratio of Compliance Point to Source Concentration	C _{ED} /C ₀	9.74E-01	fraction
			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

Enter method of defining partition co-efficient (using pull down list)

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 4.00E-03 fraction

Organic carbon partition coefficient Koc 1.31E+05 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

Fraction of organic carbon in aquifer foc fraction

Soil water partition coefficient Kd 5.24E+02 l/kg

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

User defined values for dispersivity

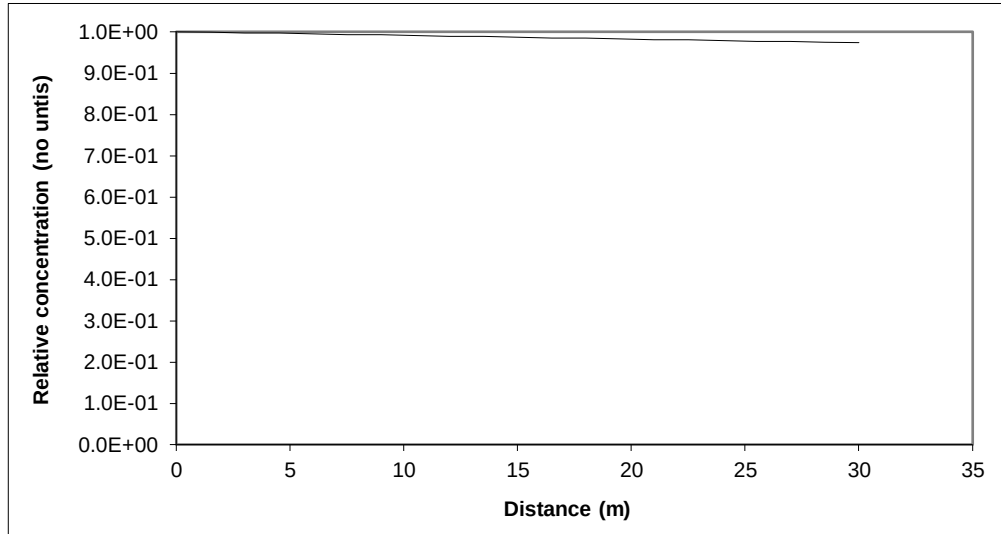
	Enter value	Calc value	Xu & Eckstein
Longitudinal dispersivity ax	3.00E+00	3.00E+00	2.13E+00 m
Transverse dispersivity az	3.00E-01	3.00E-01	2.13E-01 m
Vertical dispersivity ay	1.00E-99	3.00E-02	2.13E-02 m

Note values of dispersivity must be > 0

Xu & Eckstein (1995) report ax = 0.83(log₁₀x)^{2.414} ; az = ax/10, ay = ax/100 are assumed

Note

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



Note: 'Relative concentration' is the ratio of calculated concentration at a given position compared to the source concentration. The calculations assume plume disperses from the top of the aquifer. An alternative solution assuming the centre of the plume is located at the mid-depth of the aquifer is presented in the calculation sheets.

Calculated (relative) concentrations for distance-concentration graph

Ogata Banks

Distance	Relative concentration (No units)	Concentration mg/l
0	1.0E+00	4.21E-02
1.5	9.99E-01	4.21E-02
3.0	9.97E-01	4.20E-02
4.5	9.96E-01	4.20E-02
6.0	9.95E-01	4.19E-02
7.5	9.93E-01	4.19E-02
9.0	9.92E-01	4.18E-02
10.5	9.91E-01	4.17E-02
12.0	9.89E-01	4.17E-02
13.5	9.88E-01	4.16E-02
15.0	9.87E-01	4.16E-02
16.5	9.85E-01	4.15E-02
18.0	9.84E-01	4.15E-02
19.5	9.83E-01	4.14E-02
21.0	9.82E-01	4.14E-02
22.5	9.80E-01	4.13E-02
24.0	9.79E-01	4.12E-02
25.5	9.78E-01	4.12E-02
27.0	9.76E-01	4.11E-02
28.5	9.75E-01	4.11E-02
30.0	9.74E-01	4.10E-02

This sheet calculates the Level 3 remedial target for soils(mg/kg) or for pore water (mg/l), based on the distance to the receptor or compliance located down hydraulic gradient of the source Three solution methods are included, the preferred option is Ogata Banks.By setting a long travel time (e.g. 9E99) it will give the steady state solution, which should always be used when calculating remedial targets.

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 3 remedial target to determine the need for further action.

Note if contaminant is not subject to first order degradation, then set half life as 9.9E+99.

Site being assessed:	NGET Tottenham
Completed by:	M Craske
Date:	#####
Version:	x.xx

R&D Publication 20 Remedial Targets Worksheet, Release 3.2

Level 3 - Groundwater

See Note

Input Parameters (using pull down menu)

Contaminant		Benzo(a)pyrene	from Level 1
Target Concentration	C _T	1.70E-07	mg/l from Level 1

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

Ogata Banks	Equations in HRA publication
-------------	------------------------------

Approach for simulating vertical dispersion: Simulate vertical dispersion in 1 direction

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

Approach for simulating degradation of pollutants: Apply degradation rate to dissolved pollutants only

Initial contaminant concentration in groundwater at plume core	C ₀	1.00E+00	mg/l	Source of parameter value
Half life for degradation of contaminant in water	t _{1/2}	4.50E+03	days	Based on site data
Calculated decay rate	λ	1.54E-04	days ⁻¹	
Width of plume in aquifer at source (perpendicular to flow)	Sz	2.50E+02	m	
Plume thickness at source	Sy	2.54E+00	m	
Saturated aquifer thickness	da	2.54E+00	m	Average thickness of Kempton Park Grave
Bulk density of aquifer materials	ρ	1.80E+00	g/cm ³	Literature estimate for RTD
Effective porosity of aquifer	n	2.00E-01	fraction	Literature estimate for RTD
Hydraulic gradient	i	2.00E-03	fraction	Based on average of site-specific GW measurements (SSE groundwater flow) - 0.0005 - 0.002 between
Hydraulic conductivity of aquifer	K	1.00E+01	m/d	WP 2013 value for KPG
Distance to compliance point	x	3.00E+01	m	Longitudinal dispersivity
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	Transverse dispersivity
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	Vertical dispersivity
Time since pollutant entered groundwater	t	9.99E+99	days	Note values of dispersivity must be > 0
Parameters values determined from options				For calculated value, assumes ax = 0.1 * x, az = 0.01 * x, ay = 0.001 * x
Partition coefficient	Kd	5.24E+02	l/kg	Xu & Eckstein (1995) report ax = 0.83(log ₁₀ x) ^{2.414} ; az = ax/10, ay = ax/100 are assumed
Longitudinal dispersivity	ax	3.00E+00	m	
Transverse dispersivity	az	3.00E-01	m	
Vertical dispersivity	ay	1.00E-99	m	

Calculated Parameters

Groundwater flow velocity	v	1.00E-01	m/d
Retardation factor	Rf	4.72E+03	fraction
Decay rate used	λ	3.27E-08	d ⁻¹
Rate of contaminant flow due to retardation	u	2.12E-05	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C _{ED}	9.55E-01	mg/l
Attenuation factor (one way vertical dispersion, CO/CED)	AF	1.05E+00	

Remedial Targets

Remedial Target	1.78E-07	mg/l	For comparison with measured groundwater concentration.
Ogata Banks			
Distance to compliance point	30	m	
Concentration of contaminant at compliance point after	C _{ED} /C ₀	9.55E-01	mg/l
		1.0E+100	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)

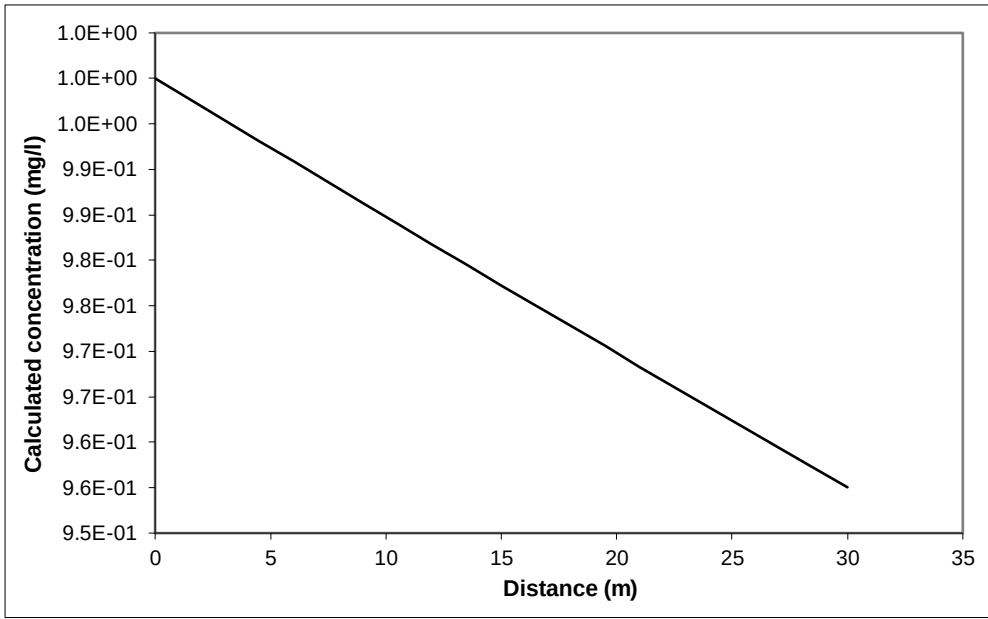
Calculate for non-polar organic chemicals

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	4.00E-03 fraction
Organic carbon partition coefficient	Koc	1.31E+05 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	
Fraction of organic carbon in aquifer	foc	fraction
Soil water partition coefficient	Kd	5.24E+02 l/kg

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

User defined values for dispersivity

Longitudinal dispersivity	ax	3.00E+00	3.00E+00	2.13E+00	m
Transverse dispersivity	az	3.00E-01	3.00E-01	2.13E-01	m
Vertical dispersivity	ay	1.00E-99	3.00E-02	2.13E-02	
Note values of dispersivity must be > 0					
For calculated value, assumes ax = 0.1 * x, az = 0.01 * x, ay = 0.001 * x					
Xu & Eckstein (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.

Note

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

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

The measured groundwater concentration should be compared with the Level 3 remedial target to determine the need for further action. Note if contaminant is not subject to first order degradation, then set half life as 9.0E+99.

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

Calculated concentrations for distance-concentration graph

Ogata Banks From calculation sheet

Distance	Concentration
	mg/l
0	1.0E+00
1.5	9.98E-01
3.0	9.95E-01
4.5	9.93E-01
6.0	9.91E-01
7.5	9.89E-01
9.0	9.86E-01
10.5	9.84E-01
12.0	9.82E-01
13.5	9.80E-01
15.0	9.77E-01
16.5	9.75E-01
18.0	9.73E-01
19.5	9.71E-01
21.0	9.68E-01
22.5	9.66E-01
24.0	9.64E-01
25.5	9.62E-01
27.0	9.59E-01
28.5	9.57E-01
30.0	9.55E-01



Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

This worksheet has been produced in combination with the document 'Remedial Targets Methodology: Hydrogeological risk assessment for land contamination (Environment Agency 2006).

Users of this worksheet should always refer to the User Manual to the Remedial Targets Methodology 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, 2006. (Produced by the Environment Agency's Science Group)

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

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

<u>Details to be completed for each assessment</u>			
Site Name:	NGET Tottenham		
Site Address:			
Completed by:	M Craske	Version:	x.xx
Date:	27-Oct-23		
Contaminant	Benzo(a)pyrene		
Target Concentration (C_T)	7.55282E-07	mg/l	Origin of C_T: Lowest of DWS/EQS

This worksheet can be used to determine remedial targets for soils (Worksheets Level 1 Soil, Level 2 and Level 3 Soil) or to determine remedial targets for groundwater (Level 3 Groundwater). For Level 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 comparison 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 Level 1, 2 and 3 Worksheets.

Worksheet options are identified by brown background and employ a pull-down menus. Data entry are identified as blue background.

Data origin / justification should be noted in cells coloured yellow and fully documented in subsequent reports.

Data carried forward from an earlier worksheet are identified by a light green background

It is recommended that a copy of the original worksheet is saved (all data fields in the original copy are blank).

The spreadsheet also includes a porosity calculation worksheet, a soil impact calculation worksheet and a worksheet that performs some simple hydrogeological calculations.



Level 1 - Soil

Select the method of calculating the soil water
Partition Co-efficient by using the pull down menu
below

Calculate for non-polar organic chemicals

Contaminant	Benzo(a)pyrene
Target concentration	7.55282E-07 mg/l

Input Parameters

Standard entry

Water filled soil porosity	θ_w	3.70E-01	fraction	Conservative value estimated from average site mo
Air filled soil porosity	θ_a	1.90E-01	fraction	Conservative value estimated from average site mo
Bulk density of soil zone material	ρ	1.60E+00	g/cm ³	Conservative Estimate for Made Ground
Henry's Law constant	H	1.86E-05	dimensionless	83

This sheet calculates the Level 1 remedial target for soils(mg/kg) based on a selected target concentration and theoretical calculation of soil water partitioning. Three options are included for determinina the partition coefficient.
The measured soil concentration as mg/kg should be compared with the Level 1 remedial target to determine the need for further action.

Entry if specify partition coefficient (option)

Soil water partition coefficient	Kd		l/kg	3.10E+01
----------------------------------	----	--	------	----------

Entry for non-polar organic chemicals (option)

Fraction of organic carbon (in soil)	foc	8.00E-02	fraction	Average from uncontaminated site samples
Organic carbon partition coefficient	Koc	1.31E+05	l/kg	83

Entry for ionic organic chemicals (option)

Sorption coefficient for neutral species	$K_{oc,n}$		l/kg	
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg	
pH value	pH		pH units	
Acid dissociation constant	pKa			
Fraction of organic carbon (in soil)	foc		fraction	

Soil water partition coefficient used in Level Assessment	Kd	1.05E+04	l/kg	Calculated value
---	----	----------	------	------------------

Level 1 Remedial Target

Level 1 Remedial Target	7.92E-03	mg/kg	(for comparison with soil analyses)
	or		
	7.55282E-07	mg/l	(for comparison with leachate test results)

Site being assessed:	NGET Tottenham
Completed by:	M Craske
Date:	27-Oct-23
Version:	x.xx



Level 2 - Soil

Contaminant	
Target concentration	C _T

Benzo(a)pyrene
7.55282E-07

from Level 1
from Level 1

mg/l

This sheet calculates the Level 2 remedial target for soils (mg/kg) or for pore water (mg/l).

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 2 remedial target to determine the need for further action. Equations presented in 'Hydrogeological risk assessment for land contamination' (Environment Agency 2006)

Input Parameters Variable Value Unit Source of parameter value

Standard entry

Infiltration
Area of contaminant source

Inf
A

7.40E-04
1.25E+04

m/d
m²

ted from EA effective infiltration mapping and 80% ha
Length x width of site (50x250)

Not used in calculation

Entry for groundwater flow below site

Length of contaminant source in direction of groundwater flow
Saturated aquifer thickness
Hydraulic Conductivity of aquifer in which dilution occurs
Hydraulic gradient of water table
Width of contaminant source perpendicular to groundwater flow
Background concentration of contaminant in groundwater beneath site

L
da
K
i
w
Cu

5.00E+01
2.54E+00
1.00E+01
2.00E-03
2.50E+02
0.00E+00

m
m
m/d
fraction
m
mg/l

oximate lenght of site in direction of GW flow (north/s
thickness of Kempton Park Gravel based on BH logs +
WP 2013 value for KPG
between site and off site locations near Pymmes brook
ate site area perpendicular to GW flow (north-east/so

Not used in calculation

Define mixing zone depth by specifying or calculating depth (using pull down list)

Enter mixing zone thickness
Calculated mixing zone thickness

Mz
Mz

Calculate
2.54E+00

m
m

default condition

Calculated Parameters

Dilution Factor	DF	2.37E+00
Level 2 Remedial Target		1.79E-06 or 1.88E-02
		mg/l mg/kg

For comparison with measured pore water concentration. This assumes Level 1 Remedial Target is based on Target Concentrati
For comparison with measured soil concentration. This assumes Level 1
Remedial Target calculated from soil-water

Additional option

Calculation of impact on receptor

Concentration of contaminant in contaminated discharge (entering receptor)

Cc

0.00E+00

mg/l

--

Calculated concentration within receptor (dilution only)

0.00E+00

mg/l

0

Site being assessed:	NGET Tottenham
Completed by:	M Craske
Date:	27-Oct-23
Version:	x.xx

Remedial Targets Worksheet , Release 3.2

Level 3 - Soil

See Note



Input Parameters	Variable	Value	Unit	Source
Contaminant		Benzo(a)pyrene		from Level 1
Target Concentration	C _T	0.00000017	mg/l	from Level 1
Dilution Factor	DF	2.37E+00		from Level 2

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

Ogata Banks	Equations in HRA publication
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Select nature of decay rate (click on brown cell below, then on pull-down menu)

Approach for simulating degradation of pollutants:

Apply degradation rate to dissolved pollutants only

Variable	Value	Unit	Source of parameter value
Soil leachate concentration as mg/l			
Enter source concentration	0.1	mg/l	
Enter soil leachate concentration	4.50E+03	days	
Half life for degradation of contaminant in water	1.54E-04	days ⁻¹	calculated
Calculated decay rate	2.50E+02	m	from Level 2
Width of plume in aquifer at source	2.54E+00	m	from Level 2
Plume thickness in aquifer at source	1.80E+00	g/cm ³	Literature estimate for RTD
Bulk density of aquifer materials	2.00E-01	fraction	Literature estimate for RTD
Effective porosity of aquifer	3.46E-03	fraction	from Level 2 (adjusted)
Hydraulic gradient	1.00E+01	m/d	from Level 2
Hydraulic conductivity of saturated aquifer	3.00E+01	m	Default for aquifer protection
Distance (lateral) to compliance point perpendicular to flow direction		m	default condition
Distance (depth) to compliance point perpendicular to flow direction		m	default condition
Time since pollutant entered groundwater	9.99E+99	days	time variant options only
Parameters values determined from options			
Partition coefficient	Kd	5.24E+02	l/kg see options
Longitudinal dispersivity	ax	3.000	m see options
Transverse dispersivity	az	0.300	m see options
Vertical dispersivity	ay	0.000	m see options

Parameter values should be checked against Level 1 and 2

Calculated Parameters

Variable			
Groundwater flow velocity	v	1.73E-01	m/d
Retardation factor	Rf	4.72E+03	fraction
Decay rate used	λ	3.27E-08	d ⁻¹
Hydraulic gradient used in aquifer flow down-gradient	i	3.46E-03	fraction
Rate of contaminant flow due to retardation	u	3.66E-05	m/d
Ratio of Compliance Point to Source Concentration	C _{ED} /C ₀	9.74E-01	fraction
Attenuation factor (C ₀ /C _{ED})	AF	1.03E+00	fraction
Soil leachate concentration	Co	1.00E-01	

Remedial Targets

Level 3 Remedial Target	4.14E-07	mg/l	For comparison with measured pore water concentration.
Ogata Banks	or		This assumes Level 1 Remedial Target is based on Target Concentration.
	4.34E-03	mg/kg	For comparison with measured soil concentration. This
Distance to compliance point	30	m	assumes Level 1 Remedial Target calculated from soil-water partitioning equation.
Ratio of Compliance Point to Source Concentration	C _{ED} /C ₀	9.74E-01	fraction 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

Enter method of defining partition co-efficient (using pull down list)

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 4.00E-03 fraction

Organic carbon partition coefficient Koc 1.31E+05 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

Fraction of organic carbon in aquifer foc fraction

Soil water partition coefficient Kd 5.24E+02 l/kg

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

User defined values for dispersivity

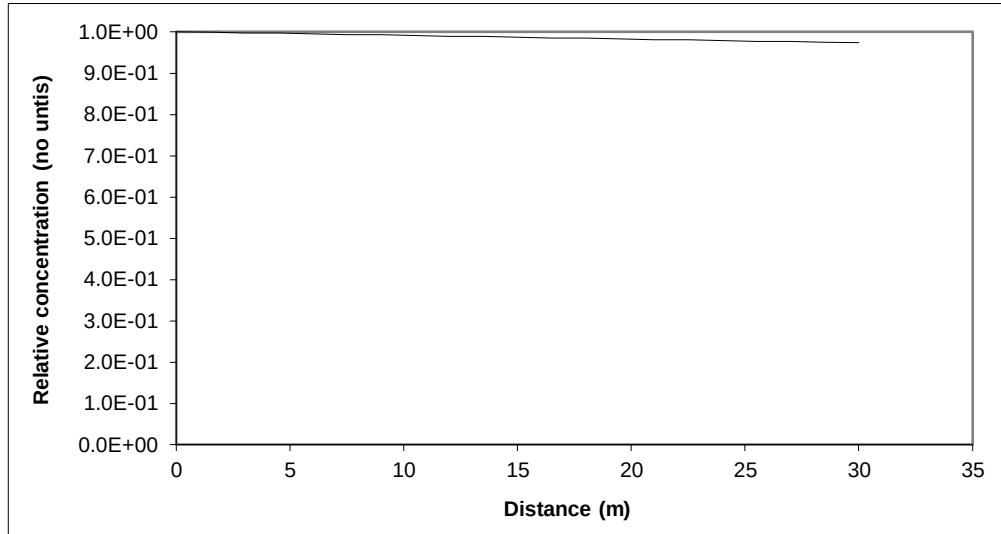
	Enter value	Calc value	Xu & Eckstein
Longitudinal dispersivity ax	3.00E+00	3.00E+00	2.13E+00 m
Transverse dispersivity az	3.00E-01	3.00E-01	2.13E-01 m
Vertical dispersivity ay	1.00E-99	3.00E-02	2.13E-02 m

Note values of dispersivity must be > 0

Xu & Eckstein (1995) report ax = 0.83(log₁₀x)^{2.414}; az = ax/10, ay = ax/100 are assumed

Note

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



Note: 'Relative concentration' is the ratio of calculated concentration at a given position compared to the source concentration. The calculations assume plume disperses from the top of the aquifer. An alternative solution assuming the centre of the plume is located at the mid-depth of the aquifer is presented in the calculation sheets.

Calculated (relative) concentrations for distance-concentration graph

Ogata Banks

From calculation sheet

Distance	Relative concentration (No units)	Concentration mg/l
0	1.0E+00	4.21E-02
1.5	9.99E-01	4.21E-02
3.0	9.97E-01	4.20E-02
4.5	9.96E-01	4.20E-02
6.0	9.95E-01	4.19E-02
7.5	9.93E-01	4.19E-02
9.0	9.92E-01	4.18E-02
10.5	9.91E-01	4.17E-02
12.0	9.89E-01	4.17E-02
13.5	9.88E-01	4.16E-02
15.0	9.87E-01	4.16E-02
16.5	9.85E-01	4.15E-02
18.0	9.84E-01	4.15E-02
19.5	9.83E-01	4.14E-02
21.0	9.82E-01	4.14E-02
22.5	9.80E-01	4.13E-02
24.0	9.79E-01	4.12E-02
25.5	9.78E-01	4.12E-02
27.0	9.76E-01	4.11E-02
28.5	9.75E-01	4.11E-02
30.0	9.74E-01	4.10E-02

This sheet calculates the Level 3 remedial target for soils(mg/kg) or for pore water (mg/l), based on the distance to the receptor or compliance located down hydraulic gradient of the source Three solution methods are included, the preferred option is Ogata Banks.By setting a long travel time (e.g. 9E99) it will give the steady state solution, which should always be used when calculating remedial targets.

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 3 remedial target to determine the need for further action.

Note if contaminant is not subject to first order degradation, then set half life as 9.9E+99.

Site being assessed:	NGET Tottenham
Completed by:	M Craske
Date:	#####
Version:	x.xx

R&D Publication 20 Remedial Targets Worksheet, Release 3.2

Level 3 - Groundwater

See Note

Input Parameters (using pull down menu)

Contaminant		Benzo(a)pyrene	from Level 1
Target Concentration	C _T	1.70E-07	mg/l from Level 1

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

Ogata Banks	Equations in HRA publication
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Approach for simulating vertical dispersion: Simulate vertical dispersion in 1 direction

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

Approach for simulating degradation of pollutants: Apply degradation rate to dissolved pollutants only

Initial contaminant concentration in groundwater at plume core	C ₀	1.00E+00	mg/l	Source of parameter value
Half life for degradation of contaminant in water	t _{1/2}	4.50E+03	days	Based on site data
Calculated decay rate	λ	1.54E-04	days ⁻¹	
Width of plume in aquifer at source (perpendicular to flow)	Sz	2.50E+02	m	
Plume thickness at source	Sy	2.54E+00	m	
Saturated aquifer thickness	da	2.54E+00	m	Average thickness of Kempton Park Grave
Bulk density of aquifer materials	ρ	1.80E+00	g/cm ³	Literature estimate for RTD
Effective porosity of aquifer	n	2.00E-01	fraction	Literature estimate for RTD
Hydraulic gradient	i	2.00E-03	fraction	Based on average of site-specific GW measurements (SSE groundwater flow) - 0.0005 - 0.002 between
Hydraulic conductivity of aquifer	K	1.00E+01	m/d	WP 2013 value for KPG
Distance to compliance point	x	3.00E+01	m	Longitudinal dispersivity
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	Transverse dispersivity
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	Vertical dispersivity
Time since pollutant entered groundwater	t	9.99E+99	days	Note values of dispersivity must be > 0
Parameters values determined from options				For calculated value, assumes ax = 0.1 * x, 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
Partition coefficient	Kd	5.24E+02	l/kg	
Longitudinal dispersivity	ax	3.00E+00	m	
Transverse dispersivity	az	3.00E-01	m	
Vertical dispersivity	ay	1.00E-99	m	

Calculated Parameters

Groundwater flow velocity	v	1.00E-01	m/d
Retardation factor	Rf	4.72E+03	fraction
Decay rate used	λ	3.27E-08	d ⁻¹
Rate of contaminant flow due to retardation	u	2.12E-05	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C _{ED}	9.55E-01	mg/l
Attenuation factor (one way vertical dispersion, CO/CED)	AF	1.05E+00	

Remedial Targets

Remedial Target	1.78E-07	mg/l	For comparison with measured groundwater concentration.
Ogata Banks			
Distance to compliance point	30	m	
Concentration of contaminant at compliance point after	C _{ED} /C ₀	9.55E-01	mg/l
		1.0E+100	days Ogata Banks

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



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

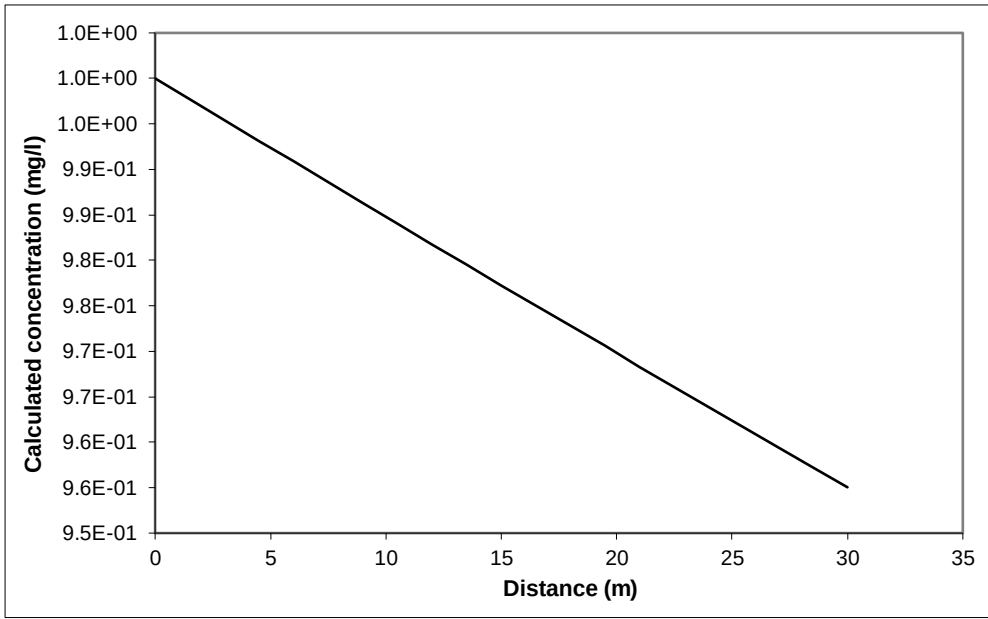
Calculate for non-polar organic chemicals

Entry if specify partition coefficient (option)		
Soil water partition coefficient	Kd	l/kg
Entry for non-polar organic chemicals (option)		
Fraction of organic carbon in aquifer	foc	4.00E-03 fraction
Organic carbon partition coefficient	Koc	1.31E+05 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	
Fraction of organic carbon in aquifer	foc	fraction
Soil water partition coefficient	Kd	5.24E+02 l/kg

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

User defined values for dispersivity

Longitudinal dispersivity	ax	3.00E+00	3.00E+00	2.13E+00	m
Transverse dispersivity	az	3.00E-01	3.00E-01	2.13E-01	m
Vertical dispersivity	ay	1.00E-99	3.00E-02	2.13E-02	



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

Note

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

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

The measured groundwater concentration should be compared with the Level 3 remedial target to determine the need for further action. Note if contaminant is not subject to first order degradation, then set half life as 9.0E+99.

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

Site being assessed:	NGET Tottenham
Completed by:	M Craske
Date:	#####
Version:	x.xx

Calculated concentrations for distance-concentration graph

Ogata Banks From calculation sheet

Distance	Concentration
	mg/l
0	1.0E+00
1.5	9.98E-01
3.0	9.95E-01
4.5	9.93E-01
6.0	9.91E-01
7.5	9.89E-01
9.0	9.86E-01
10.5	9.84E-01
12.0	9.82E-01
13.5	9.80E-01
15.0	9.77E-01
16.5	9.75E-01
18.0	9.73E-01
19.5	9.71E-01
21.0	9.68E-01
22.5	9.66E-01
24.0	9.64E-01
25.5	9.62E-01
27.0	9.59E-01
28.5	9.57E-01
30.0	9.55E-01

Remedial Targets Worksheet , Release 3.2

Level 3 - Soil

See Note



Input Parameters	Variable	Value	Unit	Source
Contaminant		Chloride		from Level 1
Target Concentration	C _T	250	mg/l	from Level 1
Dilution Factor	DF	2.37E+00		from Level 2

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

Ogata Banks	Equations in HRA publication
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Select nature of decay rate (click on brown cell below, then on pull-down menu)

Approach for simulating degradation of pollutants:

Apply degradation rate to dissolved pollutants only

Variable	Value	Unit	Source of parameter value
Soil leachate concentration as mg/l			
Enter source concentration	0.1	mg/l	
Enter soil leachate concentration	9.00E+99	days	
Half life for degradation of contaminant in water	7.70E-101	days ⁻¹	calculated
Calculated decay rate	2.50E+02	m	from Level 2
Width of plume in aquifer at source	2.54E+00	m	from Level 2
Plume thickness in aquifer at source	1.80E+00	g/cm ³	Literature estimate for RTD
Bulk density of aquifer materials	2.00E-01	fraction	Literature estimate for RTD
Effective porosity of aquifer	3.46E-03	fraction	from Level 2 (adjusted)
Hydraulic gradient	1.00E+01	m/d	from Level 2
Hydraulic conductivity of saturated aquifer	3.00E+01	m	Default for aquifer protection
Distance (lateral) to compliance point perpendicular to flow direction		m	default condition
Distance (depth) to compliance point perpendicular to flow direction		m	default condition
Time since pollutant entered groundwater	9.99E+99	days	time variant options only
Parameters values determined from options			
Partition coefficient	Kd	1.00E+00	l/kg see options
Longitudinal dispersivity	ax	3.000	m see options
Transverse dispersivity	az	0.300	m see options
Vertical dispersivity	ay	0.000	m see options

Parameter values should be checked against Level 1 and 2

Calculated Parameters

Variable			
Groundwater flow velocity	v	1.73E-01	m/d
Retardation factor	Rf	1.00E+01	fraction
Decay rate used	λ	7.70E-102	d ⁻¹
Hydraulic gradient used in aquifer flow down-gradient	i	3.46E-03	fraction
Rate of contaminant flow due to retardation	u	1.73E-02	m/d
Ratio of Compliance Point to Source Concentration	C _{ED} /C ₀	1.00E+00	fraction
Attenuation factor (C ₀ /C _{ED})	AF	1.00E+00	fraction
Soil leachate concentration	Co	1.00E-01	

Remedial Targets

Level 3 Remedial Target	5.93E+02	mg/l	For comparison with measured pore water concentration.
Ogata Banks	or		This assumes Level 1 Remedial Target is based on Target Concentration.
	7.31E+02	mg/kg	For comparison with measured soil concentration. This
Distance to compliance point	30	m	assumes Level 1 Remedial Target calculated from soil-water partitioning equation.
Ratio of Compliance Point to Source Concentration	C _{ED} /C ₀	1.00E+00	fraction 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

Enter method of defining partition co-efficient (using pull down list)

User specified value for partition coefficient

Entry if specify partition coefficient (option)

Soil water partition coefficient Kd 1.00E+00 l/kg

Entry for non-polar organic chemicals (option)

Fraction of organic carbon in aquifer foc fraction

Organic carbon partition coefficient Koc l/kg

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

Fraction of organic carbon in aquifer foc fraction

Soil water partition coefficient Kd 1.00E+00 l/kg

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

User defined values for dispersivity

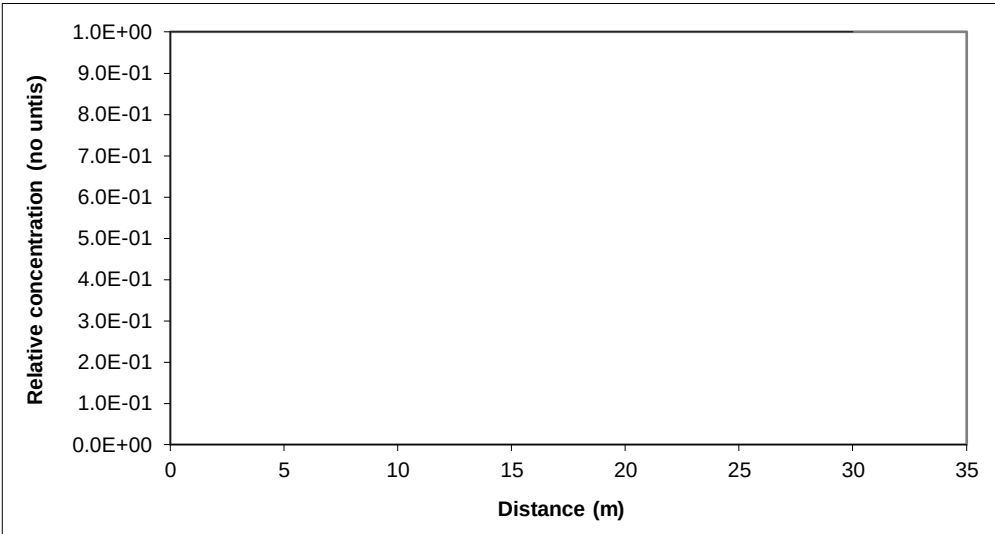
	Enter value	Calc value	Xu & Eckstein	
Longitudinal dispersivity	ax	3.00E+00	3.00E+00	2.13E+00 m
Transverse dispersivity	az	3.00E-01	3.00E-01	2.13E-01 m
Vertical dispersivity	ay	1.00E-99	3.00E-02	2.13E-02 m

Note values of dispersivity must be > 0

Xu & Eckstein (1995) report ax = 0.83(log₁₀x)^{2.414} ; az = ax/10, ay = ax/100 are assumed

Note

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



Note: 'Relative concentration' is the ratio of calculated concentration at a given position compared to the source concentration. The calculations assume plume disperses from the top of the aquifer. An alternative solution assuming the centre of the plume is located at the mid-depth of the aquifer is presented in the calculation sheets.

Calculated (relative) concentrations for distance-concentration graph

Ogata Banks

From calculation sheet

Distance	Relative concentration (No units)	Concentration mg/l
0	1.0E+00	4.21E-02
1.5	1.00E+00	4.21E-02
3.0	1.00E+00	4.21E-02
4.5	1.00E+00	4.21E-02
6.0	1.00E+00	4.21E-02
7.5	1.00E+00	4.21E-02
9.0	1.00E+00	4.21E-02
10.5	1.00E+00	4.21E-02
12.0	1.00E+00	4.21E-02
13.5	1.00E+00	4.21E-02
15.0	1.00E+00	4.21E-02
16.5	1.00E+00	4.21E-02
18.0	1.00E+00	4.21E-02
19.5	1.00E+00	4.21E-02
21.0	1.00E+00	4.21E-02
22.5	1.00E+00	4.21E-02
24.0	1.00E+00	4.21E-02
25.5	1.00E+00	4.21E-02
27.0	1.00E+00	4.21E-02
28.5	1.00E+00	4.21E-02
30.0	1.00E+00	4.21E-02

This sheet calculates the Level 3 remedial target for soils(mg/kg) or for pore water (mg/l), based on the distance to the receptor or compliance located down hydraulic gradient of the source Three solution methods are included, the preferred option is Ogata Banks.By setting a long travel time (e.g. 9E99) it will give the steady state solution, which should always be used when calculating remedial targets.

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 3 remedial target to determine the need for further action.

Note if contaminant is not subject to first order degradation, then set half life as 9.9E+99.

Site being assessed:	NGET Tottenham
Completed by:	M Craske
Date:	#####
Version:	x.xx

R&D Publication 20 Remedial Targets Worksheet, Release 3.2

Level 3 - Groundwater

See Note

Input Parameters (using pull down menu)

Contaminant	Chloride	from Level 1
Target Concentration	C _T 2.50E+02	mg/l from Level 1

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

Ogata Banks	Equations in HRA publication
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Approach for simulating vertical dispersion: Simulate vertical dispersion in 1 direction

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

Approach for simulating degradation of pollutants: Apply degradation rate to dissolved pollutants only

Initial contaminant concentration in groundwater at plume core	C ₀	1.00E+00	mg/l	Source of parameter value
Half life for degradation of contaminant in water	t _{1/2}	9.00E+99	days	Based on site data
Calculated decay rate	λ	7.70E-101	days ⁻¹	0
Width of plume in aquifer at source (perpendicular to flow)	Sz	2.50E+02	m	
Plume thickness at source	Sy	2.54E+00	m	
Saturated aquifer thickness	da	2.54E+00	m	Average thickness of Kempton Park Grave
Bulk density of aquifer materials	ρ	1.80E+00	g/cm ³	Literature estimate for RTD
Effective porosity of aquifer	n	2.00E-01	fraction	Literature estimate for RTD
Hydraulic gradient	i	2.00E-03	fraction	Based on average of site-specific GW measurements (SSE groundwater flow) - 0.0005 - 0.002 between
Hydraulic conductivity of aquifer	K	1.00E+01	m/d	WP 2013 value for KPG
Distance to compliance point	x	3.00E+01	m	Longitudinal dispersivity
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	Transverse dispersivity
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	Vertical dispersivity
Time since pollutant entered groundwater	t	9.99E+99	days	Note values of dispersivity must be > 0
Parameters values determined from options				
Partition coefficient	Kd	1.00E+00	l/kg	For calculated value, assumes ax = 0.1 * x, az = 0.01 * x, ay = 0.001 * x
Longitudinal dispersivity	ax	3.00E+00	m	Xu & Eckstein (1995) report ax = 0.83(log ₁₀ x) ^{2.414} ; az = ax/10, ay = ax/100 are assumed
Transverse dispersivity	az	3.00E-01	m	
Vertical dispersivity	ay	1.00E-99	m	

Calculated Parameters

Groundwater flow velocity	v	1.00E-01	m/d
Retardation factor	Rf	1.00E+01	fraction
Decay rate used	λ	7.70E-102	d ⁻¹
Rate of contaminant flow due to retardation	u	1.00E-02	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C _{ED}	1.00E+00	mg/l
Attenuation factor (one way vertical dispersion, CO/CED)	AF	1.00E+00	

Remedial Targets

Remedial Target	2.50E+02	mg/l	For comparison with measured groundwater concentration.
Ogata Banks			
Distance to compliance point	30	m	
Concentration of contaminant at compliance point after	C _{ED} /C ₀	1.00E+00	mg/l
		1.0E+100	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)

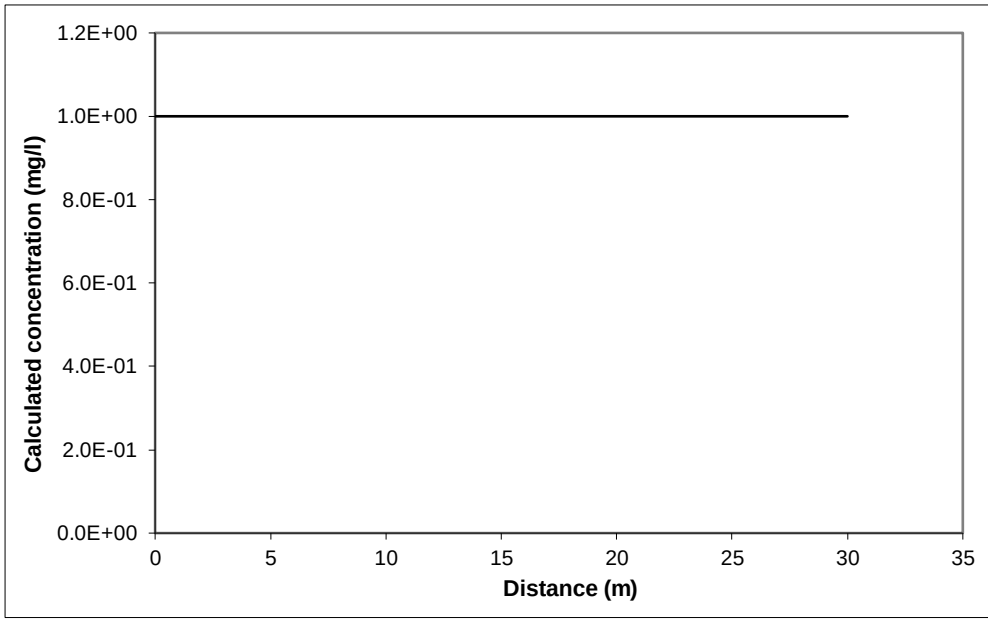
User specified value for partition coefficient

Entry if specify partition coefficient (option)	Kd	1.00E+00	l/kg
Soil water partition coefficient			
Entry for non-polar organic chemicals (option)	foc		fraction
Fraction of organic carbon in aquifer			
Organic carbon partition coefficient	Koc		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		
Fraction of organic carbon in aquifer	foc		fraction
Soil water partition coefficient	Kd	1.00E+00	l/kg

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

User defined values for dispersivity

Enter value	Calc value Xu & Eckstein	m
ax	3.00E+00	3.00E+00 2.13E+00 m
az	3.00E-01	3.00E-01 2.13E-01 m
ay	1.00E-99	3.00E-02 2.13E-02 m



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

Note

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

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

The measured groundwater concentration should be compared with the Level 3 remedial target to determine the need for further action. Note if contaminant is not subject to first order degradation, then set half life as 9.0E+99.

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

Site being assessed:	NGET Tottenham
Completed by:	M Craske
Date:	#####
Version:	x.xx

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration
	mg/l
0	1.0E+00
1.5	1.00E+00
3.0	1.00E+00
4.5	1.00E+00
6.0	1.00E+00
7.5	1.00E+00
9.0	1.00E+00
10.5	1.00E+00
12.0	1.00E+00
13.5	1.00E+00
15.0	1.00E+00
16.5	1.00E+00
18.0	1.00E+00
19.5	1.00E+00
21.0	1.00E+00
22.5	1.00E+00
24.0	1.00E+00
25.5	1.00E+00
27.0	1.00E+00
28.5	1.00E+00
30.0	1.00E+00



Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

This worksheet has been produced in combination with the document 'Remedial Targets Methodology: Hydrogeological risk assessment for land contamination (Environment Agency 2006).

Users of this worksheet should always refer to the User Manual to the Remedial Targets Methodology and to relevant guidance on UK legislation and policy, in order to understand how this procedure should be applied in an appropriate context.

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

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

Details to be completed for each assessment

Site Name:	NGET Tottenham		
Site Address:			
Completed by:	M Craske		
Date:	27-Oct-23	Version:	x.xx
Contaminant	Chloride		
Target Concentration (C_T)	1046.138823	mg/l	Origin of C_T: Lowest of DWS/EQS

This worksheet can be used to determine remedial targets for soils (Worksheets Level 1 Soil, Level 2 and Level 3 Soil) or to determine remedial targets for groundwater (Level 3 Groundwater). For Level 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 comparison 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 Level 1, 2 and 3 Worksheets.

Worksheet options are identified by brown background and employ a pull-down menus. Data entry are identified as blue background.

Data origin / justification should be noted in cells coloured yellow and fully documented in subsequent reports.

Data carried forward from an earlier worksheet are identified by a light green background

It is recommended that a copy of the original worksheet is saved (all data fields in the original copy are blank).

The spreadsheet also includes a porosity calculation worksheet, a soil impact calculation worksheet and a worksheet that performs some simple hydrogeological calculations.



Level 1 - Soil

Select the method of calculating the soil water
Partition Co-efficient by using the pull down menu
below

User specified value for partition coefficient

Contaminant	Chloride
Target concentration	1046.138823 mg/l

Input Parameters

Standard entry

Water filled soil porosity	θ_w	3.70E-01	fraction	Conservative value estimated from average site mo
Air filled soil porosity	θ_a	1.90E-01	fraction	Conservative value estimated from average site mo
Bulk density of soil zone material	ρ	1.60E+00	g/cm ³	Conservative Estimate for Made Ground
Henry's Law constant	H	0.00E+00	dimensionless	0

This sheet calculates the Level 1 remedial target for soils(mg/kg) based on a selected target concentration and theoretical calculation of soil water partitioning. Three options are included for determining the partition coefficient. The measured soil concentration as mg/kg should be compared with the Level 1 remedial target to determine the need for further action.

Entry if specify partition coefficient (option)

Soil water partition coefficient	Kd	1.00E+00	l/kg	0.00E+00
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Entry for non-polar organic chemicals (option)

Fraction of organic carbon (in soil)	foc		fraction	GI average, uncontaminated samples
Organic carbon partition coefficient	Koc		l/kg	86

Entry for ionic organic chemicals (option)

Sorption coefficient for neutral species	$K_{oc,n}$		l/kg	
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg	
pH value	pH		pH units	
Acid dissociation constant	pKa			
Fraction of organic carbon (in soil)	foc		fraction	

Soil water partition coefficient used in Level Assessment	Kd	1.00E+00	l/kg	Specified value
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Level 1 Remedial Target

Level 1 Remedial Target	1.29E+03	mg/kg	(for comparison with soil analyses)
	or		
	1046.138823	mg/l	(for comparison with leachate test results)

Site being assessed:	NGET Tottenham
Completed by:	M Craske
Date:	27-Oct-23
Version:	x.xx



Level 2 - Soil

Contaminant Target concentration C_T Chloride 1046.138823 mg/l from Level 1 from Level 1

This sheet calculates the Level 2 remedial target for soils (mg/kg) or for pore water (mg/l).

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 2 remedial target to determine the need for further action. Equations presented in 'Hydrogeological risk assessment for land contamination' (Environment Agency 2006)

Input Parameters		Variable	Value	Unit	Source of parameter value
Standard entry	Infiltration	Inf	7.40E-04	m/d	Estimated from EA effective infiltration mapping and 80% ha
	Area of contaminant source	A	1.25E+04	m ²	Length x width of site (50x250) Not used in calculation
Entry for groundwater flow below site	Length of contaminant source in direction of groundwater flow	L	5.00E+01	m	Estimated length of site in direction of GW flow (north/south)
	Saturated aquifer thickness	da	2.54E+00	m	Thickness of Kempton Park Gravel based on BH logs +
	Hydraulic Conductivity of aquifer in which dilution occurs	K	1.00E+01	m/d	WP 2013 value for KPG
	Hydraulic gradient of water table	i	2.00E-03	fraction	Between site and off site locations near Pymmes brook
	Width of contaminant source perpendicular to groundwater flow	w	2.50E+02	m	Estimated site area perpendicular to GW flow (north-east/south-west)
	Background concentration of contaminant in groundwater beneath site	Cu	0.00E+00	mg/l	Not used in calculation
	Define mixing zone depth by specifying or calculating depth (using pull down list)		Calculate		default condition
	Enter mixing zone thickness	Mz		m	
	Calculated mixing zone thickness	Mz	2.54E+00	m	

Calculated Parameters

Dilution Factor	DF	2.37E+00	
Level 2 Remedial Target		2.48E+03 mg/l or 3.06E+03 mg/kg	For comparison with measured pore water concentration. This assumes Level 1 Remedial Target is based on Target Concentration of 1046.138823 mg/l. For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water

Additional option

Calculation of impact on receptor

Concentration of contaminant in contaminated discharge (entering receptor)	Cc	0.00E+00	mg/l	
Calculated concentration within receptor (dilution only)		0.00E+00	mg/l	0

Site being assessed:	NGET Tottenham
Completed by:	M Craske
Date:	27-Oct-23
Version:	x.xx



Level 1 - Soil

Select the method of calculating the soil water
Partition Co-efficient by using the pull down menu
below

User specified value for partition coefficient

Contaminant	Chloride
Target concentration	1046.138823 mg/l

Input Parameters

Standard entry

Water filled soil porosity	θ_w	3.70E-01	fraction	Conservative value estimated from average site mo
Air filled soil porosity	θ_a	1.90E-01	fraction	Conservative value estimated from average site mo
Bulk density of soil zone material	ρ	1.60E+00	g/cm ³	Conservative Estimate for Made Ground
Henry's Law constant	H	0.00E+00	dimensionless	0

This sheet calculates the Level 1 remedial target for soils(mg/kg) based on a selected target concentration and theoretical calculation of soil water partitioning. Three options are included for determining the partition coefficient. The measured soil concentration as mg/kg should be compared with the Level 1 remedial target to determine the need for further action.

Entry if specify partition coefficient (option)

Soil water partition coefficient	Kd	1.00E+00	l/kg	0.00E+00
----------------------------------	----	----------	------	----------

Entry for non-polar organic chemicals (option)

Fraction of organic carbon (in soil)	foc		fraction	GI average, uncontaminated samples
Organic carbon partition coefficient	Koc		l/kg	86

Entry for ionic organic chemicals (option)

Sorption coefficient for neutral species	$K_{oc,n}$		l/kg	
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg	
pH value	pH		pH units	
Acid dissociation constant	pKa			
Fraction of organic carbon (in soil)	foc		fraction	

Soil water partition coefficient used in Level Assessment	Kd	1.00E+00	l/kg	Specified value
---	----	----------	------	-----------------

Level 1 Remedial Target

Level 1 Remedial Target	1.29E+03	mg/kg	(for comparison with soil analyses)
	or		
	1046.138823	mg/l	(for comparison with leachate test results)

Site being assessed:	NGET Tottenham
Completed by:	M Craske
Date:	27-Oct-23
Version:	x.xx



Level 2 - Soil

Contaminant Target concentration C_T Chloride 1046.138823 mg/l from Level 1 from Level 1

This sheet calculates the Level 2 remedial target for soils (mg/kg) or for pore water (mg/l).

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 2 remedial target to determine the need for further action. Equations presented in 'Hydrogeological risk assessment for land contamination' (Environment Agency 2006)

Input Parameters		Variable	Value	Unit	Source of parameter value
Standard entry	Infiltration	Inf	7.40E-04	m/d	Estimated from EA effective infiltration mapping and 80% ha
	Area of contaminant source	A	1.25E+04	m ²	Length x width of site (50x250) Not used in calculation
Entry for groundwater flow below site	Length of contaminant source in direction of groundwater flow	L	5.00E+01	m	Approximate length of site in direction of GW flow (north/south)
	Saturated aquifer thickness	da	2.54E+00	m	Thickness of Kempton Park Gravel based on BH logs +
	Hydraulic Conductivity of aquifer in which dilution occurs	K	1.00E+01	m/d	WP 2013 value for KPG
	Hydraulic gradient of water table	i	2.00E-03	fraction	Between site and off site locations near Pymmes brook
	Width of contaminant source perpendicular to groundwater flow	w	2.50E+02	m	Approximate site area perpendicular to GW flow (north-east/south-west)
	Background concentration of contaminant in groundwater beneath site	Cu	0.00E+00	mg/l	Not used in calculation
	Define mixing zone depth by specifying or calculating depth (using pull down list)		Calculate		default condition
	Enter mixing zone thickness	Mz		m	
	Calculated mixing zone thickness	Mz	2.54E+00	m	

Calculated Parameters

Dilution Factor	DF	2.37E+00	
Level 2 Remedial Target		2.48E+03 or 3.06E+03	mg/l or mg/kg
For comparison with measured pore water concentration. This assumes Level 1 Remedial Target is based on Target Concentration			
For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water			

Additional option

Calculation of impact on receptor

Concentration of contaminant in contaminated discharge (entering receptor)	Cc	0.00E+00	mg/l	
Calculated concentration within receptor (dilution only)		0.00E+00	mg/l	0

Site being assessed:	NGET Tottenham
Completed by:	M Craske
Date:	27-Oct-23
Version:	x.xx

Remedial Targets Worksheet , Release 3.2

Level 3 - Soil

See Note



Input Parameters	Variable	Value	Unit	Source
Contaminant		Chloride		from Level 1
Target Concentration	C _T	250	mg/l	from Level 1
Dilution Factor	DF	2.37E+00		from Level 2

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

Ogata Banks	Equations in HRA publication
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Select nature of decay rate (click on brown cell below, then on pull-down menu)

Approach for simulating degradation of pollutants:

Apply degradation rate to dissolved pollutants only

Variable	Value	Unit	Source of parameter value
Soil leachate concentration as mg/l			
Enter source concentration	0.1	mg/l	
Enter soil leachate concentration	9.00E+99	days	
Half life for degradation of contaminant in water	7.70E-101	days ⁻¹	calculated
Calculated decay rate	2.50E+02	m	from Level 2
Width of plume in aquifer at source	2.54E+00	m	from Level 2
Plume thickness in aquifer at source	1.80E+00	g/cm ³	Literature estimate for RTD
Bulk density of aquifer materials	2.00E-01	fraction	Literature estimate for RTD
Effective porosity of aquifer	3.46E-03	fraction	from Level 2 (adjusted)
Hydraulic gradient	1.00E+01	m/d	from Level 2
Hydraulic conductivity of saturated aquifer	3.00E+01	m	Default for aquifer protection
Distance (lateral) to compliance point perpendicular to flow direction		m	default condition
Distance (depth) to compliance point perpendicular to flow direction		m	default condition
Time since pollutant entered groundwater	9.99E+99	days	time variant options only
Parameters values determined from options			
Partition coefficient	Kd	1.00E+00	l/kg see options
Longitudinal dispersivity	ax	3.000	m see options
Transverse dispersivity	az	0.300	m see options
Vertical dispersivity	ay	0.000	m see options

Parameter values should be checked against Level 1 and 2

Calculated Parameters

Variable			
Groundwater flow velocity	v	1.73E-01	m/d
Retardation factor	Rf	1.00E+01	fraction
Decay rate used	λ	7.70E-102	d ⁻¹
Hydraulic gradient used in aquifer flow down-gradient	i	3.46E-03	fraction
Rate of contaminant flow due to retardation	u	1.73E-02	m/d
Ratio of Compliance Point to Source Concentration	C _{ED} /C ₀	1.00E+00	fraction
Attenuation factor (C ₀ /C _{ED})	AF	1.00E+00	fraction
Soil leachate concentration	Co	1.00E-01	

Remedial Targets

Level 3 Remedial Target	5.93E+02	mg/l	For comparison with measured pore water concentration.
Ogata Banks	or		This assumes Level 1 Remedial Target is based on Target Concentration.
	7.31E+02	mg/kg	For comparison with measured soil concentration. This
Distance to compliance point	30	m	assumes Level 1 Remedial Target calculated from soil-water partitioning equation.
Ratio of Compliance Point to Source Concentration	C _{ED} /C ₀	1.00E+00	fraction 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

Enter method of defining partition co-efficient (using pull down list)

User specified value for partition coefficient

Entry if specify partition coefficient (option)

Soil water partition coefficient Kd 1.00E+00 l/kg

Entry for non-polar organic chemicals (option)

Fraction of organic carbon in aquifer foc fraction

Organic carbon partition coefficient Koc l/kg

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

Fraction of organic carbon in aquifer foc fraction

Soil water partition coefficient Kd 1.00E+00 l/kg

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

User defined values for dispersivity

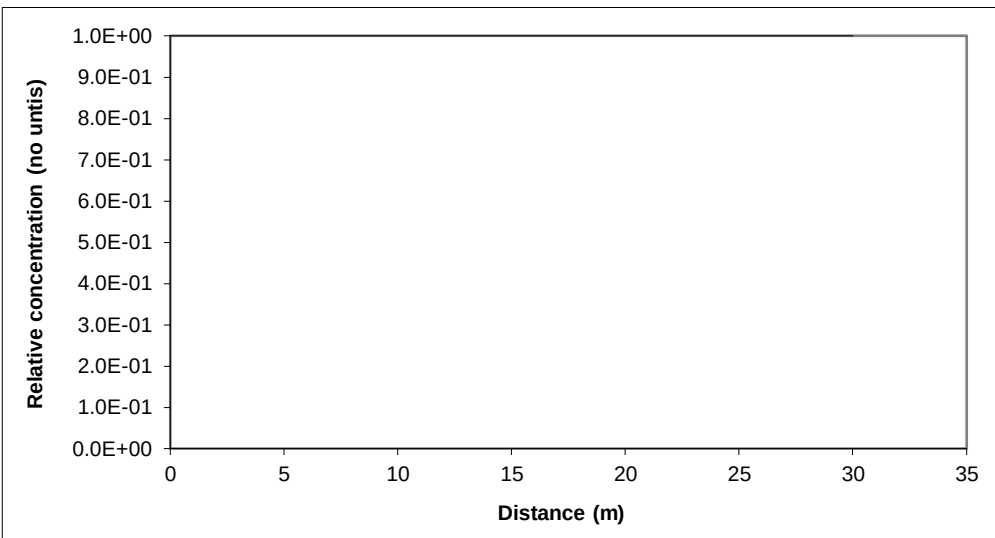
	Enter value	Calc value	Xu & Eckstein	
Longitudinal dispersivity	ax	3.00E+00	3.00E+00	2.13E+00 m
Transverse dispersivity	az	3.00E-01	3.00E-01	2.13E-01 m
Vertical dispersivity	ay	1.00E-99	3.00E-02	2.13E-02 m

Note values of dispersivity must be > 0

Xu & Eckstein (1995) report ax = 0.83(log₁₀x)^{2.414} ; az = ax/10, ay = ax/100 are assumed

Note

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



Note: 'Relative concentration' is the ratio of calculated concentration at a given position compared to the source concentration. The calculations assume plume disperses from the top of the aquifer. An alternative solution assuming the centre of the plume is located at the mid-depth of the aquifer is presented in the calculation sheets.

Calculated (relative) concentrations for distance-concentration graph

Ogata Banks

From calculation sheet

Distance	Relative concentration (No units)	Concentration mg/l
0	1.0E+00	4.21E-02
1.5	1.00E+00	4.21E-02
3.0	1.00E+00	4.21E-02
4.5	1.00E+00	4.21E-02
6.0	1.00E+00	4.21E-02
7.5	1.00E+00	4.21E-02
9.0	1.00E+00	4.21E-02
10.5	1.00E+00	4.21E-02
12.0	1.00E+00	4.21E-02
13.5	1.00E+00	4.21E-02
15.0	1.00E+00	4.21E-02
16.5	1.00E+00	4.21E-02
18.0	1.00E+00	4.21E-02
19.5	1.00E+00	4.21E-02
21.0	1.00E+00	4.21E-02
22.5	1.00E+00	4.21E-02
24.0	1.00E+00	4.21E-02
25.5	1.00E+00	4.21E-02
27.0	1.00E+00	4.21E-02
28.5	1.00E+00	4.21E-02
30.0	1.00E+00	4.21E-02

This sheet calculates the Level 3 remedial target for soils(mg/kg) or for pore water (mg/l), based on the distance to the receptor or compliance located down hydraulic gradient of the source Three solution methods are included, the preferred option is Ogata Banks.By setting a long travel time (e.g. 9E99) it will give the steady state solution, which should always be used when calculating remedial targets.

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 3 remedial target to determine the need for further action.

Note if contaminant is not subject to first order degradation, then set half life as 9.9E+99.

Site being assessed:	NGET Tottenham
Completed by:	M Craske
Date:	#####
Version:	x.xx

R&D Publication 20 Remedial Targets Worksheet, Release 3.2

Level 3 - Groundwater

See Note

Input Parameters (using pull down menu)

Contaminant	Chloride	from Level 1
Target Concentration	C _T 2.50E+02	mg/l from Level 1

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

Ogata Banks	Equations in HRA publication
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Approach for simulating vertical dispersion: Simulate vertical dispersion in 1 direction

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

Approach for simulating degradation of pollutants: Apply degradation rate to dissolved pollutants only

Initial contaminant concentration in groundwater at plume core	C ₀	1.00E+00	mg/l	Source of parameter value
Half life for degradation of contaminant in water	t _{1/2}	9.00E+99	days	Based on site data
Calculated decay rate	λ	7.70E-101	days ⁻¹	0
Width of plume in aquifer at source (perpendicular to flow)	Sz	2.50E+02	m	
Plume thickness at source	Sy	2.54E+00	m	
Saturated aquifer thickness	da	2.54E+00	m	Average thickness of Kempton Park Grave
Bulk density of aquifer materials	ρ	1.80E+00	g/cm ³	Literature estimate for RTD
Effective porosity of aquifer	n	2.00E-01	fraction	Literature estimate for RTD
Hydraulic gradient	i	2.00E-03	fraction	Based on average of site-specific GW measurements (SSE groundwater flow) - 0.0005 - 0.002 between
Hydraulic conductivity of aquifer	K	1.00E+01	m/d	WP 2013 value for KPG
Distance to compliance point	x	3.00E+01	m	Longitudinal dispersivity
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	Transverse dispersivity
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	Vertical dispersivity
Time since pollutant entered groundwater	t	9.99E+99	days	Note values of dispersivity must be > 0
Parameters values determined from options				
Partition coefficient	Kd	1.00E+00	l/kg	For calculated value, assumes ax = 0.1 * x, az = 0.01 * x, ay = 0.001 * x
Longitudinal dispersivity	ax	3.00E+00	m	Xu & Eckstein (1995) report ax = 0.83(log ₁₀ x) ^{2.414} ; az = ax/10, ay = ax/100 are assumed
Transverse dispersivity	az	3.00E-01	m	
Vertical dispersivity	ay	1.00E-99	m	

Calculated Parameters

Groundwater flow velocity	v	1.00E-01	m/d
Retardation factor	Rf	1.00E+01	fraction
Decay rate used	λ	7.70E-102	d ⁻¹
Rate of contaminant flow due to retardation	u	1.00E-02	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C _{ED}	1.00E+00	mg/l
Attenuation factor (one way vertical dispersion, CO/CED)	AF	1.00E+00	

Remedial Targets

Remedial Target	2.50E+02	mg/l	For comparison with measured groundwater concentration.
Ogata Banks			
Distance to compliance point	30	m	
Concentration of contaminant at compliance point after	C _{ED} /C ₀ 1.00E+00 1.0E+100	mg/l days	Ogata Banks

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

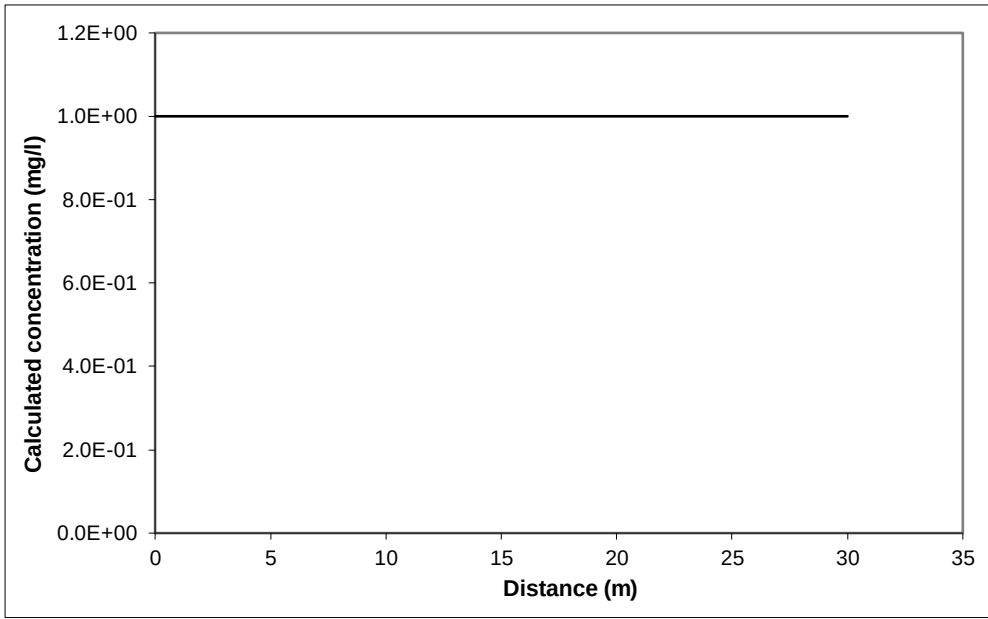


Select Method for deriving Partition Co-efficient (using pull down menu)

User specified value for partition coefficient	
Entry if specify partition coefficient (option)	
Soil water partition coefficient	Kd 1.00E+00 l/kg
Entry for non-polar organic chemicals (option)	
Fraction of organic carbon in aquifer	foc fraction
Organic carbon partition coefficient	Koc 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
Fraction of organic carbon in aquifer	foc fraction
Soil water partition coefficient	Kd 1.00E+00 l/kg

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

User defined values for dispersivity	
Longitudinal dispersivity	ax 3.00E+00 3.00E+00 2.13E+00 m
Transverse dispersivity	az 3.00E-01 3.00E-01 2.13E-01 m
Vertical dispersivity	ay 1.00E-99 3.00E-02 2.13E-02



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

Note

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

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

The measured groundwater concentration should be compared with the Level 3 remedial target to determine the need for further action. Note if contaminant is not subject to first order degradation, then set half life as 9.0E+99.

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

Site being assessed:	NGET Tottenham
Completed by:	M Craske
Date:	#####
Version:	x.xx

Calculated concentrations for distance-concentration graph

Ogata Banks From calculation sheet

Distance	Concentration
	mg/l
0	1.0E+00
1.5	1.00E+00
3.0	1.00E+00
4.5	1.00E+00
6.0	1.00E+00
7.5	1.00E+00
9.0	1.00E+00
10.5	1.00E+00
12.0	1.00E+00
13.5	1.00E+00
15.0	1.00E+00
16.5	1.00E+00
18.0	1.00E+00
19.5	1.00E+00
21.0	1.00E+00
22.5	1.00E+00
24.0	1.00E+00
25.5	1.00E+00
27.0	1.00E+00
28.5	1.00E+00
30.0	1.00E+00



Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

This worksheet has been produced in combination with the document 'Remedial Targets Methodology: Hydrogeological risk assessment for land contamination (Environment Agency 2006).

Users of this worksheet should always refer to the User Manual to the Remedial Targets Methodology and to relevant guidance on UK legislation and policy, in order to understand how this procedure should be applied in an appropriate context.

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

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

<u>Details to be completed for each assessment</u>			
Site Name:	NGET Tottenham		
Site Address:			
Completed by:	M Craske	Version:	x.xx
Date:	27-Oct-23		
Contaminant	Chloride		
Target Concentration (C_T)	1046.138823	mg/l	Origin of C_T: Lowest of DWS/EQS

This worksheet can be used to determine remedial targets for soils (Worksheets Level 1 Soil, Level 2 and Level 3 Soil) or to determine remedial targets for groundwater (Level 3 Groundwater). For Level 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 comparison 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 Level 1, 2 and 3 Worksheets.

Worksheet options are identified by brown background and employ a pull-down menus. Data entry are identified as blue background.

Data origin / justification should be noted in cells coloured yellow and fully documented in subsequent reports.

Data carried forward from an earlier worksheet are identified by a light green background

It is recommended that a copy of the original worksheet is saved (all data fields in the original copy are blank).

The spreadsheet also includes a porosity calculation worksheet, a soil impact calculation worksheet and a worksheet that performs some simple hydrogeological calculations.



Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

This worksheet has been produced in combination with the document 'Remedial Targets Methodology: Hydrogeological risk assessment for land contamination (Environment Agency 2006).

Users of this worksheet should always refer to the User Manual to the Remedial Targets Methodology and to relevant guidance on UK legislation and policy, in order to understand how this procedure should be applied in an appropriate context.

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

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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 functions).

Details to be completed for each assessment

Site Name:	NGET Tottenham		
Site Address:			
Completed by:	M Craske	Version:	x.xx
Date:	27-Oct-23		
Contaminant	Ethylbenzene		
Target Concentration (C_T)	0.29804784	mg/l	Origin of C_T: Lowest of DWS/EQS

This worksheet can be used to determine remedial targets for soils (Worksheets Level 1 Soil, Level 2 and Level 3 Soil) or to determine remedial targets for groundwater (Level 3 Groundwater). For Level 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 comparison 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 Level 1, 2 and 3 Worksheets.

Worksheet options are identified by brown background and employ a pull-down menus. Data entry are identified as blue background.

Data origin / justification should be noted in cells coloured yellow and fully documented in subsequent reports.

Data carried forward from an earlier worksheet are identified by a light green background

It is recommended that a copy of the original worksheet is saved (all data fields in the original copy are blank).

The spreadsheet also includes a porosity calculation worksheet, a soil impact calculation worksheet and a worksheet that performs some simple hydrogeological calculations.



Level 1 - Soil

Select the method of calculating the soil water
Partition Co-efficient by using the pull down menu
below

Calculate for non-polar organic chemicals

Contaminant	Ethylbenzene
Target concentration	0.29804784 mg/l

Input Parameters

Standard entry

Water filled soil porosity	θ_w	3.70E-01	fraction	Conservative value estimated from average site mo
Air filled soil porosity	θ_a	1.90E-01	fraction	Conservative value estimated from average site mo
Bulk density of soil zone material	ρ	1.60E+00	g/cm ³	Conservative Estimate for Made Ground
Henry's Law constant	H	3.58E-01	dimensionless	83

This sheet calculates the Level 1 remedial target for soils(mg/kg) based on a selected target concentration and theoretical calculation of soil water partitioning. Three options are included for determinina the partition coefficient.
The measured soil concentration as mg/kg should be compared with the Level 1 remedial target to determine the need for further action.

Entry if specify partition coefficient (option)

Soil water partition coefficient	Kd		l/kg	3.10E+01
----------------------------------	----	--	------	----------

Entry for non-polar organic chemicals (option)

Fraction of organic carbon (in soil)	foc	8.00E-02	fraction	Average from uncontaminated site samples
Organic carbon partition coefficient	Koc	5.37E+02	l/kg	83

Entry for ionic organic chemicals (option)

Sorption coefficient for neutral species	$K_{oc,n}$		l/kg	
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg	
pH value	pH		pH units	
Acid dissociation constant	pKa			
Fraction of organic carbon (in soil)	foc		fraction	

Soil water partition coefficient used in Level Assessment	Kd	4.30E+01	l/kg	Calculated value
---	----	----------	------	------------------

Level 1 Remedial Target

Level 1 Remedial Target	1.29E+01	mg/kg	(for comparison with soil analyses)
	or		
	0.29804784	mg/l	(for comparison with leachate test results)

Site being assessed:	NGET Tottenham
Completed by:	M Craske
Date:	27-Oct-23
Version:	x.xx



Level 2 - Soil

Contaminant Target concentration C_T Ethylbenzene 0.29804784 mg/l from Level 1 from Level 1

This sheet calculates the Level 2 remedial target for soils (mg/kg) or for pore water (mg/l).

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 2 remedial target to determine the need for further action. Equations presented in 'Hydrogeological risk assessment for land contamination' (Environment Agency 2006)

Input Parameters	Variable	Value	Unit	Source of parameter value
Standard entry				
Infiltration	Inf	7.40E-04	m/d	Estimated from EA effective infiltration mapping and 80% ha
Area of contaminant source	A	1.25E+04	m ²	Length x width of site (50x250) Not used in calculation
Entry for groundwater flow below site				
Length of contaminant source in direction of groundwater flow	L	5.00E+01	m	Approximate length of site in direction of GW flow (north/south)
Saturated aquifer thickness	da	2.54E+00	m	Thickness of Kempton Park Gravel based on BH logs +
Hydraulic Conductivity of aquifer in which dilution occurs	K	1.00E+01	m/d	WP 2013 value for KPG
Hydraulic gradient of water table	i	2.00E-03	fraction	Between site and off site locations near Pymmes brook
Width of contaminant source perpendicular to groundwater flow	w	2.50E+02	m	Approximate site area perpendicular to GW flow (north-east/south-west)
Background concentration of contaminant in groundwater beneath site	Cu	0.00E+00	mg/l	Not used in calculation
Define mixing zone depth by specifying or calculating depth (using pull down list)		Calculate		default condition
Enter mixing zone thickness	Mz		m	
Calculated mixing zone thickness	Mz	2.54E+00	m	

Calculated Parameters

Dilution Factor	DF	2.37E+00		
Level 2 Remedial Target		7.07E-01 or 3.06E+01	mg/l or mg/kg	For comparison with measured pore water concentration. This assumes Level 1 Remedial Target is based on Target Concentration of 0.298 mg/l. For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water

Additional option

Calculation of impact on receptor

Concentration of contaminant in contaminated discharge (entering receptor)	Cc	0.00E+00	mg/l	
Calculated concentration within receptor (dilution only)		0.00E+00	mg/l	0

Site being assessed:	NGET Tottenham
Completed by:	M Craske
Date:	27-Oct-23
Version:	x.xx

Remedial Targets Worksheet , Release 3.2

Level 3 - Soil

See Note



Input Parameters	Variable	Value	Unit	Source
Contaminant		Ethylbenzene		from Level 1
Target Concentration	C _T	0.3	mg/l	from Level 1
Dilution Factor	DF	2.37E+00		from Level 2

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

Ogata Banks	Equations in HRA publication
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Select nature of decay rate (click on brown cell below, then on pull-down menu)

Approach for simulating degradation of pollutants:

Apply degradation rate to dissolved pollutants only

Variable	Value	Unit	Source of parameter value
Soil leachate concentration as mg/l			
Enter source concentration	0.1	mg/l	
Enter soil leachate concentration			
Half life for degradation of contaminant in water	t _{1/2}	2.00E+02 days	77
Calculated decay rate	λ	3.47E-03 days ⁻¹	calculated
Width of plume in aquifer at source	Sz	2.50E+02 m	from Level 2
Plume thickness in aquifer at source	Sy	2.54E+00 m	from Level 2
Bulk density of aquifer materials	ρ	1.80E+00 g/cm ³	Literature estimate for RTD
Effective porosity of aquifer	n	2.00E-01 fraction	Literature estimate for RTD
Hydraulic gradient	i	3.46E-03 fraction	from Level 2 (adjusted)
Hydraulic conductivity of saturated aquifer	K	1.00E+01 m/d	from Level 2
Distance (lateral) to compliance point perpendicular to flow direction	x	3.00E+01 m	Default for aquifer protection
Distance (depth) to compliance point perpendicular to flow direction	z		default condition
Time since pollutant entered groundwater	y		default condition
	t	9.99E+99 days	time variant options only
Parameters values determined from options			
Partition coefficient	Kd	2.15E+00 l/kg	see options
Longitudinal dispersivity	ax	3.000 m	see options
Transverse dispersivity	az	0.300 m	see options
Vertical dispersivity	ay	0.000 m	see options

Parameter values should be checked against Level 1 and 2

Calculated Parameters

Variable			
Groundwater flow velocity	v	1.73E-01 m/d	
Retardation factor	Rf	2.03E+01 fraction	
Decay rate used	λ	1.70E-04 d ⁻¹	
Hydraulic gradient used in aquifer flow down-gradient	i	3.46E-03 fraction	
Rate of contaminant flow due to retardation	u	8.50E-03 m/d	
Ratio of Compliance Point to Source Concentration	C _{ED} /C ₀	5.66E-01 fraction	
Attenuation factor (C ₀ /C _{ED})	AF	1.77E+00 fraction	
Soil leachate concentration	Co	1.00E-01	

Remedial Targets

Level 3 Remedial Target	1.26E+00 mg/l		For comparison with measured pore water concentration.
Ogata Banks	or		This assumes Level 1 Remedial Target is based on Target Concentration.
	5.44E+01 mg/kg		For comparison with measured soil concentration. This
Distance to compliance point	30 m		assumes Level 1 Remedial Target calculated from soil-water partitioning equation.
Ratio of Compliance Point to Source Concentration	C _{ED} /C ₀	5.66E-01 fraction	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

Enter method of defining partition co-efficient (using pull down list)

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 4.00E-03 fraction

Organic carbon partition coefficient Koc 5.37E+02 l/kg

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

Fraction of organic carbon in aquifer foc fraction

Soil water partition coefficient Kd 2.15E+00 l/kg

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

User defined values for dispersivity

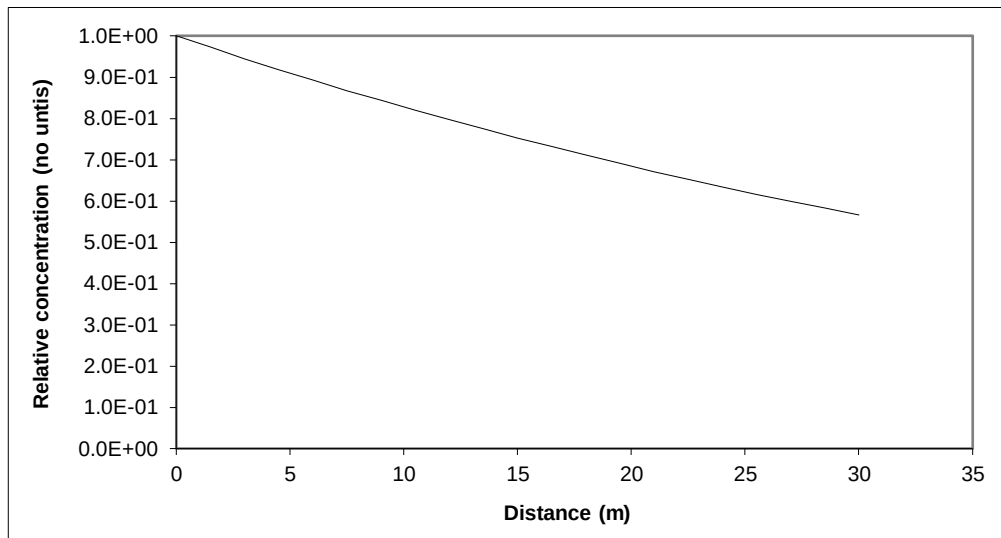
	Enter value	Calc value	Xu & Eckstein	
Longitudinal dispersivity	ax	3.00E+00	3.00E+00	2.13E+00 m
Transverse dispersivity	az	3.00E-01	3.00E-01	2.13E-01 m
Vertical dispersivity	ay	1.00E-99	3.00E-02	2.13E-02 m

Note values of dispersivity must be > 0

Xu & Eckstein (1995) report ax = 0.83(log₁₀x)^{2.414}; az = ax/10, ay = ax/100 are assumed

Note

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



Note: 'Relative concentration' is the ratio of calculated concentration at a given position compared to the source concentration. The calculations assume plume disperses from the top of the aquifer. An alternative solution assuming the centre of the plume is located at the mid-depth of the aquifer is presented in the calculation sheets.

Calculated (relative) concentrations for distance-concentration graph

Ogata Banks

From calculation sheet

Distance	Relative concentration (No units)	Concentration mg/l
0	1.0E+00	4.21E-02
1.5	9.72E-01	4.09E-02
3.0	9.45E-01	3.98E-02
4.5	9.18E-01	3.87E-02
6.0	8.92E-01	3.76E-02
7.5	8.67E-01	3.65E-02
9.0	8.43E-01	3.55E-02
10.5	8.19E-01	3.45E-02
12.0	7.96E-01	3.36E-02
13.5	7.74E-01	3.26E-02
15.0	7.52E-01	3.17E-02
16.5	7.31E-01	3.08E-02
18.0	7.11E-01	2.99E-02
19.5	6.91E-01	2.91E-02
21.0	6.71E-01	2.83E-02
22.5	6.53E-01	2.75E-02
24.0	6.34E-01	2.67E-02
25.5	6.16E-01	2.60E-02
27.0	5.99E-01	2.52E-02
28.5	5.82E-01	2.45E-02
30.0	5.66E-01	2.38E-02

This sheet calculates the Level 3 remedial target for soils(mg/kg) or for pore water (mg/l), based on the distance to the receptor or compliance located down hydraulic gradient of the source Three solution methods are included, the preferred option is Ogata Banks.By setting a long travel time (e.g. 9E99) it will give the steady state solution, which should always be used when calculating remedial targets.

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 3 remedial target to determine the need for further action.

Note if contaminant is not subject to first order degradation, then set half life as 9.9E+99.

Site being assessed:	NGET Tottenham
Completed by:	M Craske
Date:	#####
Version:	x.xx

R&D Publication 20 Remedial Targets Worksheet, Release 3.2

Level 3 - Groundwater

See Note

Input Parameters (using pull down menu)

Contaminant	Ethylbenzene	from Level 1
Target Concentration	C _T 3.00E-01	mg/l from Level 1

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

Ogata Banks	Equations in HRA publication
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Approach for simulating vertical dispersion: Simulate vertical dispersion in 1 direction

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

Approach for simulating degradation of pollutants: Apply degradation rate to dissolved pollutants only

Initial contaminant concentration in groundwater at plume core	C ₀	1.00E+00	mg/l	Source of parameter value
Half life for degradation of contaminant in water	t _{1/2}	2.00E+02	days	Based on site data
Calculated decay rate	λ	3.47E-03	days ⁻¹	77
Width of plume in aquifer at source (perpendicular to flow)	Sz	2.50E+02	m	
Plume thickness at source	Sy	2.54E+00	m	
Saturated aquifer thickness	da	2.54E+00	m	Average thickness of Kempton Park Grave
Bulk density of aquifer materials	ρ	1.80E+00	g/cm ³	Literature estimate for RTD
Effective porosity of aquifer	n	2.00E-01	fraction	Literature estimate for RTD
Hydraulic gradient	i	2.00E-03	fraction	Based on average of site-specific GW measurements (SSE groundwater flow) - 0.0005 - 0.002 between
Hydraulic conductivity of aquifer	K	1.00E+01	m/d	WP 2013 value for KPG
Distance to compliance point	x	3.00E+01	m	Longitudinal dispersivity
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	Transverse dispersivity
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	Vertical dispersivity
Time since pollutant entered groundwater	t	9.99E+99	days	Note values of dispersivity must be > 0
Parameters values determined from options				
Partition coefficient	Kd	2.15E+00	l/kg	For calculated value, assumes ax = 0.1 * x, az = 0.01 * x, ay = 0.001 * x
Longitudinal dispersivity	ax	3.00E+00	m	Xu & Eckstein (1995) report ax = 0.83(log ₁₀ x) ^{2.414} ; az = ax/10, ay = ax/100 are assumed
Transverse dispersivity	az	3.00E-01	m	
Vertical dispersivity	ay	1.00E-99	m	

Calculated Parameters

Groundwater flow velocity	v	1.00E-01	m/d
Retardation factor	Rf	2.03E+01	fraction
Decay rate used	λ	1.70E-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}	3.87E-01	mg/l
Attenuation factor (one way vertical dispersion, CO/CED)	AF	2.58E+00	

Remedial Targets

Remedial Target	7.75E-01	mg/l	For comparison with measured groundwater concentration.
Ogata Banks			
Distance to compliance point	30	m	
Concentration of contaminant at compliance point after	C _{ED} /C ₀ 3.87E-01	mg/l	Ogata Banks
	1.0E+100	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)

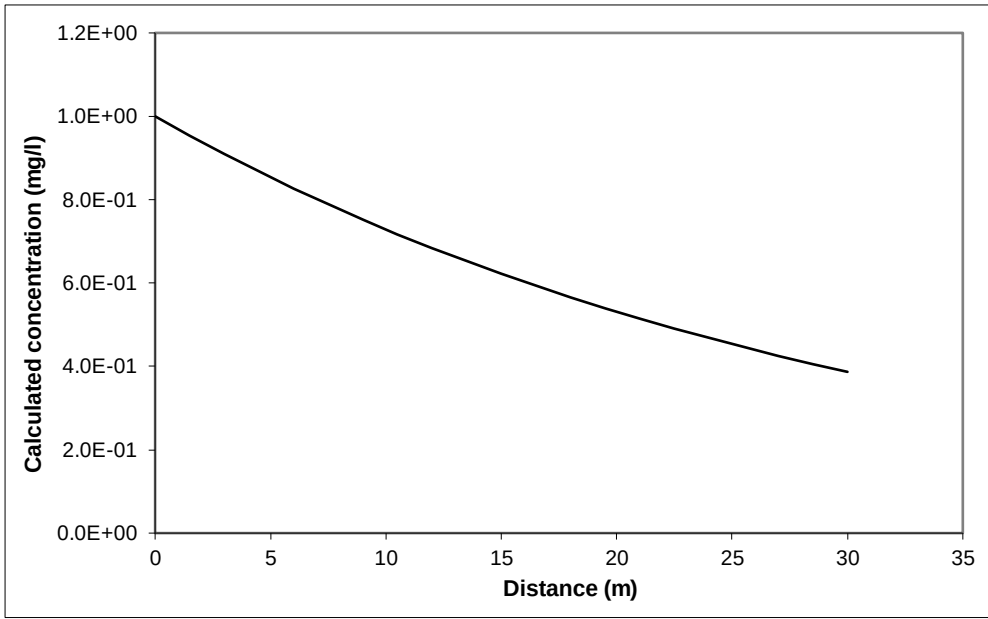
Calculate for non-polar organic chemicals

Entry if specify partition coefficient (option)	Kd		l/kg
Soil water partition coefficient			
Entry for non-polar organic chemicals (option)	foc	4.00E-03	fraction
Fraction of organic carbon in aquifer			
Organic carbon partition coefficient	Koc	5.37E+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		
Fraction of organic carbon in aquifer	foc		fraction
Soil water partition coefficient	Kd	2.15E+00	l/kg

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

User defined values for dispersivity

Enter value	Calc value	Xu & Eckstein	m
ax	3.00E+00	3.00E+00	2.13E+00
az	3.00E-01	3.00E-01	2.13E-01
ay	1.00E-99	3.00E-02	2.13E-02



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

Note

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

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

The measured groundwater concentration should be compared with the Level 3 remedial target to determine the need for further action. Note if contaminant is not subject to first order degradation, then set half life as 9.0E+99.

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

Site being assessed:	NGET Tottenham
Completed by:	M Craske
Date:	#####
Version:	x.xx

Calculated concentrations for distance-concentration graph

Ogata Banks From calculation sheet

Distance	Concentration
	mg/l
0	1.0E+00
1.5	9.54E-01
3.0	9.09E-01
4.5	8.67E-01
6.0	8.27E-01
7.5	7.89E-01
9.0	7.52E-01
10.5	7.17E-01
12.0	6.84E-01
13.5	6.52E-01
15.0	6.22E-01
16.5	5.93E-01
18.0	5.66E-01
19.5	5.39E-01
21.0	5.14E-01
22.5	4.91E-01
24.0	4.68E-01
25.5	4.46E-01
27.0	4.25E-01
28.5	4.06E-01
30.0	3.87E-01



Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

This worksheet has been produced in combination with the document 'Remedial Targets Methodology: Hydrogeological risk assessment for land contamination (Environment Agency 2006).

Users of this worksheet should always refer to the User Manual to the Remedial Targets Methodology and to relevant guidance on UK legislation and policy, in order to understand how this procedure should be applied in an appropriate context.

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

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

<u>Details to be completed for each assessment</u>			
Site Name:	NGET Tottenham		
Site Address:			
Completed by:	M Craske	Version:	x.xx
Date:	27-Oct-23		
Contaminant	Ethylbenzene		
Target Concentration (C_T)	0.29804784	mg/l	Origin of C_T: Lowest of DWS/EQS

This worksheet can be used to determine remedial targets for soils (Worksheets Level 1 Soil, Level 2 and Level 3 Soil) or to determine remedial targets for groundwater (Level 3 Groundwater). For Level 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 comparison 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 Level 1, 2 and 3 Worksheets.

Worksheet options are identified by brown background and employ a pull-down menus. Data entry are identified as blue background.

Data origin / justification should be noted in cells coloured yellow and fully documented in subsequent reports.

Data carried forward from an earlier worksheet are identified by a light green background

It is recommended that a copy of the original worksheet is saved (all data fields in the original copy are blank).

The spreadsheet also includes a porosity calculation worksheet, a soil impact calculation worksheet and a worksheet that performs some simple hydrogeological calculations.

Remedial Targets Worksheet , Release 3.2



Level 1 - Soil

Select the method of calculating the soil water
Partition Co-efficient by using the pull down menu
below

Calculate for non-polar organic chemicals

Contaminant	Ethylbenzene
Target concentration	0.29804784 mg/l

Input Parameters

Standard entry

Water filled soil porosity	θ_w	3.70E-01	fraction	Conservative value estimated from average site mo
Air filled soil porosity	θ_a	1.90E-01	fraction	Conservative value estimated from average site mo
Bulk density of soil zone material	ρ	1.60E+00	g/cm ³	Conservative Estimate for Made Ground
Henry's Law constant	H	3.58E-01	dimensionless	83

This sheet calculates the Level 1 remedial target for soils(mg/kg) based on a selected target concentration and theoretical calculation of soil water partitioning. Three options are included for determinina the partition coefficient.
The measured soil concentration as mg/kg should be compared with the Level 1 remedial target to determine the need for further action.

Entry if specify partition coefficient (option)

Soil water partition coefficient	Kd		l/kg	3.10E+01
----------------------------------	----	--	------	----------

Entry for non-polar organic chemicals (option)

Fraction of organic carbon (in soil)	foc	8.00E-02	fraction	Average from uncontaminated site samples
Organic carbon partition coefficient	Koc	5.37E+02	l/kg	83

Entry for ionic organic chemicals (option)

Sorption coefficient for neutral species	$K_{oc,n}$		l/kg	
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg	
pH value	pH		pH units	
Acid dissociation constant	pKa			
Fraction of organic carbon (in soil)	foc		fraction	

Soil water partition coefficient used in Level Assessment	Kd	4.30E+01	l/kg	Calculated value
---	----	----------	------	------------------

Level 1 Remedial Target

Level 1 Remedial Target	1.29E+01	mg/kg	(for comparison with soil analyses)
	or		
	0.29804784	mg/l	(for comparison with leachate test results)

Site being assessed:	NGET Tottenham
Completed by:	M Craske
Date:	27-Oct-23
Version:	x.xx



Level 2 - Soil

Contaminant Target concentration C_T Ethylbenzene 0.29804784 mg/l from Level 1 from Level 1

This sheet calculates the Level 2 remedial target for soils (mg/kg) or for pore water (mg/l).

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 2 remedial target to determine the need for further action. Equations presented in 'Hydrogeological risk assessment for land contamination' (Environment Agency 2006)

Input Parameters	Variable	Value	Unit	Source of parameter value
Standard entry				
Infiltration	Inf	7.40E-04	m/d	Estimated from EA effective infiltration mapping and 80% ha
Area of contaminant source	A	1.25E+04	m ²	Length x width of site (50x250) Not used in calculation
Entry for groundwater flow below site				
Length of contaminant source in direction of groundwater flow	L	5.00E+01	m	Estimated length of site in direction of GW flow (north/south)
Saturated aquifer thickness	da	2.54E+00	m	Thickness of Kempton Park Gravel based on BH logs +
Hydraulic Conductivity of aquifer in which dilution occurs	K	1.00E+01	m/d	WP 2013 value for KPG
Hydraulic gradient of water table	i	2.00E-03	fraction	Between site and off site locations near Pymmes brook
Width of contaminant source perpendicular to groundwater flow	w	2.50E+02	m	Estimated site area perpendicular to GW flow (north-east/south-west) Not used in calculation
Background concentration of contaminant in groundwater beneath site	Cu	0.00E+00	mg/l	
Define mixing zone depth by specifying or calculating depth (using pull down list)		Calculate		default condition
Enter mixing zone thickness	Mz		m	
Calculated mixing zone thickness	Mz	2.54E+00	m	

Calculated Parameters

Dilution Factor	DF	2.37E+00		
Level 2 Remedial Target		7.07E-01	mg/l	For comparison with measured pore water concentration. This assumes Level 1 Remedial Target is based on Target Concentration
		or		
		3.06E+01	mg/kg	For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water

Additional option

Calculation of impact on receptor

Concentration of contaminant in contaminated discharge (entering receptor)	Cc	0.00E+00	mg/l	
Calculated concentration within receptor (dilution only)		0.00E+00	mg/l	0

Site being assessed:	NGET Tottenham
Completed by:	M Craske
Date:	27-Oct-23
Version:	x.xx

Remedial Targets Worksheet , Release 3.2

Level 3 - Soil

See Note



Input Parameters	Variable	Value	Unit	Source
Contaminant		Ethylbenzene		from Level 1
Target Concentration	C _T	0.3	mg/l	from Level 1
Dilution Factor	DF	2.37E+00		from Level 2

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

Ogata Banks	Equations in HRA publication
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Select nature of decay rate (click on brown cell below, then on pull-down menu)

Approach for simulating degradation of pollutants:

Apply degradation rate to dissolved pollutants only

Variable	Value	Unit	Source of parameter value
Soil leachate concentration as mg/l			
Enter source concentration	0.1	mg/l	
Enter soil leachate concentration	2.00E+02	days	
Half life for degradation of contaminant in water	3.47E-03	days ⁻¹	calculated
Calculated decay rate	2.50E+02	m	from Level 2
Width of plume in aquifer at source	2.54E+00	m	from Level 2
Plume thickness in aquifer at source	1.80E+00	g/cm ³	Literature estimate for RTD
Bulk density of aquifer materials	2.00E-01	fraction	Literature estimate for RTD
Effective porosity of aquifer	3.46E-03	fraction	from Level 2 (adjusted)
Hydraulic gradient	1.00E+01	m/d	from Level 2
Hydraulic conductivity of saturated aquifer	3.00E+01	m	Default for aquifer protection
Distance (lateral) to compliance point perpendicular to flow direction		m	default condition
Distance (depth) to compliance point perpendicular to flow direction		m	default condition
Time since pollutant entered groundwater	9.99E+99	days	time variant options only
Parameters values determined from options			
Partition coefficient	Kd	2.15E+00	l/kg see options
Longitudinal dispersivity	ax	3.000	m see options
Transverse dispersivity	az	0.300	m see options
Vertical dispersivity	ay	0.000	m see options

Parameter values should be checked against Level 1 and 2

Calculated Parameters

Variable			
Groundwater flow velocity	v	1.73E-01	m/d
Retardation factor	Rf	2.03E+01	fraction
Decay rate used	λ	1.70E-04	d ⁻¹
Hydraulic gradient used in aquifer flow down-gradient	i	3.46E-03	fraction
Rate of contaminant flow due to retardation	u	8.50E-03	m/d
Ratio of Compliance Point to Source Concentration	C _{ED} /C ₀	5.66E-01	fraction
Attenuation factor (C ₀ /C _{ED})	AF	1.77E+00	fraction
Soil leachate concentration	Co	1.00E-01	

Remedial Targets

Level 3 Remedial Target	1.26E+00	mg/l	For comparison with measured pore water concentration.
Ogata Banks	or		This assumes Level 1 Remedial Target is based on Target Concentration.
	5.44E+01	mg/kg	For comparison with measured soil concentration. This
Distance to compliance point	30	m	assumes Level 1 Remedial Target calculated from soil-water
Ratio of Compliance Point to Source Concentration	C _{ED} /C ₀	5.66E-01	partitioning equation.
			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

Enter method of defining partition co-efficient (using pull down list)

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 4.00E-03 fraction

Organic carbon partition coefficient Koc 5.37E+02 l/kg

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

Fraction of organic carbon in aquifer foc fraction

Soil water partition coefficient Kd 2.15E+00 l/kg

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

User defined values for dispersivity

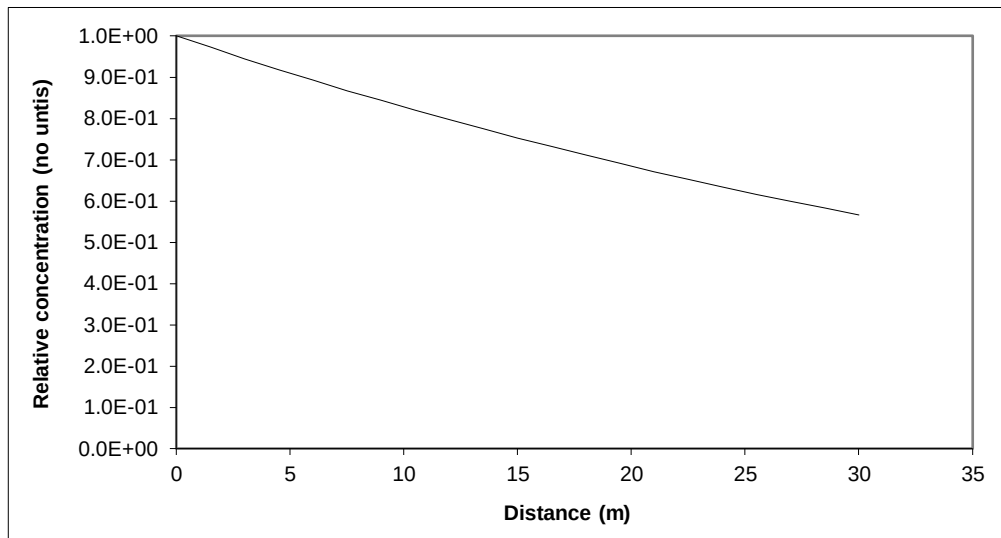
	Enter value	Calc value	Xu & Eckstein	
Longitudinal dispersivity	ax	3.00E+00	3.00E+00	2.13E+00 m
Transverse dispersivity	az	3.00E-01	3.00E-01	2.13E-01 m
Vertical dispersivity	ay	1.00E-99	3.00E-02	2.13E-02 m

Note values of dispersivity must be > 0

Xu & Eckstein (1995) report ax = 0.83(log₁₀x)^{2.414} ; az = ax/10, ay = ax/100 are assumed

Note

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



Note: 'Relative concentration' is the ratio of calculated concentration at a given position compared to the source concentration. The calculations assume plume disperses from the top of the aquifer. An alternative solution assuming the centre of the plume is located at the mid-depth of the aquifer is presented in the calculation sheets.

Calculated (relative) concentrations for distance-concentration graph

Ogata Banks

From calculation sheet

Distance	Relative concentration (No units)	Concentration mg/l
0	1.0E+00	4.21E-02
1.5	9.72E-01	4.09E-02
3.0	9.45E-01	3.98E-02
4.5	9.18E-01	3.87E-02
6.0	8.92E-01	3.76E-02
7.5	8.67E-01	3.65E-02
9.0	8.43E-01	3.55E-02
10.5	8.19E-01	3.45E-02
12.0	7.96E-01	3.36E-02
13.5	7.74E-01	3.26E-02
15.0	7.52E-01	3.17E-02
16.5	7.31E-01	3.08E-02
18.0	7.11E-01	2.99E-02
19.5	6.91E-01	2.91E-02
21.0	6.71E-01	2.83E-02
22.5	6.53E-01	2.75E-02
24.0	6.34E-01	2.67E-02
25.5	6.16E-01	2.60E-02
27.0	5.99E-01	2.52E-02
28.5	5.82E-01	2.45E-02
30.0	5.66E-01	2.38E-02

This sheet calculates the Level 3 remedial target for soils(mg/kg) or for pore water (mg/l), based on the distance to the receptor or compliance located down hydraulic gradient of the source Three solution methods are included, the preferred option is Ogata Banks.By setting a long travel time (e.g. 9E99) it will give the steady state solution, which should always be used when calculating remedial targets.

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 3 remedial target to determine the need for further action.

Note if contaminant is not subject to first order degradation, then set half life as 9.9E+99.

Site being assessed:	NGET Tottenham
Completed by:	M Craske
Date:	#####
Version:	x.xx

R&D Publication 20 Remedial Targets Worksheet, Release 3.2

Level 3 - Groundwater

See Note

Input Parameters (using pull down menu)

Contaminant	Ethylbenzene	from Level 1
Target Concentration	C _T 3.00E-01	mg/l from Level 1

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

Ogata Banks	Equations in HRA publication
-------------	------------------------------

Approach for simulating vertical dispersion:

Simulate vertical dispersion in 1 direction

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

Approach for simulating degradation of pollutants:

Apply degradation rate to dissolved pollutants only

Initial contaminant concentration in groundwater at plume core	C ₀	1.00E+00	mg/l	Source of parameter value
Half life for degradation of contaminant in water	t _{1/2}	2.00E+02	days	Based on site data
Calculated decay rate	λ	3.47E-03	days ⁻¹	77
Width of plume in aquifer at source (perpendicular to flow)	Sz	2.50E+02	m	
Plume thickness at source	Sy	2.54E+00	m	
Saturated aquifer thickness	da	2.54E+00	m	Average thickness of Kempton Park Grave
Bulk density of aquifer materials	ρ	1.80E+00	g/cm ³	Literature estimate for RTD
Effective porosity of aquifer	n	2.00E-01	fraction	Literature estimate for RTD
Hydraulic gradient	i	2.00E-03	fraction	Based on average of site-specific GW measurements (SSE groundwater flow) - 0.0005 - 0.002 between
Hydraulic conductivity of aquifer	K	1.00E+01	m/d	WP 2013 value for KPG
Distance to compliance point	x	3.00E+01	m	Longitudinal dispersivity
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	Transverse dispersivity
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	Vertical dispersivity
Time since pollutant entered groundwater	t	9.99E+99	days	Note values of dispersivity must be > 0
Parameters values determined from options				
Partition coefficient	Kd	2.15E+00	l/kg	For calculated value, assumes ax = 0.1 * x, az = 0.01 * x, ay = 0.001 * x
Longitudinal dispersivity	ax	3.00E+00	m	Xu & Eckstein (1995) report ax = 0.83(log ₁₀ x) ^{2.414} ; az = ax/10, ay = ax/100 are assumed
Transverse dispersivity	az	3.00E-01	m	
Vertical dispersivity	ay	1.00E-99	m	

Calculated Parameters

Groundwater flow velocity	v	1.00E-01	m/d
Retardation factor	Rf	2.03E+01	fraction
Decay rate used	λ	1.70E-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}	3.87E-01	mg/l
Attenuation factor (one way vertical dispersion, CO/CED)	AF	2.58E+00	

Remedial Targets

Remedial Target	7.75E-01	mg/l	For comparison with measured groundwater concentration.
Ogata Banks			
Distance to compliance point	30	m	
Concentration of contaminant at compliance point after	C _{ED} /C ₀ 3.87E-01	mg/l	Ogata Banks
	1.0E+100	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)

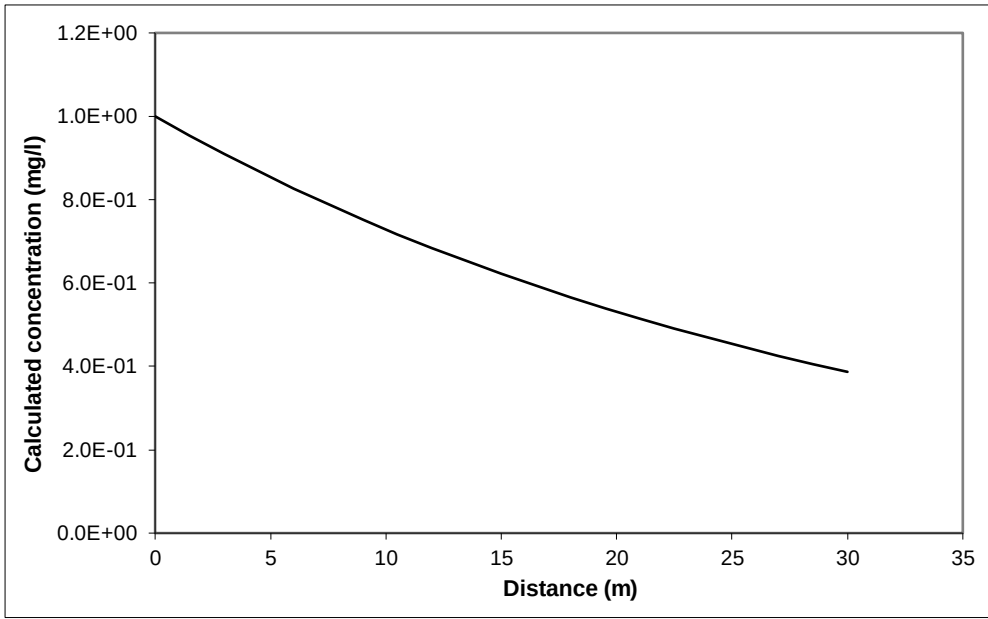
Calculate for non-polar organic chemicals

Entry if specify partition coefficient (option)	Kd		l/kg
Soil water partition coefficient			
Entry for non-polar organic chemicals (option)	foc	4.00E-03	fraction
Fraction of organic carbon in aquifer			
Organic carbon partition coefficient	Koc	5.37E+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		
Fraction of organic carbon in aquifer	foc		fraction
Soil water partition coefficient	Kd	2.15E+00	l/kg

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

User defined values for dispersivity

Enter value	Calc value	Xu & Eckstein	m
ax	3.00E+00	3.00E+00	2.13E+00
az	3.00E-01	3.00E-01	2.13E-01
ay	1.00E-99	3.00E-02	2.13E-02



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

Note

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

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

The measured groundwater concentration should be compared with the Level 3 remedial target to determine the need for further action. Note if contaminant is not subject to first order degradation, then set half life as 9.0E+99.

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

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration
	mg/l
0	1.0E+00
1.5	9.54E-01
3.0	9.09E-01
4.5	8.67E-01
6.0	8.27E-01
7.5	7.89E-01
9.0	7.52E-01
10.5	7.17E-01
12.0	6.84E-01
13.5	6.52E-01
15.0	6.22E-01
16.5	5.93E-01
18.0	5.66E-01
19.5	5.39E-01
21.0	5.14E-01
22.5	4.91E-01
24.0	4.68E-01
25.5	4.46E-01
27.0	4.25E-01
28.5	4.06E-01
30.0	3.87E-01



Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

This worksheet has been produced in combination with the document 'Remedial Targets Methodology: Hydrogeological risk assessment for land contamination (Environment Agency 2006).

Users of this worksheet should always refer to the User Manual to the Remedial Targets Methodology and to relevant guidance on UK legislation and policy, in order to understand how this procedure should be applied in an appropriate context.

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

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

<u>Details to be completed for each assessment</u>			
Site Name:	NGET Tottenham		
Site Address:			
Completed by:	M Craske	Version:	x.xx
Date:	27-Oct-23		
Contaminant	Fluoranthene		
Target Concentration (C_T)	3.56772E-05	mg/l	Origin of C_T: Lowest of DWS/EQS

This worksheet can be used to determine remedial targets for soils (Worksheets Level 1 Soil, Level 2 and Level 3 Soil) or to determine remedial targets for groundwater (Level 3 Groundwater). For Level 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 comparison 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 Level 1, 2 and 3 Worksheets.

Worksheet options are identified by brown background and employ a pull-down menus. Data entry are identified as blue background.

Data origin / justification should be noted in cells coloured yellow and fully documented in subsequent reports.

Data carried forward from an earlier worksheet are identified by a light green background

It is recommended that a copy of the original worksheet is saved (all data fields in the original copy are blank).

The spreadsheet also includes a porosity calculation worksheet, a soil impact calculation worksheet and a worksheet that performs some simple hydrogeological calculations.

Remedial Targets Worksheet , Release 3.2



Level 1 - Soil

Select the method of calculating the soil water
Partition Co-efficient by using the pull down menu
below

Calculate for non-polar organic chemicals

Contaminant	Fluoranthene
Target concentration	3.56772E-05 mg/l

Input Parameters

Standard entry

Water filled soil porosity	θ_w	3.70E-01	fraction	Conservative value estimated from average site mo
Air filled soil porosity	θ_a	1.90E-01	fraction	Conservative value estimated from average site mo
Bulk density of soil zone material	ρ	1.60E+00	g/cm ³	Conservative Estimate for Made Ground
Henry's Law constant	H	4.17E-04	dimensionless	83

This sheet calculates the Level 1 remedial target for soils(mg/kg) based on a selected target concentration and theoretical calculation of soil water partitioning. Three options are included for determinina the partition coefficient.
The measured soil concentration as mg/kg should be compared with the Level 1 remedial target to determine the need for further action.

Entry if specify partition coefficient (option)

Soil water partition coefficient	Kd		l/kg	3.10E+01
----------------------------------	----	--	------	----------

Entry for non-polar organic chemicals (option)

Fraction of organic carbon (in soil)	foc	8.00E-02	fraction	Average from uncontaminated site samples
Organic carbon partition coefficient	Koc	2.78E+04	l/kg	83

Entry for ionic organic chemicals (option)

Sorption coefficient for neutral species	$K_{oc,n}$		l/kg	
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg	
pH value	pH		pH units	
Acid dissociation constant	pKa			
Fraction of organic carbon (in soil)	foc		fraction	

Soil water partition coefficient used in Level Assessment	Kd	2.22E+03	l/kg	Calculated value
---	----	----------	------	------------------

Level 1 Remedial Target

Level 1 Remedial Target	7.94E-02	mg/kg	(for comparison with soil analyses)
	or		
	3.56772E-05	mg/l	(for comparison with leachate test results)

Site being assessed:	NGET Tottenham
Completed by:	M Craske
Date:	27-Oct-23
Version:	x.xx



Level 2 - Soil

Contaminant
Target concentration

C_T

Fluoranthene

3.56772E-05

mg/l

from Level 1

from Level 1

This sheet calculates the Level 2 remedial target for soils (mg/kg) or for pore water (mg/l).

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 2 remedial target to determine the need for further action. Equations presented in 'Hydrogeological risk assessment for land contamination' (Environment Agency 2006)

Input Parameters	Variable	Value	Unit	Source of parameter value
Standard entry				
Infiltration	Inf	7.40E-04	m/d	Estimated from EA effective infiltration mapping and 80% ha
Area of contaminant source	A	1.25E+04	m ²	Length x width of site (50x250) Not used in calculation
Entry for groundwater flow below site				
Length of contaminant source in direction of groundwater flow	L	5.00E+01	m	Approximate length of site in direction of GW flow (north/south)
Saturated aquifer thickness	da	2.54E+00	m	Thickness of Kempton Park Gravel based on BH logs +
Hydraulic Conductivity of aquifer in which dilution occurs	K	1.00E+01	m/d	WP 2013 value for KPG
Hydraulic gradient of water table	i	2.00E-03	fraction	Between site and off site locations near Pymmes brook
Width of contaminant source perpendicular to groundwater flow	w	2.50E+02	m	Approximate site area perpendicular to GW flow (north-east/south-west)
Background concentration of contaminant in groundwater beneath site	Cu	0.00E+00	mg/l	Not used in calculation
Define mixing zone depth by specifying or calculating depth (using pull down list)		Calculate		default condition
Enter mixing zone thickness	Mz		m	
Calculated mixing zone thickness	Mz	2.54E+00	m	

Calculated Parameters

Dilution Factor	DF	2.37E+00		
Level 2 Remedial Target		8.47E-05	mg/l	For comparison with measured pore water concentration. This assumes Level 1 Remedial Target is based on Target Concentration
		or		
		1.88E-01	mg/kg	For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water

Additional option

Calculation of impact on receptor

Concentration of contaminant in contaminated discharge (entering receptor)	Cc	0.00E+00	mg/l	
Calculated concentration within receptor (dilution only)		0.00E+00	mg/l	0

Site being assessed:	NGET Tottenham
Completed by:	M Craske
Date:	27-Oct-23
Version:	x.xx

Remedial Targets Worksheet , Release 3.2

Level 3 - Soil

See Note



Input Parameters	Variable	Value	Unit	Source
Contaminant		Fluoranthene		from Level 1
Target Concentration	C _T	0.0000063	mg/l	from Level 1
Dilution Factor	DF	2.37E+00		from Level 2

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

Ogata Banks	Equations in HRA publication
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Select nature of decay rate (click on brown cell below, then on pull-down menu)

Approach for simulating degradation of pollutants: Apply degradation rate to dissolved pollutants only

Variable	Value	Unit	Source of parameter value
Soil leachate concentration as mg/l			
Enter soil leachate concentration	0.1	mg/l	
Half life for degradation of contaminant in water	8.80E+02	days	79
Calculated decay rate	7.88E-04	days ⁻¹	calculated
Width of plume in aquifer at source	2.50E+02	m	from Level 2
Plume thickness in aquifer at source	2.54E+00	m	from Level 2
Bulk density of aquifer materials	1.80E+00	g/cm ³	Literature estimate for RTD
Effective porosity of aquifer	2.00E-01	fraction	Literature estimate for RTD
Hydraulic gradient	3.46E-03	fraction	from Level 2 (adjusted)
Hydraulic conductivity of saturated aquifer	1.00E+01	m/d	from Level 2
Distance (lateral) to compliance point perpendicular to flow direction	3.00E+01	m	Default for aquifer protection
Distance (depth) to compliance point perpendicular to flow direction		m	default condition
Time since pollutant entered groundwater	9.99E+99	days	time variant options only
Parameters values determined from options			
Partition coefficient	Kd	1.11E+02	l/kg see options
Longitudinal dispersivity	ax	3.000	m see options
Transverse dispersivity	az	0.300	m see options
Vertical dispersivity	ay	0.000	m see options

Parameter values should be checked against Level 1 and 2

Calculated Parameters

Variable			
Groundwater flow velocity	v	1.73E-01	m/d
Retardation factor	Rf	1.00E+03	fraction
Decay rate used	λ	7.86E-07	d ⁻¹
Hydraulic gradient used in aquifer flow down-gradient	i	3.46E-03	fraction
Rate of contaminant flow due to retardation	u	1.72E-04	m/d
Ratio of Compliance Point to Source Concentration	C _{ED} /C ₀	8.74E-01	fraction
Attenuation factor (C ₀ /C _{ED})	AF	1.14E+00	fraction
Soil leachate concentration	Co	1.00E-01	

Remedial Targets

Level 3 Remedial Target	1.71E-05	mg/l	For comparison with measured pore water concentration.
Ogata Banks	or		This assumes Level 1 Remedial Target is based on Target Concentration.
	3.81E-02	mg/kg	For comparison with measured soil concentration. This
Distance to compliance point	30	m	assumes Level 1 Remedial Target calculated from soil-water partitioning equation.
Ratio of Compliance Point to Source Concentration	C _{ED} /C ₀	8.74E-01	fraction 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

Enter method of defining partition co-efficient (using pull down list)

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 4.00E-03 fraction

Organic carbon partition coefficient Koc 2.78E+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

Fraction of organic carbon in aquifer foc fraction

Soil water partition coefficient Kd 1.11E+02 l/kg

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

User defined values for dispersivity

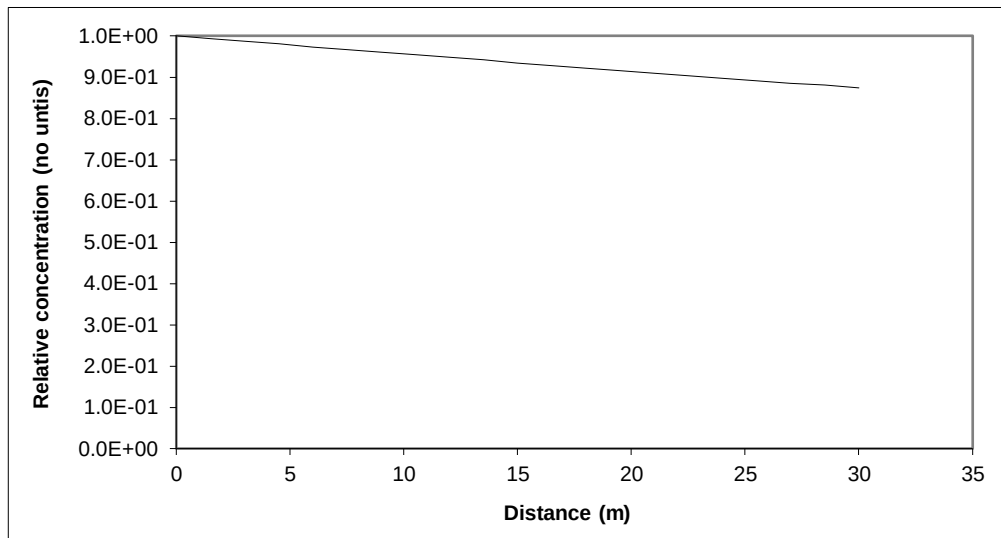
	Enter value	Calc value	Xu & Eckstein
Longitudinal dispersivity ax	3.00E+00	3.00E+00	2.13E+00 m
Transverse dispersivity az	3.00E-01	3.00E-01	2.13E-01 m
Vertical dispersivity ay	1.00E-99	3.00E-02	2.13E-02 m

Note values of dispersivity must be > 0

Xu & Eckstein (1995) report ax = 0.83(log₁₀x)^{2.414} ; az = ax/10, ay = ax/100 are assumed

Note

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



Note: 'Relative concentration' is the ratio of calculated concentration at a given position compared to the source concentration. The calculations assume plume disperses from the top of the aquifer. An alternative solution assuming the centre of the plume is located at the mid-depth of the aquifer is presented in the calculation sheets.

Calculated (relative) concentrations for distance-concentration graph

Ogata Banks

From calculation sheet

Distance	Relative concentration (No units)	Concentration mg/l
0	1.0E+00	4.21E-02
1.5	9.93E-01	4.18E-02
3.0	9.87E-01	4.16E-02
4.5	9.80E-01	4.13E-02
6.0	9.73E-01	4.10E-02
7.5	9.67E-01	4.07E-02
9.0	9.60E-01	4.05E-02
10.5	9.54E-01	4.02E-02
12.0	9.47E-01	3.99E-02
13.5	9.41E-01	3.97E-02
15.0	9.35E-01	3.94E-02
16.5	9.28E-01	3.91E-02
18.0	9.22E-01	3.89E-02
19.5	9.16E-01	3.86E-02
21.0	9.10E-01	3.83E-02
22.5	9.04E-01	3.81E-02
24.0	8.98E-01	3.78E-02
25.5	8.92E-01	3.76E-02
27.0	8.86E-01	3.73E-02
28.5	8.80E-01	3.71E-02
30.0	8.74E-01	3.68E-02

This sheet calculates the Level 3 remedial target for soils(mg/kg) or for pore water (mg/l), based on the distance to the receptor or compliance located down hydraulic gradient of the source Three solution methods are included, the preferred option is Ogata Banks.By setting a long travel time (e.g. 9E99) it will give the steady state solution, which should always be used when calculating remedial targets.

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 3 remedial target to determine the need for further action.

Note if contaminant is not subject to first order degradation, then set half life as 9.9E+99.

Site being assessed:	NGET Tottenham
Completed by:	M Craske
Date:	#####
Version:	x.xx

R&D Publication 20 Remedial Targets Worksheet, Release 3.2

Level 3 - Groundwater

See Note

Input Parameters (using pull down menu)

Contaminant	Fluoranthene	from Level 1
Target Concentration	C _T 6.30E-06	mg/l from Level 1

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

Ogata Banks	Equations in HRA publication
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Approach for simulating vertical dispersion: Simulate vertical dispersion in 1 direction

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

Approach for simulating degradation of pollutants: Apply degradation rate to dissolved pollutants only

Initial contaminant concentration in groundwater at plume core	C ₀	1.00E+00	mg/l	Source of parameter value
Half life for degradation of contaminant in water	t _{1/2}	8.80E+02	days	Based on site data
Calculated decay rate	λ	7.88E-04	days ⁻¹	
Width of plume in aquifer at source (perpendicular to flow)	Sz	2.50E+02	m	
Plume thickness at source	Sy	2.54E+00	m	
Saturated aquifer thickness	da	2.54E+00	m	Average thickness of Kempton Park Grave
Bulk density of aquifer materials	ρ	1.80E+00	g/cm ³	Literature estimate for RTD
Effective porosity of aquifer	n	2.00E-01	fraction	Literature estimate for RTD
Hydraulic gradient	i	2.00E-03	fraction	Based on average of site-specific GW measurements (SSE groundwater flow) - 0.0005 - 0.002 between
Hydraulic conductivity of aquifer	K	1.00E+01	m/d	WP 2013 value for KPG
Distance to compliance point	x	3.00E+01	m	Longitudinal dispersivity
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	Transverse dispersivity
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	Vertical dispersivity
Time since pollutant entered groundwater	t	9.99E+99	days	Note values of dispersivity must be > 0
Parameters values determined from options				For calculated value, assumes ax = 0.1 * x, az = 0.01 * x, ay = 0.001 * x
Partition coefficient	Kd	1.11E+02	l/kg	Xu & Eckstein (1995) report ax = 0.83(log ₁₀ x) ^{2.414} ; az = ax/10, ay = ax/100 are assumed
Longitudinal dispersivity	ax	3.00E+00	m	
Transverse dispersivity	az	3.00E-01	m	
Vertical dispersivity	ay	1.00E-99	m	

Calculated Parameters

Groundwater flow velocity	v	1.00E-01	m/d
Retardation factor	Rf	1.00E+03	fraction
Decay rate used	λ	7.86E-07	d ⁻¹
Rate of contaminant flow due to retardation	u	9.98E-05	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C _{ED}	7.94E-01	mg/l
Attenuation factor (one way vertical dispersion, CO/CED)	AF	1.26E+00	

Remedial Targets

Remedial Target	7.94E-06	mg/l	For comparison with measured groundwater concentration.
Ogata Banks			
Distance to compliance point	30	m	
Concentration of contaminant at compliance point after	C _{ED} /C ₀ 7.94E-01	mg/l	Ogata Banks
	1.0E+100	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)

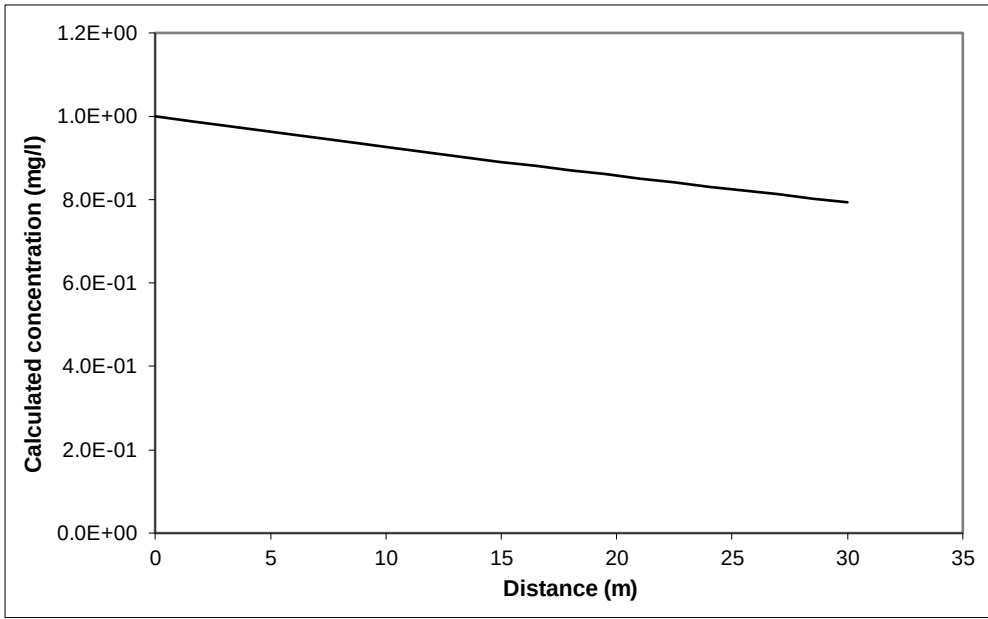
Calculate for non-polar organic chemicals

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	4.00E-03 fraction
Organic carbon partition coefficient	Koc	2.78E+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	
Fraction of organic carbon in aquifer	foc	fraction
Soil water partition coefficient	Kd	1.11E+02 l/kg

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

User defined values for dispersivity

Enter value	Calc value Xu & Eckstein	m
ax	3.00E+00	3.00E+00 2.13E+06 m
az	3.00E-01	3.00E-01 2.13E-01 m
ay	1.00E-99	3.00E-02 2.13E-02 m



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

Note

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

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

The measured groundwater concentration should be compared with the Level 3 remedial target to determine the need for further action. Note if contaminant is not subject to first order degradation, then set half life as 9.0E+99.

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

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration
	mg/l
0	1.0E+00
1.5	9.89E-01
3.0	9.77E-01
4.5	9.66E-01
6.0	9.56E-01
7.5	9.44E-01
9.0	9.33E-01
10.5	9.22E-01
12.0	9.12E-01
13.5	9.01E-01
15.0	8.91E-01
16.5	8.81E-01
18.0	8.71E-01
19.5	8.61E-01
21.0	8.51E-01
22.5	8.41E-01
24.0	8.31E-01
25.5	8.22E-01
27.0	8.12E-01
28.5	8.03E-01
30.0	7.94E-01



Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

This worksheet has been produced in combination with the document 'Remedial Targets Methodology: Hydrogeological risk assessment for land contamination (Environment Agency 2006).

Users of this worksheet should always refer to the User Manual to the Remedial Targets Methodology and to relevant guidance on UK legislation and policy, in order to understand how this procedure should be applied in an appropriate context.

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

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

<u>Details to be completed for each assessment</u>			
Site Name:	NGET Tottenham		
Site Address:			
Completed by:	M Craske	Version:	x.xx
Date:	27-Oct-23		
Contaminant	Fluoranthene		
Target Concentration (C_T)	3.56772E-05	mg/l	Origin of C_T: Lowest of DWS/EQS

This worksheet can be used to determine remedial targets for soils (Worksheets Level 1 Soil, Level 2 and Level 3 Soil) or to determine remedial targets for groundwater (Level 3 Groundwater). For Level 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 comparison 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 Level 1, 2 and 3 Worksheets.

Worksheet options are identified by brown background and employ a pull-down menus. Data entry are identified as blue background.

Data origin / justification should be noted in cells coloured yellow and fully documented in subsequent reports.

Data carried forward from an earlier worksheet are identified by a light green background

It is recommended that a copy of the original worksheet is saved (all data fields in the original copy are blank).

The spreadsheet also includes a porosity calculation worksheet, a soil impact calculation worksheet and a worksheet that performs some simple hydrogeological calculations.

Remedial Targets Worksheet , Release 3.2



Level 1 - Soil

Select the method of calculating the soil water
Partition Co-efficient by using the pull down menu
below

Calculate for non-polar organic chemicals

Contaminant	Fluoranthene
Target concentration	3.56772E-05 mg/l

Input Parameters

Standard entry

Water filled soil porosity	θ_w	3.70E-01	fraction	Conservative value estimated from average site mo
Air filled soil porosity	θ_a	1.90E-01	fraction	Conservative value estimated from average site mo
Bulk density of soil zone material	ρ	1.60E+00	g/cm ³	Conservative Estimate for Made Ground
Henry's Law constant	H	4.17E-04	dimensionless	83

This sheet calculates the Level 1 remedial target for soils(mg/kg) based on a selected target concentration and theoretical calculation of soil water partitioning. Three options are included for determinina the partition coefficient.
The measured soil concentration as mg/kg should be compared with the Level 1 remedial target to determine the need for further action.

Entry if specify partition coefficient (option)

Soil water partition coefficient	Kd		l/kg	3.10E+01
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Entry for non-polar organic chemicals (option)

Fraction of organic carbon (in soil)	foc	8.00E-02	fraction	Average from uncontaminated site samples
Organic carbon partition coefficient	Koc	2.78E+04	l/kg	83

Entry for ionic organic chemicals (option)

Sorption coefficient for neutral species	$K_{oc,n}$		l/kg	
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg	
pH value	pH		pH units	
Acid dissociation constant	pKa			
Fraction of organic carbon (in soil)	foc		fraction	

Soil water partition coefficient used in Level Assessment	Kd	2.22E+03	l/kg	Calculated value
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Level 1 Remedial Target

Level 1 Remedial Target	7.94E-02	mg/kg	(for comparison with soil analyses)
	or		
	3.56772E-05	mg/l	(for comparison with leachate test results)

Site being assessed:	NGET Tottenham
Completed by:	M Craske
Date:	27-Oct-23
Version:	x.xx



Level 2 - Soil

Contaminant
Target concentration C_T Fluoranthene
3.56772E-05 mg/l

This sheet calculates the Level 2 remedial target for soils (mg/kg) or for pore water (mg/l).

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 2 remedial target to determine the need for further action. Equations presented in 'Hydrogeological risk assessment for land contamination' (Environment Agency 2006)

Input Parameters	Variable	Value	Unit	Source of parameter value
Standard entry				
Infiltration	Inf	7.40E-04	m/d	Estimated from EA effective infiltration mapping and 80% ha
Area of contaminant source	A	1.25E+04	m ²	Length x width of site (50x250) Not used in calculation
Entry for groundwater flow below site				
Length of contaminant source in direction of groundwater flow	L	5.00E+01	m	Estimated length of site in direction of GW flow (north/south)
Saturated aquifer thickness	da	2.54E+00	m	Thickness of Kempton Park Gravel based on BH logs +
Hydraulic Conductivity of aquifer in which dilution occurs	K	1.00E+01	m/d	WP 2013 value for KPG
Hydraulic gradient of water table	i	2.00E-03	fraction	Between site and off site locations near Pymmes brook
Width of contaminant source perpendicular to groundwater flow	w	2.50E+02	m	Estimated site area perpendicular to GW flow (north-east/south-west)
Background concentration of contaminant in groundwater beneath site	Cu	0.00E+00	mg/l	Not used in calculation
Define mixing zone depth by specifying or calculating depth (using pull down list)		Calculate		default condition
Enter mixing zone thickness	Mz		m	
Calculated mixing zone thickness	Mz	2.54E+00	m	

Calculated Parameters

Dilution Factor	DF	2.37E+00	
Level 2 Remedial Target		8.47E-05 mg/l or 1.88E-01 mg/kg	For comparison with measured pore water concentration. This assumes Level 1 Remedial Target is based on Target Concentration For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water

Additional option

Calculation of impact on receptor

Concentration of contaminant in contaminated discharge (entering receptor)	Cc	0.00E+00	mg/l	
Calculated concentration within receptor (dilution only)		0.00E+00	mg/l	0

Site being assessed:	NGET Tottenham
Completed by:	M Craske
Date:	27-Oct-23
Version:	x.xx

Remedial Targets Worksheet , Release 3.2

Level 3 - Soil

See Note



Input Parameters	Variable	Value	Unit	Source
Contaminant		Fluoranthene		from Level 1
Target Concentration	C _T	0.0000063	mg/l	from Level 1
Dilution Factor	DF	2.37E+00		from Level 2

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

Ogata Banks	Equations in HRA publication
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Select nature of decay rate (click on brown cell below, then on pull-down menu)

Approach for simulating degradation of pollutants: Apply degradation rate to dissolved pollutants only

Variable	Value	Unit	Source of parameter value
Soil leachate concentration as mg/l			
Enter soil leachate concentration	0.1	mg/l	
Half life for degradation of contaminant in water	8.80E+02	days	79
Calculated decay rate	7.88E-04	days ⁻¹	calculated
Width of plume in aquifer at source	2.50E+02	m	from Level 2
Plume thickness in aquifer at source	2.54E+00	m	from Level 2
Bulk density of aquifer materials	1.80E+00	g/cm ³	Literature estimate for RTD
Effective porosity of aquifer	2.00E-01	fraction	Literature estimate for RTD
Hydraulic gradient	3.46E-03	fraction	from Level 2 (adjusted)
Hydraulic conductivity of saturated aquifer	1.00E+01	m/d	from Level 2
Distance (lateral) to compliance point perpendicular to flow direction	3.00E+01	m	Default for aquifer protection
Distance (depth) to compliance point perpendicular to flow direction		m	default condition
Time since pollutant entered groundwater	9.99E+99	days	time variant options only
Parameters values determined from options			
Partition coefficient	Kd	1.11E+02	l/kg see options
Longitudinal dispersivity	ax	3.000	m see options
Transverse dispersivity	az	0.300	m see options
Vertical dispersivity	ay	0.000	m see options

Parameter values should be checked against Level 1 and 2

Calculated Parameters

Variable			
Groundwater flow velocity	v	1.73E-01	m/d
Retardation factor	Rf	1.00E+03	fraction
Decay rate used	λ	7.86E-07	d ⁻¹
Hydraulic gradient used in aquifer flow down-gradient	i	3.46E-03	fraction
Rate of contaminant flow due to retardation	u	1.72E-04	m/d
Ratio of Compliance Point to Source Concentration	C _{ED} /C ₀	8.74E-01	fraction
Attenuation factor (C ₀ /C _{ED})	AF	1.14E+00	fraction
Soil leachate concentration	Co	1.00E-01	

Remedial Targets

Level 3 Remedial Target	1.71E-05	mg/l	For comparison with measured pore water concentration.
Ogata Banks	or		This assumes Level 1 Remedial Target is based on Target Concentration.
	3.81E-02	mg/kg	For comparison with measured soil concentration. This
Distance to compliance point	30	m	assumes Level 1 Remedial Target calculated from soil-water partitioning equation.
Ratio of Compliance Point to Source Concentration	C _{ED} /C ₀	8.74E-01	fraction 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

Enter method of defining partition co-efficient (using pull down list)

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 4.00E-03 fraction

Organic carbon partition coefficient Koc 2.78E+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

Fraction of organic carbon in aquifer foc fraction

Soil water partition coefficient Kd 1.11E+02 l/kg

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

User defined values for dispersivity

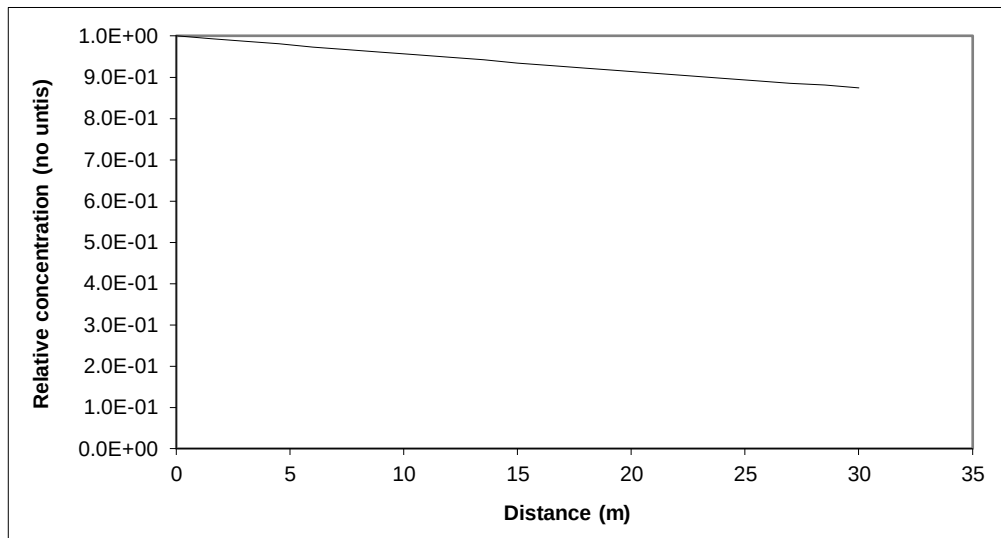
	Enter value	Calc value	Xu & Eckstein
Longitudinal dispersivity ax	3.00E+00	3.00E+00	2.13E+00 m
Transverse dispersivity az	3.00E-01	3.00E-01	2.13E-01 m
Vertical dispersivity ay	1.00E-99	3.00E-02	2.13E-02 m

Note values of dispersivity must be > 0

Xu & Eckstein (1995) report ax = 0.83(log₁₀x)^{2.414} ; az = ax/10, ay = ax/100 are assumed

Note

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



Note: 'Relative concentration' is the ratio of calculated concentration at a given position compared to the source concentration. The calculations assume plume disperses from the top of the aquifer. An alternative solution assuming the centre of the plume is located at the mid-depth of the aquifer is presented in the calculation sheets.

Calculated (relative) concentrations for distance-concentration graph

Ogata Banks

From calculation sheet

Distance	Relative concentration (No units)	Concentration mg/l
0	1.0E+00	4.21E-02
1.5	9.93E-01	4.18E-02
3.0	9.87E-01	4.16E-02
4.5	9.80E-01	4.13E-02
6.0	9.73E-01	4.10E-02
7.5	9.67E-01	4.07E-02
9.0	9.60E-01	4.05E-02
10.5	9.54E-01	4.02E-02
12.0	9.47E-01	3.99E-02
13.5	9.41E-01	3.97E-02
15.0	9.35E-01	3.94E-02
16.5	9.28E-01	3.91E-02
18.0	9.22E-01	3.89E-02
19.5	9.16E-01	3.86E-02
21.0	9.10E-01	3.83E-02
22.5	9.04E-01	3.81E-02
24.0	8.98E-01	3.78E-02
25.5	8.92E-01	3.76E-02
27.0	8.86E-01	3.73E-02
28.5	8.80E-01	3.71E-02
30.0	8.74E-01	3.68E-02

This sheet calculates the Level 3 remedial target for soils(mg/kg) or for pore water (mg/l), based on the distance to the receptor or compliance located down hydraulic gradient of the source Three solution methods are included, the preferred option is Ogata Banks.By setting a long travel time (e.g. 9E99) it will give the steady state solution, which should always be used when calculating remedial targets.

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 3 remedial target to determine the need for further action.

Note if contaminant is not subject to first order degradation, then set half life as 9.9E+99.

Site being assessed:	NGET Tottenham
Completed by:	M Craske
Date:	#####
Version:	x.xx

R&D Publication 20 Remedial Targets Worksheet, Release 3.2

Level 3 - Groundwater

See Note

Input Parameters (using pull down menu)

Contaminant		Fluoranthene	from Level 1
Target Concentration	C _T	6.30E-06	mg/l from Level 1

Ogata Banks

Equations in HRA publication

Approach for simulating vertical dispersion:

Simulate vertical dispersion in 1 direction

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

Approach for simulating degradation of pollutants:

Apply degradation rate to dissolved pollutants only

Initial contaminant concentration in groundwater at plume core	C ₀	1.00E+00	mg/l	Source of parameter value
Half life for degradation of contaminant in water	t _{1/2}	8.80E+02	days	Based on site data
Calculated decay rate	λ	7.88E-04	days ⁻¹	
Width of plume in aquifer at source (perpendicular to flow)	Sz	2.50E+02	m	
Plume thickness at source	Sy	2.54E+00	m	
Saturated aquifer thickness	da	2.54E+00	m	Average thickness of Kempton Park Grave
Bulk density of aquifer materials	ρ	1.80E+00	g/cm ³	Literature estimate for RTD
Effective porosity of aquifer	n	2.00E-01	fraction	Literature estimate for RTD
Hydraulic gradient	i	2.00E-03	fraction	Based on average of site-specific GW measurements (SSE groundwater flow) - 0.0005 - 0.002 between
Hydraulic conductivity of aquifer	K	1.00E+01	m/d	WP 2013 value for KPG
Distance to compliance point	x	3.00E+01	m	Longitudinal dispersivity
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	Transverse dispersivity
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	Vertical dispersivity
Time since pollutant entered groundwater	t	9.99E+99	days	Note values of dispersivity must be > 0
Parameters values determined from options				For calculated value, assumes ax = 0.1 * x, 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
Partition coefficient	Kd	1.11E+02	l/kg	
Longitudinal dispersivity	ax	3.00E+00	m	
Transverse dispersivity	az	3.00E-01	m	
Vertical dispersivity	ay	1.00E-99	m	

Calculated Parameters

Groundwater flow velocity	v	1.00E-01	m/d
Retardation factor	Rf	1.00E+03	fraction
Decay rate used	λ	7.86E-07	d ⁻¹
Rate of contaminant flow due to retardation	u	9.98E-05	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C _{ED}	7.94E-01	mg/l
Attenuation factor (one way vertical dispersion, CO/CED)	AF	1.26E+00	

Remedial Targets

Remedial Target	7.94E-06	mg/l	For comparison with measured groundwater concentration.
Ogata Banks			
Distance to compliance point	30	m	
Concentration of contaminant at compliance point after	C _{ED} /C ₀	7.94E-01	mg/l
		1.0E+100	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)

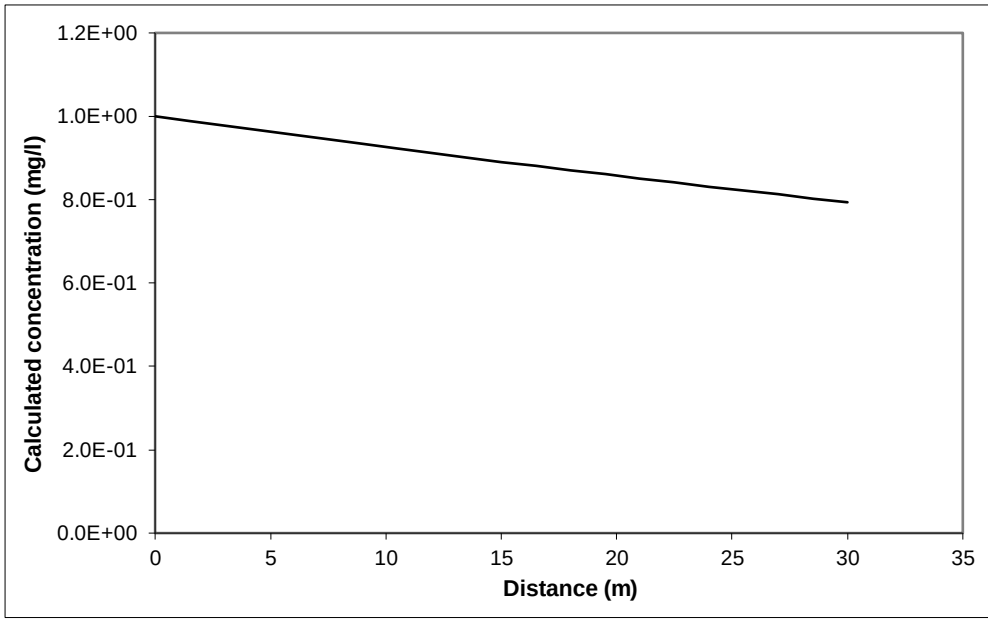
Calculate for non-polar organic chemicals

Entry if specify partition coefficient (option)		
Soil water partition coefficient	Kd	
Entry for non-polar organic chemicals (option)		
Fraction of organic carbon in aquifer	foc	4.00E-03 fraction
Organic carbon partition coefficient	Koc	2.78E+04 l/kg
Entry for ionic organic chemicals (option)		
Sorption coefficient for related species	K _{oc,n}	
Sorption coefficient for ionised species	K _{oc,i}	
pH value	pH	
acid dissociation constant	pKa	
Fraction of organic carbon in aquifer	foc	
Soil water partition coefficient	Kd	1.11E+02 l/kg

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

User defined values for dispersivity

Enter value	Calc value Xu & Eckstein	
ax	3.00E+00	3.00E+00 2.13E+06 m
az	3.00E-01	3.00E-01 2.13E-01 m
ay	1.00E-99	3.00E-02 2.13E-02 m



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

Note

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

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

The measured groundwater concentration should be compared with the Level 3 remedial target to determine the need for further action. Note if contaminant is not subject to first order degradation, then set half life as 9.0E+99.

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

Site being assessed:	NGET Tottenham
Completed by:	M Craske
Date:	#####
Version:	x.xx

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration
	mg/l
0	1.0E+00
1.5	9.89E-01
3.0	9.77E-01
4.5	9.66E-01
6.0	9.56E-01
7.5	9.44E-01
9.0	9.33E-01
10.5	9.22E-01
12.0	9.12E-01
13.5	9.01E-01
15.0	8.91E-01
16.5	8.81E-01
18.0	8.71E-01
19.5	8.61E-01
21.0	8.51E-01
22.5	8.41E-01
24.0	8.31E-01
25.5	8.22E-01
27.0	8.12E-01
28.5	8.03E-01
30.0	7.94E-01



Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

This worksheet has been produced in combination with the document 'Remedial Targets Methodology: Hydrogeological risk assessment for land contamination (Environment Agency 2006).

Users of this worksheet should always refer to the User Manual to the Remedial Targets Methodology and to relevant guidance on UK legislation and policy, in order to understand how this procedure should be applied in an appropriate context.

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

<u>Details to be completed for each assessment</u>			
Site Name:	NGET Tottenham		
Site Address:			
Completed by:	M Craske	Version:	x.xx
Date:	27-Oct-23		
Contaminant	Lead		
Target Concentration (C_T)	0.037158851	mg/l	Origin of C_T: Lowest of DWS/EQS

This worksheet can be used to determine remedial targets for soils (Worksheets Level 1 Soil, Level 2 and Level 3 Soil) or to determine remedial targets for groundwater (Level 3 Groundwater). For Level 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 comparison 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 Level 1, 2 and 3 Worksheets.

Worksheet options are identified by brown background and employ a pull-down menus. Data entry are identified as blue background.

Data origin / justification should be noted in cells coloured yellow and fully documented in subsequent reports.

Data carried forward from an earlier worksheet are identified by a light green background

It is recommended that a copy of the original worksheet is saved (all data fields in the original copy are blank).

The spreadsheet also includes a porosity calculation worksheet, a soil impact calculation worksheet and a worksheet that performs some simple hydrogeological calculations.

Remedial Targets Worksheet , Release 3.2



Level 1 - Soil

Select the method of calculating the soil water
Partition Co-efficient by using the pull down menu
below

User specified value for partition coefficient

Contaminant	Lead
Target concentration	0.037158851 mg/l

Input Parameters

Standard entry

Water filled soil porosity	θ_w	3.70E-01	fraction	Conservative value estimated from average site mo
Air filled soil porosity	θ_a	1.90E-01	fraction	Conservative value estimated from average site mo
Bulk density of soil zone material	ρ	1.60E+00	g/cm ³	Conservative Estimate for Made Ground
Henry's Law constant	H	0.00E+00	dimensionless	0

Entry if specify partition coefficient (option)

Soil water partition coefficient	Kd	2.70E+02	l/kg	3.10E+01
----------------------------------	----	----------	------	----------

Entry for non-polar organic chemicals (option)

Fraction of organic carbon (in soil)	foc		fraction	GI average, uncontaminated samples
Organic carbon partition coefficient	Koc		l/kg	86

Entry for ionic organic chemicals (option)

Sorption coefficient for neutral species	$K_{oc,n}$		l/kg	
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg	
pH value	pH		pH units	
Acid dissociation constant	pKa			
Fraction of organic carbon (in soil)	foc		fraction	

Soil water partition coefficient used in Level Assessment	Kd	2.70E+02	l/kg	Specified value
---	----	----------	------	-----------------

Level 1 Remedial Target

Level 1 Remedial Target	1.00E+01	mg/kg	(for comparison with soil analyses)
	or		
	0.037158851	mg/l	(for comparison with leachate test results)

Site being assessed:	NGET Tottenham
Completed by:	M Craske
Date:	27-Oct-23
Version:	x.xx



Level 2 - Soil

Contaminant Target concentration C_T **Lead** from Level 1
0.037158851 mg/l from Level 1

This sheet calculates the Level 2 remedial target for soils (mg/kg) or for pore water (mg/l).

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 2 remedial target to determine the need for further action. Equations presented in 'Hydrogeological risk assessment for land contamination' (Environment Agency 2006)

Input Parameters		Variable	Value	Unit	Source of parameter value
Standard entry	Infiltration	Inf	7.40E-04	m/d	Estimated from EA effective infiltration mapping and 80% ha
	Area of contaminant source	A	1.25E+04	m ²	Length x width of site (50x250) Not used in calculation
Entry for groundwater flow below site	Length of contaminant source in direction of groundwater flow	L	5.00E+01	m	Approximate length of site in direction of GW flow (north/south)
	Saturated aquifer thickness	da	2.54E+00	m	Thickness of Kempton Park Gravel based on BH logs +
	Hydraulic Conductivity of aquifer in which dilution occurs	K	1.00E+01	m/d	WP 2013 value for KPG
	Hydraulic gradient of water table	i	2.00E-03	fraction	Between site and off site locations near Pymmes brook
	Width of contaminant source perpendicular to groundwater flow	w	2.50E+02	m	Approximate site area perpendicular to GW flow (north-east/south-west)
	Background concentration of contaminant in groundwater beneath site	Cu	0.00E+00	mg/l	Not used in calculation
	Define mixing zone depth by specifying or calculating depth (using pull down list)		Calculate		default condition
	Enter mixing zone thickness	Mz		m	
	Calculated mixing zone thickness	Mz	2.54E+00	m	

Calculated Parameters

Dilution Factor	DF	2.37E+00		
Level 2 Remedial Target		8.82E-02	mg/l	For comparison with measured pore water concentration. This assumes Level 1 Remedial Target is based on Target Concentration
		or		
		2.38E+01	mg/kg	For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water

Additional option

Calculation of impact on receptor

Concentration of contaminant in contaminated discharge (entering receptor)	Cc	0.00E+00	mg/l	
Calculated concentration within receptor (dilution only)		0.00E+00	mg/l	0

Site being assessed:	NGET Tottenham
Completed by:	M Craske
Date:	27-Oct-23
Version:	x.xx



Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

This worksheet has been produced in combination with the document 'Remedial Targets Methodology: Hydrogeological risk assessment for land contamination (Environment Agency 2006).

Users of this worksheet should always refer to the User Manual to the Remedial Targets Methodology and to relevant guidance on UK legislation and policy, in order to understand how this procedure should be applied in an appropriate context.

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

Details to be completed for each assessment

Site Name:	NGET Tottenham		
Site Address:			
Completed by:	M Craske	Version:	x.xx
Date:	27-Oct-23		
Contaminant	Lead		
Target Concentration (C_T)	0.0088	mg/l	Origin of C_T: Lowest of DWS/EQS

This worksheet can be used to determine remedial targets for soils (Worksheets Level 1 Soil, Level 2 and Level 3 Soil) or to determine remedial targets for groundwater (Level 3 Groundwater). For Level 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 comparison 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 Level 1, 2 and 3 Worksheets.

Worksheet options are identified by brown background and employ a pull-down menus. Data entry are identified as blue background.

Data origin / justification should be noted in cells coloured yellow and fully documented in subsequent reports.

Data carried forward from an earlier worksheet are identified by a light green background

It is recommended that a copy of the original worksheet is saved (all data fields in the original copy are blank).

The spreadsheet also includes a porosity calculation worksheet, a soil impact calculation worksheet and a worksheet that performs some simple hydrogeological calculations.



Level 1 - Soil

Select the method of calculating the soil water
Partition Co-efficient by using the pull down menu
below

User specified value for partition coefficient

Contaminant	Lead
Target concentration	0.0088 mg/l

Input Parameters

Standard entry

Water filled soil porosity	θ_w	3.70E-01	fraction	Conservative value estimated from average site mo
Air filled soil porosity	θ_a	1.90E-01	fraction	Conservative value estimated from average site mo
Bulk density of soil zone material	ρ	1.60E+00	g/cm ³	Conservative Estimate for Made Ground
Henry's Law constant	H	0.00E+00	dimensionless	0

Entry if specify partition coefficient (option)

Soil water partition coefficient	Kd	2.70E+02	l/kg	3.10E+01
----------------------------------	----	----------	------	----------

Entry for non-polar organic chemicals (option)

Fraction of organic carbon (in soil)	foc		fraction	GI average, uncontaminated samples
Organic carbon partition coefficient	Koc		l/kg	86

Entry for ionic organic chemicals (option)

Sorption coefficient for neutral species	$K_{oc,n}$		l/kg	
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg	
pH value	pH		pH units	
Acid dissociation constant	pKa			
Fraction of organic carbon (in soil)	foc		fraction	

Soil water partition coefficient used in Level Assessment	Kd	2.70E+02	l/kg	Specified value
---	----	----------	------	-----------------

Level 1 Remedial Target

Level 1 Remedial Target	2.38E+00	mg/kg	(for comparison with soil analyses)
	or		
	0.0088	mg/l	(for comparison with leachate test results)

Site being assessed:	NGET Tottenham
Completed by:	M Craske
Date:	27-Oct-23
Version:	x.xx



Level 2 - Soil

Contaminant
Target concentration

C_T

Lead
0.0088

mg/l
from Level 1
from Level 1

This sheet calculates the Level 2 remedial target for soils (mg/kg) or for pore water (mg/l).

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 2 remedial target to determine the need for further action. Equations presented in 'Hydrogeological risk assessment for land contamination' (Environment Agency 2006)

Input Parameters

Variable

Value

Unit

Source of parameter value

Standard entry

Infiltration
Area of contaminant source

Inf
A

7.40E-04
1.25E+04

m/d
m²

ted from EA effective infiltration mapping and 80% ha
Length x width of site (50x250)

Not used in calculation

Entry for groundwater flow below site

Length of contaminant source in direction of groundwater flow
Saturated aquifer thickness
Hydraulic Conductivity of aquifer in which dilution occurs
Hydraulic gradient of water table
Width of contaminant source perpendicular to groundwater flow
Background concentration of contaminant in groundwater beneath site

L
da
K
i
w
Cu

5.00E+01
2.54E+00
1.00E+01
2.00E-03
2.50E+02
0.00E+00

m
m
m/d
fraction
m
mg/l

oximate lenght of site in direction of GW flow (north/s
hickness of Kempton Park Gravel based on BH logs +
WP 2013 value for KPG
etween site and off site locations near Pymmes brook
ate site area perpendicular to GW flow (north-east/so

Not used in calculation

Define mixing zone depth by specifying or calculating depth (using pull down list)

Enter mixing zone thickness
Calculated mixing zone thickness

Mz
Mz

Calculate
2.54E+00

m
m

default condition

Calculated Parameters

Dilution Factor	DF	2.37E+00
Level 2 Remedial Target		2.09E-02 or 5.64E+00
		mg/l mg/kg

For comparison with measured pore water concentration. This assumes Level 1 Remedial Target is based on Target Concentration

For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water

Additional option

Calculation of impact on receptor

Concentration of contaminant in contaminated discharge (entering receptor)

Cc

0.00E+00

mg/l

--

Calculated concentration within receptor (dilution only)

0.00E+00

mg/l

0

Site being assessed:	NGET Tottenham
Completed by:	M Craske
Date:	27-Oct-23
Version:	x.xx

Remedial Targets Worksheet , Release 3.2

Level 3 - Soil

See Note



Input Parameters	Variable	Value	Unit	Source
Contaminant		Lead		from Level 1
Target Concentration	C _T	0.0088	mg/l	from Level 1
Dilution Factor	DF	2.37E+00		from Level 2

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

Ogata Banks	Equations in HRA publication
-------------	------------------------------

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

Approach for simulating degradation of pollutants: Apply degradation rate to dissolved pollutants only

Variable	Value	Unit	Source of parameter value
Soil leachate concentration as mg/l			
Enter soil leachate concentration	0.1	mg/l	
Half life for degradation of contaminant in water	9.00E+99	days	
Calculated decay rate	7.70E-101	days ⁻¹	calculated
Width of plume in aquifer at source	2.50E+02	m	from Level 2
Plume thickness in aquifer at source	2.54E+00	m	from Level 2
Bulk density of aquifer materials	1.80E+00	g/cm ³	Literature estimate for RTD
Effective porosity of aquifer	2.00E-01	fraction	Literature estimate for RTD
Hydraulic gradient	3.46E-03	fraction	from Level 2 (adjusted)
Hydraulic conductivity of saturated aquifer	1.00E+01	m/d	from Level 2
Distance (lateral) to compliance point perpendicular to flow direction	3.00E+01	m	Default for aquifer protection
Distance (depth) to compliance point perpendicular to flow direction		m	default condition
Time since pollutant entered groundwater	9.99E+99	days	time variant options only
Parameters values determined from options			
Partition coefficient	Kd	2.70E+02	l/kg see options
Longitudinal dispersivity	ax	3.000	m see options
Transverse dispersivity	az	0.300	m see options
Vertical dispersivity	ay	0.000	m see options

Parameter values should be checked against Level 1 and 2

Calculated Parameters

Variable			
Groundwater flow velocity	v	1.73E-01	m/d
Retardation factor	Rf	2.43E+03	fraction
Decay rate used	λ	3.17E-104	d ⁻¹
Hydraulic gradient used in aquifer flow down-gradient	i	3.46E-03	fraction
Rate of contaminant flow due to retardation	u	7.11E-05	m/d
Ratio of Compliance Point to Source Concentration	C _{ED} /C ₀	1.00E+00	fraction
Attenuation factor (C ₀ /C _{ED})	AF	1.00E+00	fraction
Soil leachate concentration	Co	1.00E-01	

Remedial Targets

Level 3 Remedial Target	2.09E-02	mg/l	For comparison with measured pore water concentration.
Ogata Banks	or		This assumes Level 1 Remedial Target is based on Target Concentration.
	5.64E+00	mg/kg	For comparison with measured soil concentration. This
Distance to compliance point	30	m	assumes Level 1 Remedial Target calculated from soil-water partitioning equation.
Ratio of Compliance Point to Source Concentration	C _{ED} /C ₀	1.00E+00	fraction 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

Enter method of defining partition co-efficient (using pull down list)

User specified value for partition coefficient

Entry if specify partition coefficient (option)

Soil water partition coefficient Kd 2.70E+02 l/kg

Entry for non-polar organic chemicals (option)

Fraction of organic carbon in aquifer foc fraction

Organic carbon partition coefficient Koc 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

Fraction of organic carbon in aquifer foc fraction

Soil water partition coefficient Kd 2.70E+02 l/kg

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

User defined values for dispersivity

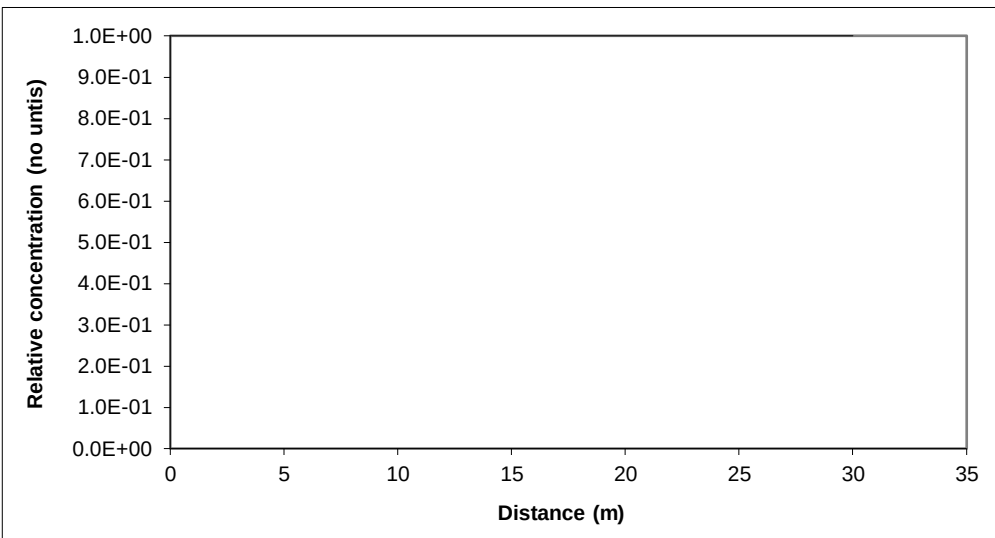
	Enter value	Calc value	Xu & Eckstein	
Longitudinal dispersivity	ax	3.00E+00	3.00E+00	2.13E+00 m
Transverse dispersivity	az	3.00E-01	3.00E-01	2.13E-01 m
Vertical dispersivity	ay	1.00E-99	3.00E-02	2.13E-02 m

Note values of dispersivity must be > 0

Xu & Eckstein (1995) report ax = 0.83(log₁₀x)^{2.414}; az = ax/10, ay = ax/100 are assumed

Note

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



Note: 'Relative concentration' is the ratio of calculated concentration at a given position compared to the source concentration. The calculations assume plume disperses from the top of the aquifer. An alternative solution assuming the centre of the plume is located at the mid-depth of the aquifer is presented in the calculation sheets.

Calculated (relative) concentrations for distance-concentration graph

Ogata Banks

Distance	Relative concentration (No units)	Concentration mg/l
0	1.0E+00	4.21E-02
1.5	1.00E+00	4.21E-02
3.0	1.00E+00	4.21E-02
4.5	1.00E+00	4.21E-02
6.0	1.00E+00	4.21E-02
7.5	1.00E+00	4.21E-02
9.0	1.00E+00	4.21E-02
10.5	1.00E+00	4.21E-02
12.0	1.00E+00	4.21E-02
13.5	1.00E+00	4.21E-02
15.0	1.00E+00	4.21E-02
16.5	1.00E+00	4.21E-02
18.0	1.00E+00	4.21E-02
19.5	1.00E+00	4.21E-02
21.0	1.00E+00	4.21E-02
22.5	1.00E+00	4.21E-02
24.0	1.00E+00	4.21E-02
25.5	1.00E+00	4.21E-02
27.0	1.00E+00	4.21E-02
28.5	1.00E+00	4.21E-02
30.0	1.00E+00	4.21E-02

This sheet calculates the Level 3 remedial target for soils(mg/kg) or for pore water (mg/l), based on the distance to the receptor or compliance located down hydraulic gradient of the source Three solution methods are included, the preferred option is Ogata Banks.By setting a long travel time (e.g. 9E99) it will give the steady state solution, which should always be used when calculating remedial targets.

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 3 remedial target to determine the need for further action.

Note if contaminant is not subject to first order degradation, then set half life as 9.9E+99.

Site being assessed:	NGET Tottenham
Completed by:	M Craske
Date:	#####
Version:	x.xx

R&D Publication 20 Remedial Targets Worksheet, Release 3.2

Level 3 - Groundwater

See Note

Input Parameters (using pull down menu)

Contaminant	Lead	from Level 1
Target Concentration	C _T 8.80E-03	mg/l from Level 1

Ogata Banks

Equations in HRA publication

Approach for simulating vertical dispersion:

Simulate vertical dispersion in 1 direction

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

Approach for simulating degradation of pollutants:

Apply degradation rate to dissolved pollutants only

Initial contaminant concentration in groundwater at plume core	C ₀	1.00E+00	mg/l	Source of parameter value
Half life for degradation of contaminant in water	t _{1/2}	9.00E+99	days	Based on site data
Calculated decay rate	λ	7.70E-101	days ⁻¹	0
Width of plume in aquifer at source (perpendicular to flow)	Sz	2.50E+02	m	
Plume thickness at source	Sy	2.54E+00	m	
Saturated aquifer thickness	da	2.54E+00	m	Average thickness of Kempton Park Grave
Bulk density of aquifer materials	ρ	1.80E+00	g/cm ³	Literature estimate for RTD
Effective porosity of aquifer	n	2.00E-01	fraction	Literature estimate for RTD
Hydraulic gradient	i	2.00E-03	fraction	Based on average of site-specific GW measurements (SSE groundwater flow) - 0.0005 - 0.002 between
Hydraulic conductivity of aquifer	K	1.00E+01	m/d	WP 2013 value for KPG
Distance to compliance point	x	3.00E+01	m	Longitudinal dispersivity
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	Transverse dispersivity
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	Vertical dispersivity
Time since pollutant entered groundwater	t	9.99E+99	days	Note values of dispersivity must be > 0
Parameters values determined from options				For calculated value, assumes ax = 0.1 * x, az = 0.01 * x, ay = 0.001 * x
Partition coefficient	Kd	2.70E+02	l/kg	Xu & Eckstein (1995) report ax = 0.83(log ₁₀ x) ^{2.414} ; az = ax/10, ay = ax/100 are assumed
Longitudinal dispersivity	ax	3.00E+00	m	
Transverse dispersivity	az	3.00E-01	m	
Vertical dispersivity	ay	1.00E-99	m	

Calculated Parameters

Groundwater flow velocity	v	1.00E-01	m/d
Retardation factor	Rf	2.43E+03	fraction
Decay rate used	λ	3.17E-104	d ⁻¹
Rate of contaminant flow due to retardation	u	4.11E-05	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C _{ED}	1.00E+00	mg/l
Attenuation factor (one way vertical dispersion, CO/CED)	AF	1.00E+00	

Remedial Targets

Remedial Target	8.80E-03	mg/l	For comparison with measured groundwater concentration.
Ogata Banks			
Distance to compliance point	30	m	
Concentration of contaminant at compliance point after	C _{ED} /C ₀	1.00E+00	mg/l
		1.0E+100	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)

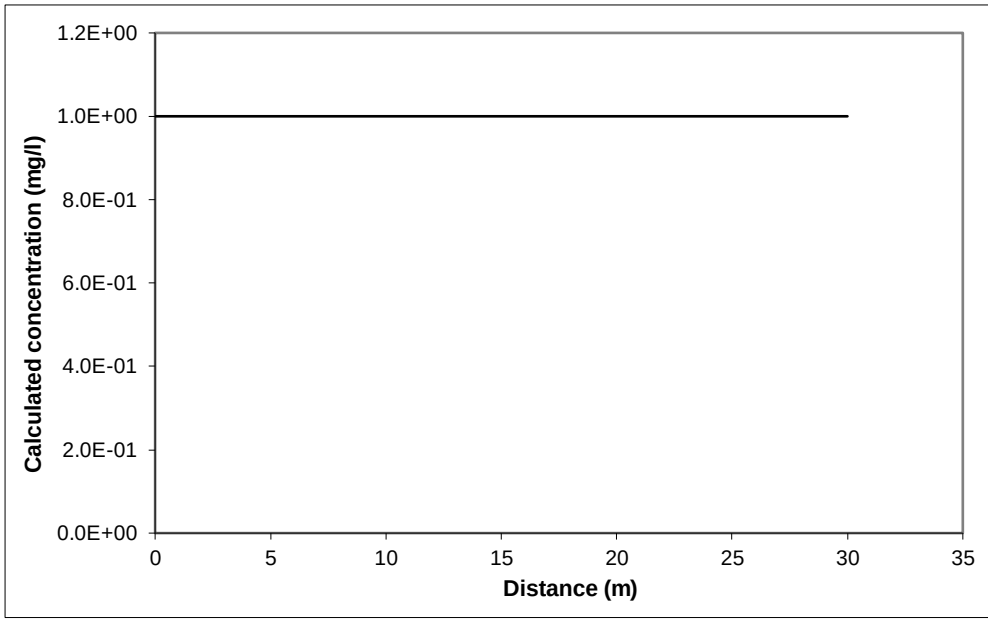
User specified value for partition coefficient

Entry if specify partition coefficient (option)		
Soil water partition coefficient	Kd	2.70E+02 l/kg
Entry for non-polar organic chemicals (option)		
Fraction of organic carbon in aquifer	foc	fraction
Organic carbon partition coefficient	Koc	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	
Fraction of organic carbon in aquifer	foc	fraction
Soil water partition coefficient	Kd	2.70E+02 l/kg

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

User defined values for dispersivity

Enter value	Calc value Xu & Eckstein	m
ax	3.00E+00	3.00E+00 2.13E-06 m
az	3.00E-01	3.00E-01 2.13E-01 m
ay	1.00E-99	3.00E-02 2.13E-02 m



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

Note

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

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

The measured groundwater concentration should be compared with the Level 3 remedial target to determine the need for further action. Note if contaminant is not subject to first order degradation, then set half life as 9.0E+99.

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

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration
	mg/l
0	1.0E+00
1.5	1.00E+00
3.0	1.00E+00
4.5	1.00E+00
6.0	1.00E+00
7.5	1.00E+00
9.0	1.00E+00
10.5	1.00E+00
12.0	1.00E+00
13.5	1.00E+00
15.0	1.00E+00
16.5	1.00E+00
18.0	1.00E+00
19.5	1.00E+00
21.0	1.00E+00
22.5	1.00E+00
24.0	1.00E+00
25.5	1.00E+00
27.0	1.00E+00
28.5	1.00E+00
30.0	1.00E+00



Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

This worksheet has been produced in combination with the document 'Remedial Targets Methodology: Hydrogeological risk assessment for land contamination (Environment Agency 2006).

Users of this worksheet should always refer to the User Manual to the Remedial Targets Methodology and to relevant guidance on UK legislation and policy, in order to understand how this procedure should be applied in an appropriate context.

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

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

<u>Details to be completed for each assessment</u>			
Site Name:	NGET Tottenham		
Site Address:			
Completed by:	M Craske	Version:	x.xx
Date:	27-Oct-23		
Contaminant	Lead		
Target Concentration (C_T)	0.037158851	mg/l	Origin of C_T: Lowest of DWS/EQS

This worksheet can be used to determine remedial targets for soils (Worksheets Level 1 Soil, Level 2 and Level 3 Soil) or to determine remedial targets for groundwater (Level 3 Groundwater). For Level 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 comparison 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 Level 1, 2 and 3 Worksheets.

Worksheet options are identified by brown background and employ a pull-down menus. Data entry are identified as blue background.

Data origin / justification should be noted in cells coloured yellow and fully documented in subsequent reports.

Data carried forward from an earlier worksheet are identified by a light green background

It is recommended that a copy of the original worksheet is saved (all data fields in the original copy are blank).

The spreadsheet also includes a porosity calculation worksheet, a soil impact calculation worksheet and a worksheet that performs some simple hydrogeological calculations.

Remedial Targets Worksheet , Release 3.2



Level 1 - Soil

Select the method of calculating the soil water
Partition Co-efficient by using the pull down menu
below

User specified value for partition coefficient

Contaminant	Lead
Target concentration	0.037158851 mg/l

Input Parameters

Standard entry

Water filled soil porosity	θ_w	3.70E-01	fraction	Conservative value estimated from average site mo
Air filled soil porosity	θ_a	1.90E-01	fraction	Conservative value estimated from average site mo
Bulk density of soil zone material	ρ	1.60E+00	g/cm ³	Conservative Estimate for Made Ground
Henry's Law constant	H	0.00E+00	dimensionless	0

Entry if specify partition coefficient (option)

Soil water partition coefficient	Kd	2.70E+02	l/kg	3.10E+01
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Entry for non-polar organic chemicals (option)

Fraction of organic carbon (in soil)	foc		fraction	GI average, uncontaminated samples
Organic carbon partition coefficient	Koc		l/kg	86

Entry for ionic organic chemicals (option)

Sorption coefficient for neutral species	$K_{oc,n}$		l/kg	
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg	
pH value	pH		pH units	
Acid dissociation constant	pKa			
Fraction of organic carbon (in soil)	foc		fraction	

Soil water partition coefficient used in Level Assessment	Kd	2.70E+02	l/kg	Specified value
---	----	----------	------	-----------------

Level 1 Remedial Target

Level 1 Remedial Target	1.00E+01	mg/kg	(for comparison with soil analyses)
	or		
	0.037158851	mg/l	(for comparison with leachate test results)

Site being assessed:	NGET Tottenham
Completed by:	M Craske
Date:	27-Oct-23
Version:	x.xx



Level 2 - Soil

Contaminant
Target concentration

C_T

Lead

0.037158851

mg/l

from Level 1

from Level 1

This sheet calculates the Level 2 remedial target for soils (mg/kg) or for pore water (mg/l).

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 2 remedial target to determine the need for further action. Equations presented in 'Hydrogeological risk assessment for land contamination' (Environment Agency 2006)

Input Parameters	Variable	Value	Unit	Source of parameter value
Standard entry				
Infiltration	Inf	7.40E-04	m/d	Estimated from EA effective infiltration mapping and 80% ha
Area of contaminant source	A	1.25E+04	m ²	Length x width of site (50x250) Not used in calculation
Entry for groundwater flow below site				
Length of contaminant source in direction of groundwater flow	L	5.00E+01	m	Approximate length of site in direction of GW flow (north/south)
Saturated aquifer thickness	da	2.54E+00	m	Thickness of Kempton Park Gravel based on BH logs +
Hydraulic Conductivity of aquifer in which dilution occurs	K	1.00E+01	m/d	WP 2013 value for KPG
Hydraulic gradient of water table	i	2.00E-03	fraction	Between site and off site locations near Pymmes brook
Width of contaminant source perpendicular to groundwater flow	w	2.50E+02	m	Approximate site area perpendicular to GW flow (north-east/south-west)
Background concentration of contaminant in groundwater beneath site	Cu	0.00E+00	mg/l	Not used in calculation
Define mixing zone depth by specifying or calculating depth (using pull down list)		Calculate		default condition
Enter mixing zone thickness	Mz		m	
Calculated mixing zone thickness	Mz	2.54E+00	m	

Calculated Parameters

Dilution Factor	DF	2.37E+00		
Level 2 Remedial Target		8.82E-02	mg/l	For comparison with measured pore water concentration. This assumes Level 1 Remedial Target is based on Target Concentration
		or		
		2.38E+01	mg/kg	For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water

Additional option

Calculation of impact on receptor

Concentration of contaminant in contaminated discharge (entering receptor)	Cc	0.00E+00	mg/l	
Calculated concentration within receptor (dilution only)		0.00E+00	mg/l	0

Site being assessed:	NGET Tottenham
Completed by:	M Craske
Date:	27-Oct-23
Version:	x.xx



Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

This worksheet has been produced in combination with the document 'Remedial Targets Methodology: Hydrogeological risk assessment for land contamination (Environment Agency 2006).

Users of this worksheet should always refer to the User Manual to the Remedial Targets Methodology and to relevant guidance on UK legislation and policy, in order to understand how this procedure should be applied in an appropriate context.

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

Details to be completed for each assessment

Site Name:	NGET Tottenham		
Site Address:			
Completed by:	M Craske	Version:	x.xx
Date:	27-Oct-23		
Contaminant	Lead		
Target Concentration (C_T)	0.0088	mg/l	Origin of C_T: Lowest of DWS/EQS

This worksheet can be used to determine remedial targets for soils (Worksheets Level 1 Soil, Level 2 and Level 3 Soil) or to determine remedial targets for groundwater (Level 3 Groundwater). For Level 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 comparison 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 Level 1, 2 and 3 Worksheets.

Worksheet options are identified by brown background and employ a pull-down menus. Data entry are identified as blue background.

Data origin / justification should be noted in cells coloured yellow and fully documented in subsequent reports.

Data carried forward from an earlier worksheet are identified by a light green background

It is recommended that a copy of the original worksheet is saved (all data fields in the original copy are blank).

The spreadsheet also includes a porosity calculation worksheet, a soil impact calculation worksheet and a worksheet that performs some simple hydrogeological calculations.



Level 1 - Soil

Select the method of calculating the soil water
Partition Co-efficient by using the pull down menu
below

User specified value for partition coefficient

Contaminant	Lead
Target concentration	0.0088 mg/l

Input Parameters

Standard entry

Water filled soil porosity	θ_w	3.70E-01	fraction	Conservative value estimated from average site mo
Air filled soil porosity	θ_a	1.90E-01	fraction	Conservative value estimated from average site mo
Bulk density of soil zone material	ρ	1.60E+00	g/cm ³	Conservative Estimate for Made Ground
Henry's Law constant	H	0.00E+00	dimensionless	0

This sheet calculates the Level 1 remedial target for soils(mg/kg) based on a selected target concentration and theoretical calculation of soil water partitioning. Three options are included for determining the partition coefficient. The measured soil concentration as mg/kg should be compared with the Level 1 remedial target to determine the need for further action.

Entry if specify partition coefficient (option)

Soil water partition coefficient	Kd	2.70E+02	l/kg	3.10E+01
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Entry for non-polar organic chemicals (option)

Fraction of organic carbon (in soil)	foc		fraction	GI average, uncontaminated samples
Organic carbon partition coefficient	Koc		l/kg	86

Entry for ionic organic chemicals (option)

Sorption coefficient for neutral species	$K_{oc,n}$		l/kg	
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg	
pH value	pH		pH units	
Acid dissociation constant	pKa			
Fraction of organic carbon (in soil)	foc		fraction	

Soil water partition coefficient used in Level Assessment	Kd	2.70E+02	l/kg	Specified value
---	----	----------	------	-----------------

Level 1 Remedial Target

Level 1 Remedial Target	2.38E+00	mg/kg	(for comparison with soil analyses)
	or		
	0.0088	mg/l	(for comparison with leachate test results)

Site being assessed:	NGET Tottenham
Completed by:	M Craske
Date:	27-Oct-23
Version:	x.xx



Level 2 - Soil

Contaminant
Target concentration

C_T

Lead
0.0088

mg/l
from Level 1
from Level 1

This sheet calculates the Level 2 remedial target for soils (mg/kg) or for pore water (mg/l).

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 2 remedial target to determine the need for further action. Equations presented in 'Hydrogeological risk assessment for land contamination' (Environment Agency 2006)

Input Parameters

Variable

Value

Unit

Source of parameter value

Standard entry

Infiltration
Area of contaminant source

Inf
A

7.40E-04
1.25E+04

m/d
m²

ted from EA effective infiltration mapping and 80% ha
Length x width of site (50x250)

Not used in calculation

Entry for groundwater flow below site

Length of contaminant source in direction of groundwater flow
Saturated aquifer thickness
Hydraulic Conductivity of aquifer in which dilution occurs
Hydraulic gradient of water table
Width of contaminant source perpendicular to groundwater flow
Background concentration of contaminant in groundwater beneath site

L
da
K
i
w
Cu

5.00E+01
2.54E+00
1.00E+01
2.00E-03
2.50E+02
0.00E+00

m
m
m/d
fraction
m
mg/l

oximate lenght of site in direction of GW flow (north/s
hickness of Kempton Park Gravel based on BH logs +
WP 2013 value for KPG
etween site and off site locations near Pymmes brook
ate site area perpendicular to GW flow (north-east/so

Not used in calculation

Define mixing zone depth by specifying or calculating depth (using pull down list)

Enter mixing zone thickness
Calculated mixing zone thickness

Mz
Mz

Calculate
2.54E+00

m
m

default condition

Calculated Parameters

Dilution Factor	DF	2.37E+00
Level 2 Remedial Target		2.09E-02 or 5.64E+00
		mg/l mg/kg

For comparison with measured pore water concentration. This assumes Level 1 Remedial Target is based on Target Concentrati

For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water

Additional option

Calculation of impact on receptor

Concentration of contaminant in contaminated discharge (entering receptor)

Cc

0.00E+00

mg/l

--

Calculated concentration within receptor (dilution only)

0.00E+00

mg/l

0

Site being assessed:	NGET Tottenham
Completed by:	M Craske
Date:	27-Oct-23
Version:	x.xx

Remedial Targets Worksheet , Release 3.2

Level 3 - Soil

See Note



Input Parameters	Variable	Value	Unit	Source
Contaminant		Lead		from Level 1
Target Concentration	C _T	0.0088	mg/l	from Level 1
Dilution Factor	DF	2.37E+00		from Level 2

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

Ogata Banks	Equations in HRA publication
-------------	------------------------------

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

Approach for simulating degradation of pollutants:

Apply degradation rate to dissolved pollutants only

Variable	Value	Unit	Source of parameter value
Soil leachate concentration as mg/l			
Enter soil leachate concentration	0.1	mg/l	
Half life for degradation of contaminant in water	9.00E+99	days	
Calculated decay rate	7.70E-101	days ⁻¹	calculated
Width of plume in aquifer at source	2.50E+02	m	from Level 2
Plume thickness in aquifer at source	2.54E+00	m	from Level 2
Bulk density of aquifer materials	1.80E+00	g/cm ³	Literature estimate for RTD
Effective porosity of aquifer	2.00E-01	fraction	Literature estimate for RTD
Hydraulic gradient	3.46E-03	fraction	from Level 2 (adjusted)
Hydraulic conductivity of saturated aquifer	1.00E+01	m/d	from Level 2
Distance (lateral) to compliance point perpendicular to flow direction	3.00E+01	m	Default for aquifer protection
Distance (depth) to compliance point perpendicular to flow direction		m	default condition
Time since pollutant entered groundwater	9.99E+99	days	time variant options only
Parameters values determined from options			
Partition coefficient	Kd	2.70E+02	l/kg see options
Longitudinal dispersivity	ax	3.000	m see options
Transverse dispersivity	az	0.300	m see options
Vertical dispersivity	ay	0.000	m see options

Parameter values should be checked against Level 1 and 2

Calculated Parameters

Variable			
Groundwater flow velocity	v	1.73E-01	m/d
Retardation factor	Rf	2.43E+03	fraction
Decay rate used	λ	3.17E-104	d ⁻¹
Hydraulic gradient used in aquifer flow down-gradient	i	3.46E-03	fraction
Rate of contaminant flow due to retardation	u	7.11E-05	m/d
Ratio of Compliance Point to Source Concentration	C _{ED} /C ₀	1.00E+00	fraction
Attenuation factor (C ₀ /C _{ED})	AF	1.00E+00	fraction
Soil leachate concentration	Co	1.00E-01	

Remedial Targets

Level 3 Remedial Target	2.09E-02	mg/l	For comparison with measured pore water concentration.
Ogata Banks	or		This assumes Level 1 Remedial Target is based on Target Concentration.
	5.64E+00	mg/kg	For comparison with measured soil concentration. This
Distance to compliance point	30	m	assumes Level 1 Remedial Target calculated from soil-water partitioning equation.
Ratio of Compliance Point to Source Concentration	C _{ED} /C ₀	1.00E+00	fraction 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

Enter method of defining partition co-efficient (using pull down list)

User specified value for partition coefficient

Entry if specify partition coefficient (option)

Soil water partition coefficient Kd 2.70E+02 l/kg

Entry for non-polar organic chemicals (option)

Fraction of organic carbon in aquifer foc fraction

Organic carbon partition coefficient Koc l/kg

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

Fraction of organic carbon in aquifer foc fraction

Soil water partition coefficient Kd 2.70E+02 l/kg

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

User defined values for dispersivity

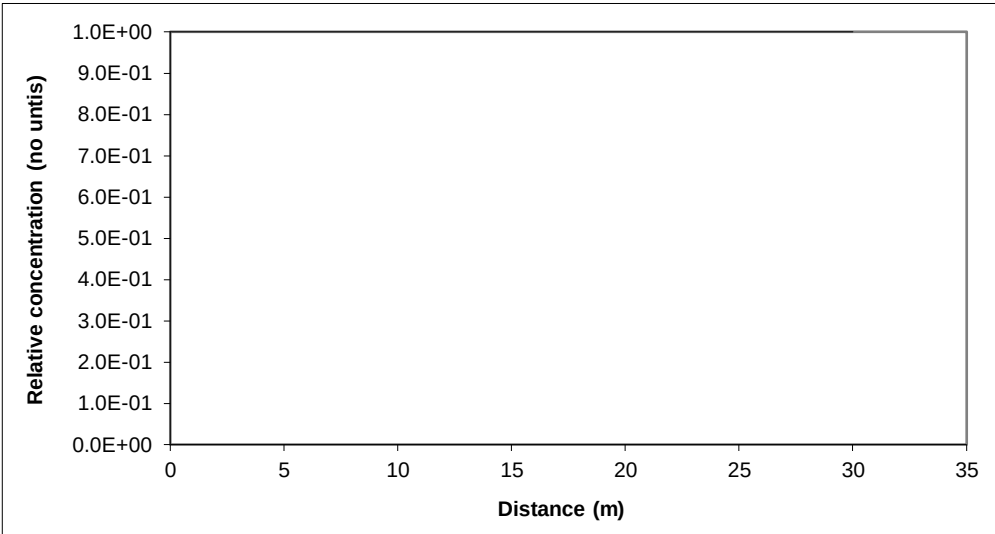
	Enter value	Calc value	Xu & Eckstein	
Longitudinal dispersivity	ax	3.00E+00	3.00E+00	2.13E+00 m
Transverse dispersivity	az	3.00E-01	3.00E-01	2.13E-01 m
Vertical dispersivity	ay	1.00E-99	3.00E-02	2.13E-02 m

Note values of dispersivity must be > 0

Xu & Eckstein (1995) report ax = 0.83(log₁₀x)^{2.414} ; az = ax/10, ay = ax/100 are assumed

Note

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



Note: 'Relative concentration' is the ratio of calculated concentration at a given position compared to the source concentration. The calculations assume plume disperses from the top of the aquifer. An alternative solution assuming the centre of the plume is located at the mid-depth of the aquifer is presented in the calculation sheets.

Calculated (relative) concentrations for distance-concentration graph

Ogata Banks

From calculation sheet

Distance	Relative concentration (No units)	Concentration mg/l
0	1.0E+00	4.21E-02
1.5	1.00E+00	4.21E-02
3.0	1.00E+00	4.21E-02
4.5	1.00E+00	4.21E-02
6.0	1.00E+00	4.21E-02
7.5	1.00E+00	4.21E-02
9.0	1.00E+00	4.21E-02
10.5	1.00E+00	4.21E-02
12.0	1.00E+00	4.21E-02
13.5	1.00E+00	4.21E-02
15.0	1.00E+00	4.21E-02
16.5	1.00E+00	4.21E-02
18.0	1.00E+00	4.21E-02
19.5	1.00E+00	4.21E-02
21.0	1.00E+00	4.21E-02
22.5	1.00E+00	4.21E-02
24.0	1.00E+00	4.21E-02
25.5	1.00E+00	4.21E-02
27.0	1.00E+00	4.21E-02
28.5	1.00E+00	4.21E-02
30.0	1.00E+00	4.21E-02

This sheet calculates the Level 3 remedial target for soils(mg/kg) or for pore water (mg/l), based on the distance to the receptor or compliance located down hydraulic gradient of the source Three solution methods are included, the preferred option is Ogata Banks.By setting a long travel time (e.g. 9E99) it will give the steady state solution, which should always be used when calculating remedial targets.

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 3 remedial target to determine the need for further action.

Note if contaminant is not subject to first order degradation, then set half life as 9.9E+99.

Site being assessed:	NGET Tottenham
Completed by:	M Craske
Date:	#####
Version:	x.xx

R&D Publication 20 Remedial Targets Worksheet, Release 3.2

Level 3 - Groundwater

See Note

Input Parameters (using pull down menu)

Contaminant	Lead	from Level 1
Target Concentration	C _T 8.80E-03	mg/l from Level 1

mg/l

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

Ogata Banks

Equations in HRA publication

Approach for simulating vertical dispersion:

Simulate vertical dispersion in 1 direction

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

Approach for simulating degradation of pollutants:

Apply degradation rate to dissolved pollutants only

Initial contaminant concentration in groundwater at plume core	C ₀	1.00E+00	mg/l	Source of parameter value
Half life for degradation of contaminant in water	t _{1/2}	9.00E+99	days	Based on site data
Calculated decay rate	λ	7.70E-101	days ⁻¹	0
Width of plume in aquifer at source (perpendicular to flow)	Sz	2.50E+02	m	
Plume thickness at source	Sy	2.54E+00	m	
Saturated aquifer thickness	da	2.54E+00	m	Average thickness of Kempton Park Grave
Bulk density of aquifer materials	ρ	1.80E+00	g/cm ³	Literature estimate for RTD
Effective porosity of aquifer	n	2.00E-01	fraction	Literature estimate for RTD
Hydraulic gradient	i	2.00E-03	fraction	Based on average of site-specific GW measurements (SSE groundwater flow) - 0.0005 - 0.002 between
Hydraulic conductivity of aquifer	K	1.00E+01	m/d	WP 2013 value for KPG
Distance to compliance point	x	3.00E+01	m	Longitudinal dispersivity
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	Transverse dispersivity
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	Vertical dispersivity
Time since pollutant entered groundwater	t	9.99E+99	days	Note values of dispersivity must be > 0
Parameters values determined from options				For calculated value, assumes ax = 0.1 * x, az = 0.01 * x, ay = 0.001 * x
Partition coefficient	Kd	2.70E+02	l/kg	Xu & Eckstein (1995) report ax = 0.83(log ₁₀ x) ^{2.414} ; az = ax/10, ay = ax/100 are assumed
Longitudinal dispersivity	ax	3.00E+00	m	
Transverse dispersivity	az	3.00E-01	m	
Vertical dispersivity	ay	1.00E-99	m	

Calculated Parameters

Groundwater flow velocity	v	1.00E-01	m/d
Retardation factor	Rf	2.43E+03	fraction
Decay rate used	λ	3.17E-104	d ⁻¹
Rate of contaminant flow due to retardation	u	4.11E-05	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C _{ED}	1.00E+00	mg/l
Attenuation factor (one way vertical dispersion, CO/CED)	AF	1.00E+00	

Remedial Targets

Remedial Target	8.80E-03	mg/l	For comparison with measured groundwater concentration.
Ogata Banks			
Distance to compliance point	30	m	
Concentration of contaminant at compliance point after	C _{ED} /C ₀	1.00E+00	mg/l
		1.0E+100	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)

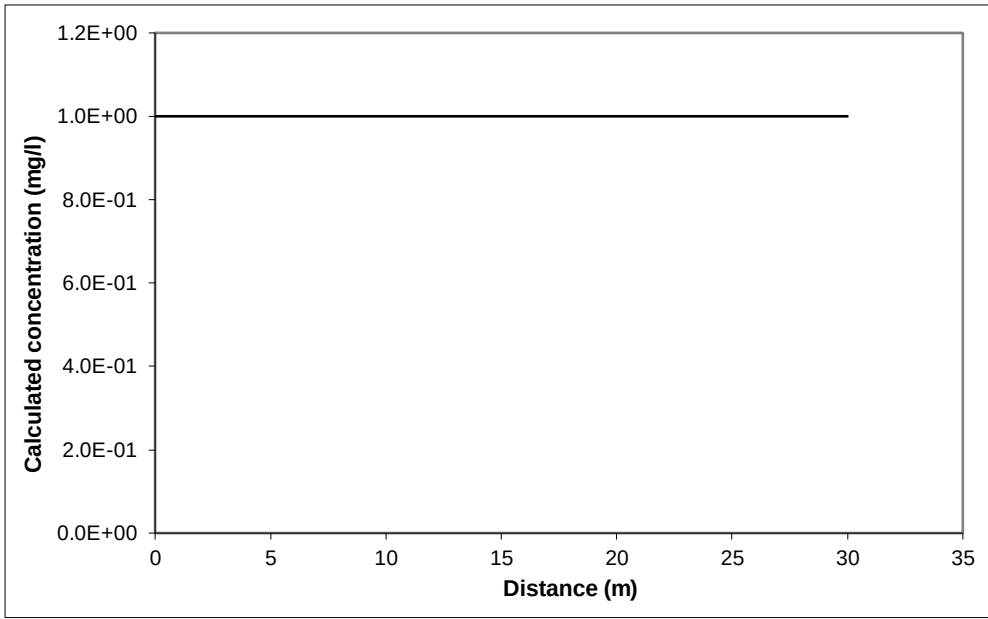
User specified value for partition coefficient

Entry if specify partition coefficient (option)		
Soil water partition coefficient	Kd	2.70E+02 l/kg
Entry for non-polar organic chemicals (option)		
Fraction of organic carbon in aquifer	foc	fraction
Organic carbon partition coefficient	Koc	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	
Fraction of organic carbon in aquifer	foc	fraction
Soil water partition coefficient	Kd	2.70E+02 l/kg

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

User defined values for dispersivity

Enter value	Calc value Xu & Eckstein	m
ax	3.00E+00	3.00E+00 2.13E-06 m
az	3.00E-01	3.00E-01 2.13E-01 m
ay	1.00E-99	3.00E-02 2.13E-02 m



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

Note

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

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

The measured groundwater concentration should be compared with the Level 3 remedial target to determine the need for further action. Note if contaminant is not subject to first order degradation, then set half life as 9.0E+99.

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

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration
	mg/l
0	1.0E+00
1.5	1.00E+00
3.0	1.00E+00
4.5	1.00E+00
6.0	1.00E+00
7.5	1.00E+00
9.0	1.00E+00
10.5	1.00E+00
12.0	1.00E+00
13.5	1.00E+00
15.0	1.00E+00
16.5	1.00E+00
18.0	1.00E+00
19.5	1.00E+00
21.0	1.00E+00
22.5	1.00E+00
24.0	1.00E+00
25.5	1.00E+00
27.0	1.00E+00
28.5	1.00E+00
30.0	1.00E+00



Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

This worksheet has been produced in combination with the document 'Remedial Targets Methodology: Hydrogeological risk assessment for land contamination (Environment Agency 2006).

Users of this worksheet should always refer to the User Manual to the Remedial Targets Methodology and to relevant guidance on UK legislation and policy, in order to understand how this procedure should be applied in an appropriate context.

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

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

<u>Details to be completed for each assessment</u>			
Site Name:	NGET Tottenham		
Site Address:			
Completed by:	M Craske	Version:	x.xx
Date:	27-Oct-23		
Contaminant	Naphthalene		
Target Concentration (C_T)	0.133863705	mg/l	Origin of C_T: Lowest of DWS/EQS

This worksheet can be used to determine remedial targets for soils (Worksheets Level 1 Soil, Level 2 and Level 3 Soil) or to determine remedial targets for groundwater (Level 3 Groundwater). For Level 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 comparison 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 Level 1, 2 and 3 Worksheets.

Worksheet options are identified by brown background and employ a pull-down menus. Data entry are identified as blue background.

Data origin / justification should be noted in cells coloured yellow and fully documented in subsequent reports.

Data carried forward from an earlier worksheet are identified by a light green background

It is recommended that a copy of the original worksheet is saved (all data fields in the original copy are blank).

The spreadsheet also includes a porosity calculation worksheet, a soil impact calculation worksheet and a worksheet that performs some simple hydrogeological calculations.



Level 1 - Soil

Select the method of calculating the soil water
Partition Co-efficient by using the pull down menu
below

Calculate for non-polar organic chemicals

Contaminant	Naphthalene
Target concentration	0.133863705 mg/l

Input Parameters

Standard entry

Water filled soil porosity	θ_w	3.70E-01	fraction	Conservative value estimated from average site mo
Air filled soil porosity	θ_a	1.90E-01	fraction	Conservative value estimated from average site mo
Bulk density of soil zone material	ρ	1.60E+00	g/cm ³	Conservative Estimate for Made Ground
Henry's Law constant	H	1.74E-02	dimensionless	83

Entry if specify partition coefficient (option)

Soil water partition coefficient	Kd		l/kg	3.10E+01
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Entry for non-polar organic chemicals (option)

Fraction of organic carbon (in soil)	foc	8.00E-02	fraction	Average from uncontaminated site samples
Organic carbon partition coefficient	Koc	8.44E+02	l/kg	83

Entry for ionic organic chemicals (option)

Sorption coefficient for neutral species	$K_{oc,n}$		l/kg	
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg	
pH value	pH		pH units	
Acid dissociation constant	pKa			
Fraction of organic carbon (in soil)	foc		fraction	

Soil water partition coefficient used in Level Assessment	Kd	6.75E+01	l/kg	Calculated value
---	----	----------	------	------------------

Level 1 Remedial Target

Level 1 Remedial Target	9.07E+00	mg/kg	(for comparison with soil analyses)
	or		
	0.133863705	mg/l	(for comparison with leachate test results)

Site being assessed:	NGET Tottenham
Completed by:	M Craske
Date:	27-Oct-23
Version:	x.xx



Level 2 - Soil

Contaminant
Target concentration

C_T

Naphthalene

0.133863705

mg/l

from Level 1

from Level 1

This sheet calculates the Level 2 remedial target for soils (mg/kg) or for pore water (mg/l).

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 2 remedial target to determine the need for further action. Equations presented in 'Hydrogeological risk assessment for land contamination' (Environment Agency 2006)

Input Parameters	Variable	Value	Unit	Source of parameter value
Standard entry				
Infiltration	Inf	7.40E-04	m/d	Estimated from EA effective infiltration mapping and 80% ha
Area of contaminant source	A	1.25E+04	m ²	Length x width of site (50x250) Not used in calculation
Entry for groundwater flow below site				
Length of contaminant source in direction of groundwater flow	L	5.00E+01	m	Estimated length of site in direction of GW flow (north/south)
Saturated aquifer thickness	da	2.54E+00	m	Thickness of Kempton Park Gravel based on BH logs +
Hydraulic Conductivity of aquifer in which dilution occurs	K	1.00E+01	m/d	WP 2013 value for KPG
Hydraulic gradient of water table	i	2.00E-03	fraction	Between site and off site locations near Pymmes brook
Width of contaminant source perpendicular to groundwater flow	w	2.50E+02	m	Estimated site area perpendicular to GW flow (north-east/south-west)
Background concentration of contaminant in groundwater beneath site	Cu	0.00E+00	mg/l	Not used in calculation
Define mixing zone depth by specifying or calculating depth (using pull down list)		Calculate		default condition
Enter mixing zone thickness	Mz		m	
Calculated mixing zone thickness	Mz	2.54E+00	m	

Calculated Parameters

Dilution Factor	DF	2.37E+00		
Level 2 Remedial Target		3.18E-01	mg/l	For comparison with measured pore water concentration. This assumes Level 1 Remedial Target is based on Target Concentration
		or		
		2.15E+01	mg/kg	For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water

Additional option

Calculation of impact on receptor

Concentration of contaminant in contaminated discharge (entering receptor)	Cc	0.00E+00	mg/l	
Calculated concentration within receptor (dilution only)		0.00E+00	mg/l	0

Site being assessed:	NGET Tottenham
Completed by:	M Craske
Date:	27-Oct-23
Version:	x.xx

Remedial Targets Worksheet , Release 3.2

Level 3 - Soil

See Note



Input Parameters	Variable	Value	Unit	Source
Contaminant		Naphthalene		from Level 1
Target Concentration	C _T	0.002	mg/l	from Level 1
Dilution Factor	DF	2.37E+00		from Level 2

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

Ogata Banks	Equations in HRA publication
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Select nature of decay rate (click on brown cell below, then on pull-down menu)

Approach for simulating degradation of pollutants:

Apply degradation rate to dissolved pollutants only

Variable	Value	Unit	Source of parameter value
Soil leachate concentration as mg/l			
Enter soil leachate concentration	0.1	mg/l	
Half life for degradation of contaminant in water	3.00E+02	days	77
Calculated decay rate	2.31E-03	days ⁻¹	calculated
Width of plume in aquifer at source	2.50E+02	m	from Level 2
Plume thickness in aquifer at source	2.54E+00	m	from Level 2
Bulk density of aquifer materials	1.80E+00	g/cm ³	Literature estimate for RTD
Effective porosity of aquifer	2.00E-01	fraction	Literature estimate for RTD
Hydraulic gradient	3.46E-03	fraction	from Level 2 (adjusted)
Hydraulic conductivity of saturated aquifer	1.00E+01	m/d	from Level 2
Distance (lateral) to compliance point perpendicular to flow direction	3.00E+01	m	Default for aquifer protection
Distance (depth) to compliance point perpendicular to flow direction		m	default condition
Time since pollutant entered groundwater	9.99E+99	days	time variant options only
Parameters values determined from options			
Partition coefficient	Kd	3.38E+00	l/kg see options
Longitudinal dispersivity	ax	3.000	m see options
Transverse dispersivity	az	0.300	m see options
Vertical dispersivity	ay	0.000	m see options

Parameter values should be checked against Level 1 and 2

Calculated Parameters

Variable			
Groundwater flow velocity	v	1.73E-01	m/d
Retardation factor	Rf	3.14E+01	fraction
Decay rate used	λ	7.36E-05	d ⁻¹
Hydraulic gradient used in aquifer flow down-gradient	i	3.46E-03	fraction
Rate of contaminant flow due to retardation	u	5.51E-03	m/d
Ratio of Compliance Point to Source Concentration	C _{ED} /C ₀	6.80E-01	fraction
Attenuation factor (C ₀ /C _{ED})	AF	1.47E+00	fraction
Soil leachate concentration	Co	1.00E-01	

Remedial Targets

Level 3 Remedial Target	6.98E-03	mg/l	For comparison with measured pore water concentration.
Ogata Banks	or		This assumes Level 1 Remedial Target is based on Target Concentration.
	4.73E-01	mg/kg	For comparison with measured soil concentration. This
Distance to compliance point	30	m	assumes Level 1 Remedial Target calculated from soil-water partitioning equation.
Ratio of Compliance Point to Source Concentration	C _{ED} /C ₀	6.80E-01	fraction 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

Enter method of defining partition co-efficient (using pull down list)

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 4.00E-03 fraction

Organic carbon partition coefficient Koc 8.44E+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

Fraction of organic carbon in aquifer foc fraction

Soil water partition coefficient Kd 3.38E+00 l/kg

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

User defined values for dispersivity

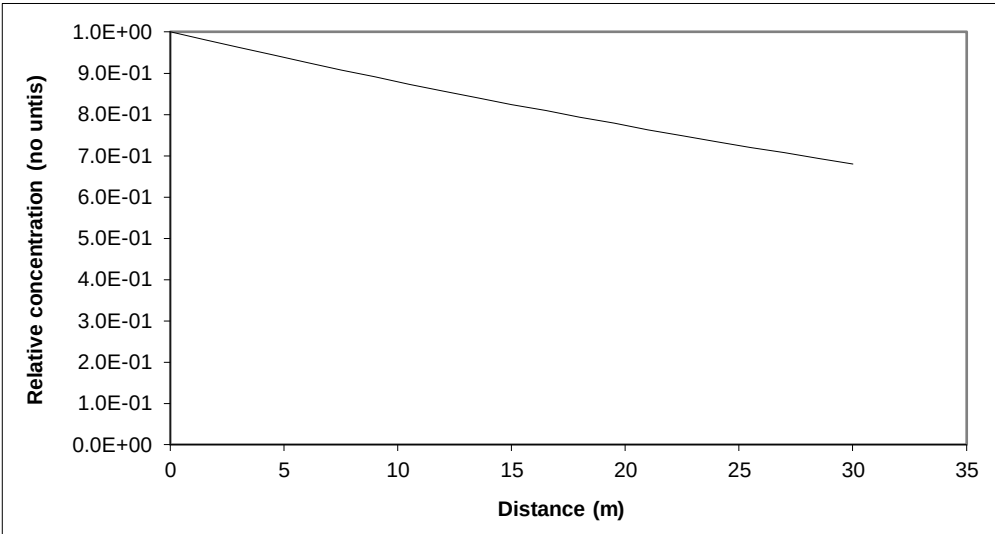
	Enter value	Calc value	Xu & Eckstein	
Longitudinal dispersivity	ax	3.00E+00	3.00E+00	2.13E+00 m
Transverse dispersivity	az	3.00E-01	3.00E-01	2.13E-01 m
Vertical dispersivity	ay	1.00E-99	3.00E-02	2.13E-02 m

Note values of dispersivity must be > 0

Xu & Eckstein (1995) report ax = 0.83(log₁₀x)^{2.414}; az = ax/10, ay = ax/100 are assumed

Note

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



Note: 'Relative concentration' is the ratio of calculated concentration at a given position compared to the source concentration. The calculations assume plume disperses from the top of the aquifer. An alternative solution assuming the centre of the plume is located at the mid-depth of the aquifer is presented in the calculation sheets.

Calculated (relative) concentrations for distance-concentration graph

Ogata Banks

From calculation sheet

Distance	Relative concentration (No units)	Concentration mg/l
0	1.0E+00	4.21E-02
1.5	9.81E-01	4.13E-02
3.0	9.62E-01	4.05E-02
4.5	9.44E-01	3.98E-02
6.0	9.26E-01	3.90E-02
7.5	9.08E-01	3.83E-02
9.0	8.91E-01	3.75E-02
10.5	8.74E-01	3.68E-02
12.0	8.57E-01	3.61E-02
13.5	8.40E-01	3.54E-02
15.0	8.24E-01	3.47E-02
16.5	8.09E-01	3.41E-02
18.0	7.93E-01	3.34E-02
19.5	7.78E-01	3.28E-02
21.0	7.63E-01	3.22E-02
22.5	7.49E-01	3.15E-02
24.0	7.34E-01	3.09E-02
25.5	7.20E-01	3.03E-02
27.0	7.06E-01	2.98E-02
28.5	6.93E-01	2.92E-02
30.0	6.80E-01	2.86E-02

This sheet calculates the Level 3 remedial target for soils(mg/kg) or for pore water (mg/l), based on the distance to the receptor or compliance located down hydraulic gradient of the source Three solution methods are included, the preferred option is Ogata Banks.By setting a long travel time (e.g. 9E99) it will give the steady state solution, which should always be used when calculating remedial targets.

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 3 remedial target to determine the need for further action.

Note if contaminant is not subject to first order degradation, then set half life as 9.9E+99.

Site being assessed:	NGET Tottenham
Completed by:	M Craske
Date:	#####
Version:	x.xx

R&D Publication 20 Remedial Targets Worksheet, Release 3.2

Level 3 - Groundwater

See Note

Input Parameters (using pull down menu)

Contaminant		Naphthalene	from Level 1
Target Concentration	C _T	2.00E-03	mg/l from Level 1

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

Ogata Banks	Equations in HRA publication
-------------	------------------------------

Approach for simulating vertical dispersion: Simulate vertical dispersion in 1 direction

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

Approach for simulating degradation of pollutants: Apply degradation rate to dissolved pollutants only

Initial contaminant concentration in groundwater at plume core	C ₀	1.00E+00	mg/l	Source of parameter value
Half life for degradation of contaminant in water	t _{1/2}	3.00E+02	days	Based on site data
Calculated decay rate	λ	2.31E-03	days ⁻¹	77
Width of plume in aquifer at source (perpendicular to flow)	Sz	2.50E+02	m	
Plume thickness at source	Sy	2.54E+00	m	
Saturated aquifer thickness	da	2.54E+00	m	Average thickness of Kempton Park Grave
Bulk density of aquifer materials	ρ	1.80E+00	g/cm ³	Literature estimate for RTD
Effective porosity of aquifer	n	2.00E-01	fraction	Literature estimate for RTD
Hydraulic gradient	i	2.00E-03	fraction	Based on average of site-specific GW measurements (SSE groundwater flow) - 0.0005 - 0.002 between
Hydraulic conductivity of aquifer	K	1.00E+01	m/d	WP 2013 value for KPG
Distance to compliance point	x	3.00E+01	m	Longitudinal dispersivity
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	Transverse dispersivity
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	Vertical dispersivity
Time since pollutant entered groundwater	t	9.99E+99	days	Note values of dispersivity must be > 0
Parameters values determined from options				For calculated value, assumes ax = 0.1 * x, az = 0.01 * x, ay = 0.001 * x
Partition coefficient	Kd	3.38E+00	l/kg	Xu & Eckstein (1995) report ax = 0.83(log ₁₀ x) ^{2.414} ; az = ax/10, ay = ax/100 are assumed
Longitudinal dispersivity	ax	3.00E+00	m	
Transverse dispersivity	az	3.00E-01	m	
Vertical dispersivity	ay	1.00E-99	m	

Calculated Parameters

Groundwater flow velocity	v	1.00E-01	m/d
Retardation factor	Rf	3.14E+01	fraction
Decay rate used	λ	7.36E-05	d ⁻¹
Rate of contaminant flow due to retardation	u	3.19E-03	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C _{ED}	5.22E-01	mg/l
Attenuation factor (one way vertical dispersion, CO/CED)	AF	1.92E+00	

Remedial Targets

Remedial Target	3.83E-03	mg/l	For comparison with measured groundwater concentration.
Ogata Banks			
Distance to compliance point	30	m	
Concentration of contaminant at compliance point after	C _{ED} /C ₀	5.22E-01	mg/l
		1.0E+100	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)

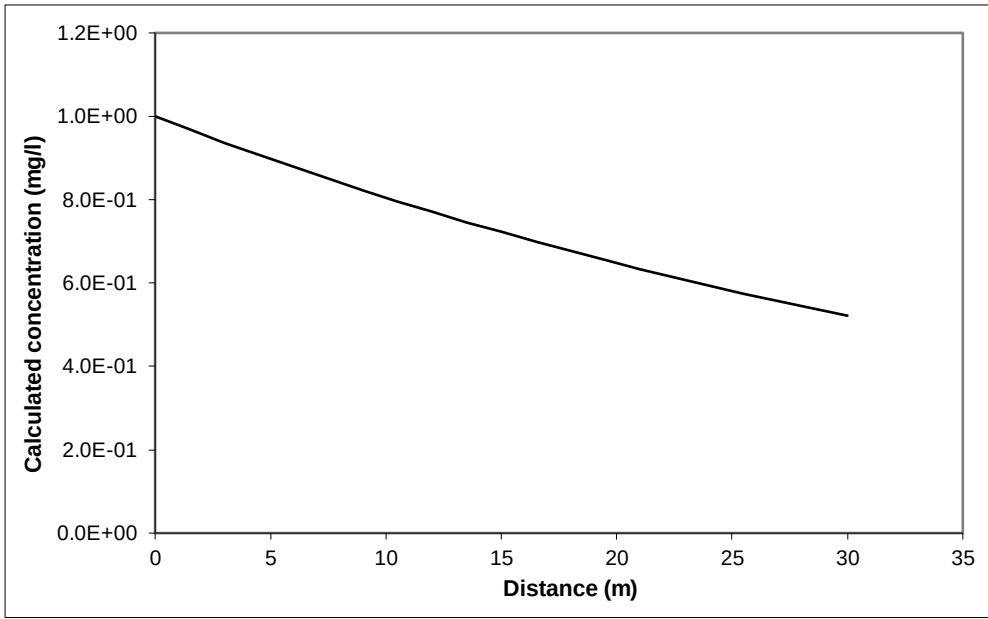
Calculate for non-polar organic chemicals

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	4.00E-03 fraction
Organic carbon partition coefficient	Koc	8.44E+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	
Fraction of organic carbon in aquifer	foc	fraction
Soil water partition coefficient	Kd	3.38E+00 l/kg

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

User defined values for dispersivity

Longitudinal dispersivity	ax	3.00E+00	3.00E+00	2.13E+00	m
Transverse dispersivity	az	3.00E-01	3.00E-01	2.13E-01	m
Vertical dispersivity	ay	1.00E-99	3.00E-02	2.13E-02	
Note values of dispersivity must be > 0					
For calculated value, assumes ax = 0.1 * x, az = 0.01 * x, ay = 0.001 * x					
Xu & Eckstein (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.

Note

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

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

The measured groundwater concentration should be compared with the Level 3 remedial target to determine the need for further action. Note if contaminant is not subject to first order degradation, then set half life as 9.0E+99.

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

Calculated concentrations for distance-concentration graph

Ogata Banks From calculation sheet

Distance	Concentration
	mg/l
0	1.0E+00
1.5	9.68E-01
3.0	9.37E-01
4.5	9.07E-01
6.0	8.78E-01
7.5	8.50E-01
9.0	8.23E-01
10.5	7.96E-01
12.0	7.71E-01
13.5	7.46E-01
15.0	7.22E-01
16.5	6.99E-01
18.0	6.77E-01
19.5	6.55E-01
21.0	6.34E-01
22.5	6.14E-01
24.0	5.94E-01
25.5	5.75E-01
27.0	5.57E-01
28.5	5.39E-01
30.0	5.22E-01



Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

This worksheet has been produced in combination with the document 'Remedial Targets Methodology: Hydrogeological risk assessment for land contamination (Environment Agency 2006).

Users of this worksheet should always refer to the User Manual to the Remedial Targets Methodology and to relevant guidance on UK legislation and policy, in order to understand how this procedure should be applied in an appropriate context.

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

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

<u>Details to be completed for each assessment</u>			
Site Name:	NGET Tottenham		
Site Address:			
Completed by:	M Craske	Version:	x.xx
Date:	27-Oct-23		
Contaminant	Naphthalene		
Target Concentration (C_T)	0.133863705	mg/l	Origin of C_T: Lowest of DWS/EQS

This worksheet can be used to determine remedial targets for soils (Worksheets Level 1 Soil, Level 2 and Level 3 Soil) or to determine remedial targets for groundwater (Level 3 Groundwater). For Level 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 comparison 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 Level 1, 2 and 3 Worksheets.

Worksheet options are identified by brown background and employ a pull-down menus. Data entry are identified as blue background.

Data origin / justification should be noted in cells coloured yellow and fully documented in subsequent reports.

Data carried forward from an earlier worksheet are identified by a light green background

It is recommended that a copy of the original worksheet is saved (all data fields in the original copy are blank).

The spreadsheet also includes a porosity calculation worksheet, a soil impact calculation worksheet and a worksheet that performs some simple hydrogeological calculations.



Level 1 - Soil

Select the method of calculating the soil water
Partition Co-efficient by using the pull down menu
below

Calculate for non-polar organic chemicals

Contaminant	Naphthalene
Target concentration	0.133863705 mg/l

Input Parameters

Standard entry

Water filled soil porosity	θ_w	3.70E-01	fraction	Conservative value estimated from average site mo
Air filled soil porosity	θ_a	1.90E-01	fraction	Conservative value estimated from average site mo
Bulk density of soil zone material	ρ	1.60E+00	g/cm ³	Conservative Estimate for Made Ground
Henry's Law constant	H	1.74E-02	dimensionless	83

This sheet calculates the Level 1 remedial target for soils(mg/kg) based on a selected target concentration and theoretical calculation of soil water partitioning. Three options are included for determinina the partition coefficient.
The measured soil concentration as mg/kg should be compared with the Level 1 remedial target to determine the need for further action.

Entry if specify partition coefficient (option)

Soil water partition coefficient	Kd		l/kg	3.10E+01
----------------------------------	----	--	------	----------

Entry for non-polar organic chemicals (option)

Fraction of organic carbon (in soil)	foc	8.00E-02	fraction	Average from uncontaminated site samples
Organic carbon partition coefficient	Koc	8.44E+02	l/kg	83

Entry for ionic organic chemicals (option)

Sorption coefficient for neutral species	$K_{oc,n}$		l/kg	
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg	
pH value	pH		pH units	
Acid dissociation constant	pKa			
Fraction of organic carbon (in soil)	foc		fraction	

Soil water partition coefficient used in Level Assessment	Kd	6.75E+01	l/kg	Calculated value
---	----	----------	------	------------------

Level 1 Remedial Target

Level 1 Remedial Target	9.07E+00	mg/kg	(for comparison with soil analyses)
	or		
	0.133863705	mg/l	(for comparison with leachate test results)

Site being assessed:	NGET Tottenham
Completed by:	M Craske
Date:	27-Oct-23
Version:	x.xx



Level 2 - Soil

Contaminant
Target concentration

C_T

Naphthalene

0.133863705

mg/l

from Level 1

from Level 1

This sheet calculates the Level 2 remedial target for soils (mg/kg) or for pore water (mg/l).

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 2 remedial target to determine the need for further action. Equations presented in 'Hydrogeological risk assessment for land contamination' (Environment Agency 2006)

Input Parameters	Variable	Value	Unit	Source of parameter value
Standard entry				
Infiltration	Inf	7.40E-04	m/d	Estimated from EA effective infiltration mapping and 80% ha
Area of contaminant source	A	1.25E+04	m ²	Length x width of site (50x250) Not used in calculation
Entry for groundwater flow below site				
Length of contaminant source in direction of groundwater flow	L	5.00E+01	m	Approximate length of site in direction of GW flow (north/south)
Saturated aquifer thickness	da	2.54E+00	m	Thickness of Kempton Park Gravel based on BH logs +
Hydraulic Conductivity of aquifer in which dilution occurs	K	1.00E+01	m/d	WP 2013 value for KPG
Hydraulic gradient of water table	i	2.00E-03	fraction	Between site and off site locations near Pymmes brook
Width of contaminant source perpendicular to groundwater flow	w	2.50E+02	m	Approximate site area perpendicular to GW flow (north-east/south-west)
Background concentration of contaminant in groundwater beneath site	Cu	0.00E+00	mg/l	Not used in calculation
Define mixing zone depth by specifying or calculating depth (using pull down list)		Calculate		default condition
Enter mixing zone thickness	Mz		m	
Calculated mixing zone thickness	Mz	2.54E+00	m	

Calculated Parameters

Dilution Factor	DF	2.37E+00		
Level 2 Remedial Target		3.18E-01	mg/l	For comparison with measured pore water concentration. This assumes Level 1 Remedial Target is based on Target Concentration
		or		
		2.15E+01	mg/kg	For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water

Additional option

Calculation of impact on receptor

Concentration of contaminant in contaminated discharge (entering receptor)	Cc	0.00E+00	mg/l	
Calculated concentration within receptor (dilution only)		0.00E+00	mg/l	0

Site being assessed:	NGET Tottenham
Completed by:	M Craske
Date:	27-Oct-23
Version:	x.xx

Remedial Targets Worksheet , Release 3.2

Level 3 - Soil

See Note



Input Parameters	Variable	Value	Unit	Source
Contaminant		Naphthalene		from Level 1
Target Concentration	C _T	0.002	mg/l	from Level 1
Dilution Factor	DF	2.37E+00		from Level 2

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

Ogata Banks	Equations in HRA publication
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Select nature of decay rate (click on brown cell below, then on pull-down menu)

Approach for simulating degradation of pollutants:

Apply degradation rate to dissolved pollutants only

Variable	Value	Unit	Source of parameter value
Soil leachate concentration as mg/l			
Enter soil leachate concentration	0.1	mg/l	
Half life for degradation of contaminant in water	t _{1/2}	3.00E+02 days	77
Calculated decay rate	λ	2.31E-03 days ⁻¹	calculated
Width of plume in aquifer at source	Sz	2.50E+02 m	from Level 2
Plume thickness in aquifer at source	Sy	2.54E+00 m	from Level 2
Bulk density of aquifer materials	ρ	1.80E+00 g/cm ³	Literature estimate for RTD
Effective porosity of aquifer	n	2.00E-01 fraction	Literature estimate for RTD
Hydraulic gradient	i	3.46E-03 fraction	from Level 2 (adjusted)
Hydraulic conductivity of saturated aquifer	K	1.00E+01 m/d	from Level 2
Distance (lateral) to compliance point perpendicular to flow direction	x	3.00E+01 m	Default for aquifer protection
Distance (depth) to compliance point perpendicular to flow direction	z	m	default condition
Time since pollutant entered groundwater	y	m	default condition
Time since pollutant entered groundwater	t	9.99E+99 days	time variant options only
Parameters values determined from options			
Partition coefficient	Kd	3.38E+00 l/kg	see options
Longitudinal dispersivity	ax	3.000 m	see options
Transverse dispersivity	az	0.300 m	see options
Vertical dispersivity	ay	0.000 m	see options

Parameter values should be checked against Level 1 and 2

Calculated Parameters

Variable			
Groundwater flow velocity	v	1.73E-01 m/d	
Retardation factor	Rf	3.14E+01 fraction	
Decay rate used	λ	7.36E-05 d ⁻¹	
Hydraulic gradient used in aquifer flow down-gradient	i	3.46E-03 fraction	
Rate of contaminant flow due to retardation	u	5.51E-03 m/d	
Ratio of Compliance Point to Source Concentration	C _{ED} /C ₀	6.80E-01 fraction	
Attenuation factor (C ₀ /C _{ED})	AF	1.47E+00 fraction	
Soil leachate concentration	Co	1.00E-01	

Remedial Targets

Level 3 Remedial Target	6.98E-03	mg/l	For comparison with measured pore water concentration.
Ogata Banks	or		This assumes Level 1 Remedial Target is based on Target Concentration.
	4.73E-01	mg/kg	For comparison with measured soil concentration. This
Distance to compliance point	30	m	assumes Level 1 Remedial Target calculated from soil-water partitioning equation.
Ratio of Compliance Point to Source Concentration	C _{ED} /C ₀	6.80E-01	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

Enter method of defining partition co-efficient (using pull down list)

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 4.00E-03 fraction

Organic carbon partition coefficient Koc 8.44E+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

Fraction of organic carbon in aquifer foc fraction

Soil water partition coefficient Kd 3.38E+00 l/kg

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

User defined values for dispersivity

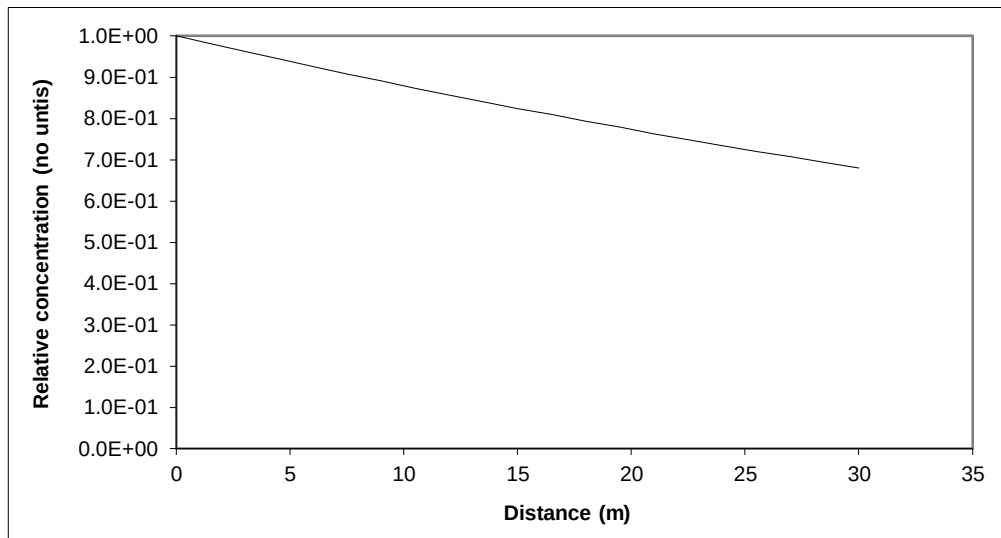
	Enter value	Calc value	Xu & Eckstein	
Longitudinal dispersivity	ax	3.00E+00	3.00E+00	2.13E+00 m
Transverse dispersivity	az	3.00E-01	3.00E-01	2.13E-01 m
Vertical dispersivity	ay	1.00E-99	3.00E-02	2.13E-02 m

Note values of dispersivity must be > 0

Xu & Eckstein (1995) report ax = 0.83(log₁₀x)^{2.414}; az = ax/10, ay = ax/100 are assumed

Note

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



Note: 'Relative concentration' is the ratio of calculated concentration at a given position compared to the source concentration. The calculations assume plume disperses from the top of the aquifer. An alternative solution assuming the centre of the plume is located at the mid-depth of the aquifer is presented in the calculation sheets.

Calculated (relative) concentrations for distance-concentration graph

Ogata Banks

From calculation sheet

Distance	Relative concentration (No units)	Concentration mg/l
0	1.0E+00	4.21E-02
1.5	9.81E-01	4.13E-02
3.0	9.62E-01	4.05E-02
4.5	9.44E-01	3.98E-02
6.0	9.26E-01	3.90E-02
7.5	9.08E-01	3.83E-02
9.0	8.91E-01	3.75E-02
10.5	8.74E-01	3.68E-02
12.0	8.57E-01	3.61E-02
13.5	8.40E-01	3.54E-02
15.0	8.24E-01	3.47E-02
16.5	8.09E-01	3.41E-02
18.0	7.93E-01	3.34E-02
19.5	7.78E-01	3.28E-02
21.0	7.63E-01	3.22E-02
22.5	7.49E-01	3.15E-02
24.0	7.34E-01	3.09E-02
25.5	7.20E-01	3.03E-02
27.0	7.06E-01	2.98E-02
28.5	6.93E-01	2.92E-02
30.0	6.80E-01	2.86E-02

This sheet calculates the Level 3 remedial target for soils(mg/kg) or for pore water (mg/l), based on the distance to the receptor or compliance located down hydraulic gradient of the source Three solution methods are included, the preferred option is Ogata Banks.By setting a long travel time (e.g. 9E99) it will give the steady state solution, which should always be used when calculating remedial targets.

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 3 remedial target to determine the need for further action.

Note if contaminant is not subject to first order degradation, then set half life as 9.9E+99.

Site being assessed:	NGET Tottenham
Completed by:	M Craske
Date:	#####
Version:	x.xx

R&D Publication 20 Remedial Targets Worksheet, Release 3.2

Level 3 - Groundwater

See Note

Input Parameters (using pull down menu)

Contaminant		Naphthalene	from Level 1
Target Concentration	C _T	2.00E-03	mg/l from Level 1

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

Ogata Banks	Equations in HRA publication
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Approach for simulating vertical dispersion: Simulate vertical dispersion in 1 direction

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

Approach for simulating degradation of pollutants: Apply degradation rate to dissolved pollutants only

Initial contaminant concentration in groundwater at plume core	C ₀	1.00E+00	mg/l	Source of parameter value
Half life for degradation of contaminant in water	t _{1/2}	3.00E+02	days	Based on site data
Calculated decay rate	λ	2.31E-03	days ⁻¹	77
Width of plume in aquifer at source (perpendicular to flow)	Sz	2.50E+02	m	
Plume thickness at source	Sy	2.54E+00	m	
Saturated aquifer thickness	da	2.54E+00	m	Average thickness of Kempton Park Grave
Bulk density of aquifer materials	ρ	1.80E+00	g/cm ³	Literature estimate for RTD
Effective porosity of aquifer	n	2.00E-01	fraction	Literature estimate for RTD
Hydraulic gradient	i	2.00E-03	fraction	Based on average of site-specific GW measurements (SSE groundwater flow) - 0.0005 - 0.002 between
Hydraulic conductivity of aquifer	K	1.00E+01	m/d	WP 2013 value for KPG
Distance to compliance point	x	3.00E+01	m	Longitudinal dispersivity
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	Transverse dispersivity
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	Vertical dispersivity
Time since pollutant entered groundwater	t	9.99E+99	days	Note values of dispersivity must be > 0
Parameters values determined from options				For calculated value, assumes ax = 0.1 * x, az = 0.01 * x, ay = 0.001 * x
Partition coefficient	Kd	3.38E+00	l/kg	Xu & Eckstein (1995) report ax = 0.83(log ₁₀ x) ^{2.414} ; az = ax/10, ay = ax/100 are assumed
Longitudinal dispersivity	ax	3.00E+00	m	
Transverse dispersivity	az	3.00E-01	m	
Vertical dispersivity	ay	1.00E-99	m	

Calculated Parameters

Groundwater flow velocity	v	1.00E-01	m/d
Retardation factor	Rf	3.14E+01	fraction
Decay rate used	λ	7.36E-05	d ⁻¹
Rate of contaminant flow due to retardation	u	3.19E-03	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C _{ED}	5.22E-01	mg/l
Attenuation factor (one way vertical dispersion, CO/CED)	AF	1.92E+00	

Remedial Targets

Remedial Target	3.83E-03	mg/l	For comparison with measured groundwater concentration.
Ogata Banks			
Distance to compliance point	30	m	
Concentration of contaminant at compliance point after	C _{ED} /C ₀	5.22E-01	mg/l
		1.0E+100	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)

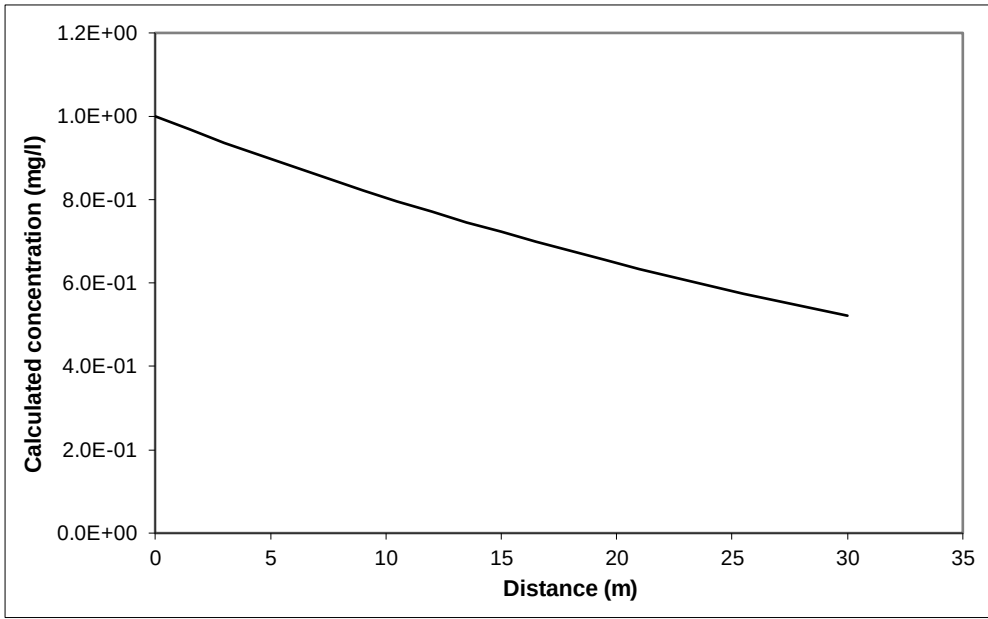
Calculate for non-polar organic chemicals

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	4.00E-03 fraction
Organic carbon partition coefficient	Koc	8.44E+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	
Fraction of organic carbon in aquifer	foc	fraction
Soil water partition coefficient	Kd	3.38E+00 l/kg

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

User defined values for dispersivity

Longitudinal dispersivity	ax	3.00E+00	3.00E+00	2.13E+00	m
Transverse dispersivity	az	3.00E-01	3.00E-01	2.13E-01	m
Vertical dispersivity	ay	1.00E-99	3.00E-02	2.13E-02	
Note values of dispersivity must be > 0					
For calculated value, assumes ax = 0.1 * x, az = 0.01 * x, ay = 0.001 * x					
Xu & Eckstein (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.

Note

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

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

The measured groundwater concentration should be compared with the Level 3 remedial target to determine the need for further action. Note if contaminant is not subject to first order degradation, then set half life as 9.0E+99.

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

Calculated concentrations for distance-concentration graph

Ogata Banks From calculation sheet

Distance	Concentration
	mg/l
0	1.0E+00
1.5	9.68E-01
3.0	9.37E-01
4.5	9.07E-01
6.0	8.78E-01
7.5	8.50E-01
9.0	8.23E-01
10.5	7.96E-01
12.0	7.71E-01
13.5	7.46E-01
15.0	7.22E-01
16.5	6.99E-01
18.0	6.77E-01
19.5	6.55E-01
21.0	6.34E-01
22.5	6.14E-01
24.0	5.94E-01
25.5	5.75E-01
27.0	5.57E-01
28.5	5.39E-01
30.0	5.22E-01



Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

This worksheet has been produced in combination with the document 'Remedial Targets Methodology: Hydrogeological risk assessment for land contamination (Environment Agency 2006).

Users of this worksheet should always refer to the User Manual to the Remedial Targets Methodology and to relevant guidance on UK legislation and policy, in order to understand how this procedure should be applied in an appropriate context.

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

<u>Details to be completed for each assessment</u>			
Site Name:	NGET Tottenham		
Site Address:			
Completed by:	M Craske	Version:	x.xx
Date:	27-Oct-23		
Contaminant	Phenol		
Target Concentration (C_T)	71.7375823	mg/l	Origin of C_T: Lowest of DWS/EQS

This worksheet can be used to determine remedial targets for soils (Worksheets Level 1 Soil, Level 2 and Level 3 Soil) or to determine remedial targets for groundwater (Level 3 Groundwater). For Level 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 comparison 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 Level 1, 2 and 3 Worksheets.

Worksheet options are identified by brown background and employ a pull-down menus. Data entry are identified as blue background.

Data origin / justification should be noted in cells coloured yellow and fully documented in subsequent reports.

Data carried forward from an earlier worksheet are identified by a light green background

It is recommended that a copy of the original worksheet is saved (all data fields in the original copy are blank).

The spreadsheet also includes a porosity calculation worksheet, a soil impact calculation worksheet and a worksheet that performs some simple hydrogeological calculations.



Level 1 - Soil

Select the method of calculating the soil water
Partition Co-efficient by using the pull down menu
below

Calculate for non-polar organic chemicals

Contaminant	Phenol
Target concentration	71.7375823 mg/l

Input Parameters

Standard entry

Water filled soil porosity	θ_w	3.70E-01	fraction	Conservative value estimated from average site mo
Air filled soil porosity	θ_a	1.90E-01	fraction	Conservative value estimated from average site mo
Bulk density of soil zone material	ρ	1.60E+00	g/cm ³	Conservative Estimate for Made Ground
Henry's Law constant	H	2.62E-05	dimensionless	86

Entry if specify partition coefficient (option)

Soil water partition coefficient	Kd		l/kg	3.10E+01
----------------------------------	----	--	------	----------

Entry for non-polar organic chemicals (option)

Fraction of organic carbon (in soil)	foc	8.00E-02	fraction	Average from uncontaminated site samples
Organic carbon partition coefficient	Koc	8.30E+01	l/kg	86

Entry for ionic organic chemicals (option)

Sorption coefficient for neutral species	$K_{oc,n}$		l/kg	
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg	
pH value	pH		pH units	
Acid dissociation constant	pKa			
Fraction of organic carbon (in soil)	foc		fraction	

Soil water partition coefficient used in Level Assessment	Kd	6.64E+00	l/kg	Calculated value
---	----	----------	------	------------------

Level 1 Remedial Target

Level 1 Remedial Target	4.93E+02	mg/kg	(for comparison with soil analyses)
	or		
	71.7375823	mg/l	(for comparison with leachate test results)

Site being assessed:	NGET Tottenham
Completed by:	M Craske
Date:	27-Oct-23
Version:	x.xx



Level 2 - Soil

Contaminant
Target concentration C_T Phenol 71.7375823 mg/l from Level 1 from Level 1

This sheet calculates the Level 2 remedial target for soils (mg/kg) or for pore water (mg/l).

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 2 remedial target to determine the need for further action. Equations presented in 'Hydrogeological risk assessment for land contamination' (Environment Agency 2006)

Input Parameters		Variable	Value	Unit	Source of parameter value
Standard entry	Infiltration	Inf	7.40E-04	m/d	Estimated from EA effective infiltration mapping and 80% ha
	Area of contaminant source	A	1.25E+04	m ²	Length x width of site (50x250) Not used in calculation
Entry for groundwater flow below site	Length of contaminant source in direction of groundwater flow	L	5.00E+01	m	Approximate length of site in direction of GW flow (north/south)
	Saturated aquifer thickness	da	2.54E+00	m	Thickness of Kempton Park Gravel based on BH logs +
	Hydraulic Conductivity of aquifer in which dilution occurs	K	1.00E+01	m/d	WP 2013 value for KPG
	Hydraulic gradient of water table	i	2.00E-03	fraction	Between site and off site locations near Pymmes brook
	Width of contaminant source perpendicular to groundwater flow	w	2.50E+02	m	Approximate site area perpendicular to GW flow (north-east/south-west)
	Background concentration of contaminant in groundwater beneath site	Cu	0.00E+00	mg/l	Not used in calculation
	Define mixing zone depth by specifying or calculating depth (using pull down list)		Calculate		default condition
	Enter mixing zone thickness	Mz		m	
	Calculated mixing zone thickness	Mz	2.54E+00	m	

Calculated Parameters

Dilution Factor	DF	2.37E+00	
Level 2 Remedial Target		1.70E+02 mg/l or 1.17E+03 mg/kg	For comparison with measured pore water concentration. This assumes Level 1 Remedial Target is based on Target Concentration of 1.70E+02 mg/l. For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water

Additional option

Calculation of impact on receptor

Concentration of contaminant in contaminated discharge (entering receptor)	Cc	0.00E+00	mg/l	
Calculated concentration within receptor (dilution only)		0.00E+00	mg/l	0

Site being assessed:	NGET Tottenham
Completed by:	M Craske
Date:	27-Oct-23
Version:	x.xx

Remedial Targets Worksheet , Release 3.2

Level 3 - Soil

See Note



Input Parameters	Variable	Value	Unit	Source
Contaminant		Phenol		from Level 1
Target Concentration	C _T	0.0077	mg/l	from Level 1
Dilution Factor	DF	2.37E+00		from Level 2

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

Ogata Banks	Equations in HRA publication
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Select nature of decay rate (click on brown cell below, then on pull-down menu)

Approach for simulating degradation of pollutants: Apply degradation rate to dissolved pollutants only

Variable	Value	Unit	Source of parameter value
Soil leachate concentration as mg/l			
Enter source concentration	0.1	mg/l	
Enter soil leachate concentration	1.00E+02	days	
Half life for degradation of contaminant in water	6.93E-03	days ⁻¹	calculated
Calculated decay rate	2.50E+02	m	from Level 2
Width of plume in aquifer at source	2.54E+00	m	from Level 2
Plume thickness in aquifer at source	1.80E+00	g/cm ³	Literature estimate for RTD
Bulk density of aquifer materials	2.00E-01	fraction	Literature estimate for RTD
Effective porosity of aquifer	3.46E-03	fraction	from Level 2 (adjusted)
Hydraulic gradient	1.00E+01	m/d	from Level 2
Hydraulic conductivity of saturated aquifer	3.00E+01	m	Default for aquifer protection
Distance (lateral) to compliance point perpendicular to flow direction		m	default condition
Distance (depth) to compliance point perpendicular to flow direction		m	default condition
Time since pollutant entered groundwater	9.99E+99	days	time variant options only
Parameters values determined from options			
Partition coefficient	3.32E-01	l/kg	see options
Longitudinal dispersivity	3.000	m	see options
Transverse dispersivity	0.300	m	see options
Vertical dispersivity	0.000	m	see options

Parameter values should be checked against Level 1 and 2

Calculated Parameters

Variable			
Groundwater flow velocity	v	1.73E-01	m/d
Retardation factor	Rf	3.99E+00	fraction
Decay rate used	λ	1.74E-03	d ⁻¹
Hydraulic gradient used in aquifer flow down-gradient	i	3.46E-03	fraction
Rate of contaminant flow due to retardation	u	4.33E-02	m/d
Ratio of Compliance Point to Source Concentration	C _{ED} /C ₀	3.38E-01	fraction
Attenuation factor (C ₀ /C _{ED})	AF	2.96E+00	fraction
Soil leachate concentration	Co	1.00E-01	

Remedial Targets

Level 3 Remedial Target	5.41E-02	mg/l	For comparison with measured pore water concentration.
Ogata Banks	3.72E-01	mg/kg	This assumes Level 1 Remedial Target is based on Target Concentration.
Distance to compliance point	30	m	For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water partitioning equation.
Ratio of Compliance Point to Source Concentration	C _{ED} /C ₀	3.38E-01	fraction

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

Enter method of defining partition co-efficient (using pull down list)

Calculate for non-polar organic chemicals

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 4.00E-03 fraction

Organic carbon partition coefficient Koc 8.30E+01 l/kg

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

Fraction of organic carbon in aquifer foc fraction

Soil water partition coefficient Kd 3.32E-01 l/kg

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

User defined values for dispersivity

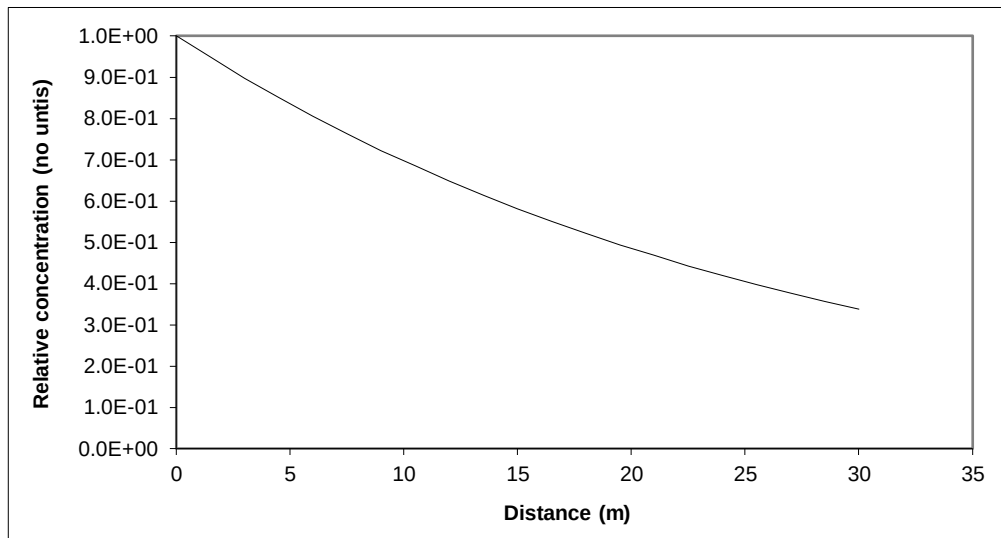
	Enter value	Calc value	Xu & Eckstein
Longitudinal dispersivity ax	3.00E+00	3.00E+00	2.13E+00 m
Transverse dispersivity az	3.00E-01	3.00E-01	2.13E-01 m
Vertical dispersivity ay	1.00E-99	3.00E-02	2.13E-02 m

Note values of dispersivity must be > 0

Xu & Eckstein (1995) report ax = 0.83(log₁₀x)^{2.414}; az = ax/10, ay = ax/100 are assumed

Note

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



Note: 'Relative concentration' is the ratio of calculated concentration at a given position compared to the source concentration. The calculations assume plume disperses from the top of the aquifer. An alternative solution assuming the centre of the plume is located at the mid-depth of the aquifer is presented in the calculation sheets.

Calculated (relative) concentrations for distance-concentration graph

Ogata Banks

From calculation sheet

Distance	Relative concentration (No units)	Concentration mg/l
0	1.0E+00	4.21E-02
1.5	9.47E-01	3.99E-02
3.0	8.97E-01	3.78E-02
4.5	8.50E-01	3.58E-02
6.0	8.05E-01	3.39E-02
7.5	7.62E-01	3.21E-02
9.0	7.22E-01	3.04E-02
10.5	6.84E-01	2.88E-02
12.0	6.48E-01	2.73E-02
13.5	6.14E-01	2.59E-02
15.0	5.81E-01	2.45E-02
16.5	5.50E-01	2.32E-02
18.0	5.21E-01	2.20E-02
19.5	4.94E-01	2.08E-02
21.0	4.68E-01	1.97E-02
22.5	4.43E-01	1.87E-02
24.0	4.20E-01	1.77E-02
25.5	3.97E-01	1.67E-02
27.0	3.76E-01	1.59E-02
28.5	3.57E-01	1.50E-02
30.0	3.38E-01	1.42E-02

This sheet calculates the Level 3 remedial target for soils(mg/kg) or for pore water (mg/l), based on the distance to the receptor or compliance located down hydraulic gradient of the source Three solution methods are included, the preferred option is Ogata Banks.By setting a long travel time (e.g. 9E99) it will give the steady state solution, which should always be used when calculating remedial targets.

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 3 remedial target to determine the need for further action.

Note if contaminant is not subject to first order degradation, then set half life as 9.9E+99.

Site being assessed:	NGET Tottenham
Completed by:	M Craske
Date:	#####
Version:	x.xx

R&D Publication 20 Remedial Targets Worksheet, Release 3.2

Level 3 - Groundwater

See Note

Input Parameters (using pull down menu)

Contaminant	Phenol	from Level 1
Target Concentration	C _T 7.70E-03	mg/l from Level 1

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

Ogata Banks	Equations in HRA publication
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Approach for simulating vertical dispersion: Simulate vertical dispersion in 1 direction

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

Approach for simulating degradation of pollutants: Apply degradation rate to dissolved pollutants only

Initial contaminant concentration in groundwater at plume core	C ₀	1.00E+00	mg/l	Source of parameter value
Half life for degradation of contaminant in water	t _{1/2}	1.00E+02	days	Based on site data
Calculated decay rate	λ	6.93E-03	days ⁻¹	
Width of plume in aquifer at source (perpendicular to flow)	Sz	2.50E+02	m	
Plume thickness at source	Sy	2.54E+00	m	
Saturated aquifer thickness	da	2.54E+00	m	Average thickness of Kempton Park Grave
Bulk density of aquifer materials	ρ	1.80E+00	g/cm ³	Literature estimate for RTD
Effective porosity of aquifer	n	2.00E-01	fraction	Literature estimate for RTD
Hydraulic gradient	i	2.00E-03	fraction	Based on average of site-specific GW measurements (SSE groundwater flow) - 0.0005 - 0.002 between
Hydraulic conductivity of aquifer	K	1.00E+01	m/d	WP 2013 value for KPG
Distance to compliance point	x	3.00E+01	m	Longitudinal dispersivity
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	Transverse dispersivity
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	Vertical dispersivity
Time since pollutant entered groundwater	t	9.99E+99	days	Note values of dispersivity must be > 0
Parameters values determined from options				For calculated value, assumes ax = 0.1 * x, az = 0.01 * x, ay = 0.001 * x
Partition coefficient	Kd	3.32E-01	l/kg	Xu & Eckstein (1995) report ax = 0.83(log ₁₀ x) ^{2.414} ; az = ax/10, ay = ax/100 are assumed
Longitudinal dispersivity	ax	3.00E+00	m	
Transverse dispersivity	az	3.00E-01	m	
Vertical dispersivity	ay	1.00E-99	m	

Calculated Parameters

Groundwater flow velocity	v	1.00E-01	m/d
Retardation factor	Rf	3.99E+00	fraction
Decay rate used	λ	1.74E-03	d ⁻¹
Rate of contaminant flow due to retardation	u	2.51E-02	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C _{ED}	1.71E-01	mg/l
Attenuation factor (one way vertical dispersion, CO/CED)	AF	5.85E+00	

Remedial Targets

Remedial Target	4.51E-02	mg/l	For comparison with measured groundwater concentration.
Ogata Banks			
Distance to compliance point	30	m	
Concentration of contaminant at compliance point after	C _{ED} /C ₀	1.71E-01	mg/l
		1.0E+100	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.

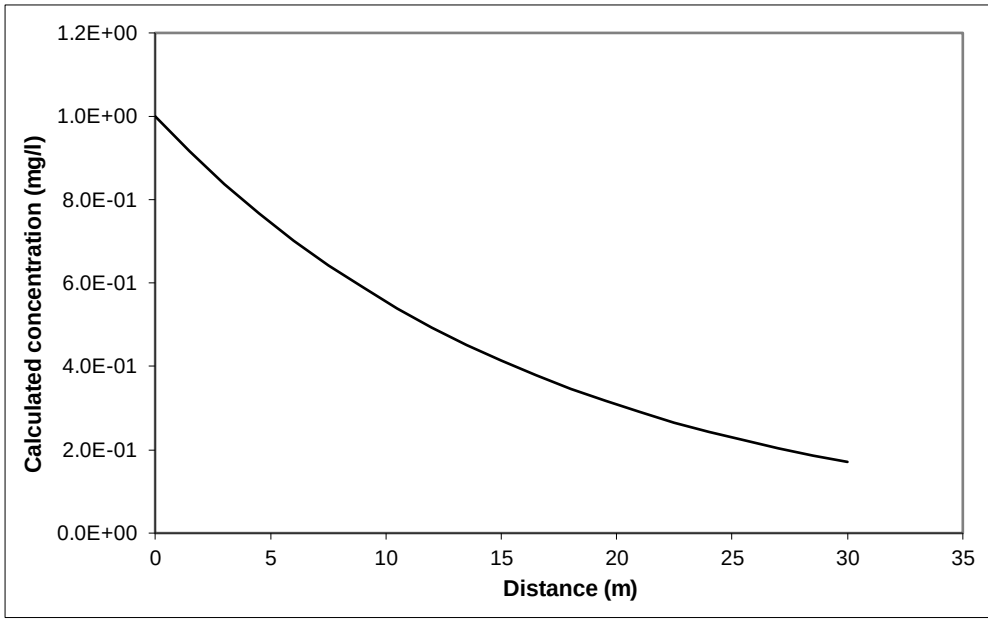
Select Method for deriving Partition Co-efficient (using pull down menu)

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	4.00E-03	fraction
Organic carbon partition coefficient	Koc	8.30E+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		
Fraction of organic carbon in aquifer	foc		fraction
Soil water partition coefficient	Kd	3.32E-01	l/kg

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

User defined values for dispersivity					
Measurements (SSE groundwater flow) - 0.0005 - 0.002 between		Enter value	Calc value	Xu & Eckstein	m
Longitudinal dispersivity	ax	3.00E+00	3.00E+00	2.13E+00	m
Transverse dispersivity	az	3.00E-01	3.00E-01	2.13E-01	m
Vertical dispersivity	ay	1.00E-99	3.00E-02	2.13E-02	

Note values of dispersivity must be > 0
For calculated value, assumes ax = 0.1 * x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report ax = 0.83(log₁₀x)^{2.414}; az = ax/10, ay = ax/100 are assumed



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

Note

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

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

The measured groundwater concentration should be compared with the Level 3 remedial target to determine the need for further action. Note if contaminant is not subject to first order degradation, then set half life as 9.0E+99.

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

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration
	mg/l
0	1.0E+00
1.5	9.15E-01
3.0	8.38E-01
4.5	7.67E-01
6.0	7.02E-01
7.5	6.43E-01
9.0	5.89E-01
10.5	5.39E-01
12.0	4.93E-01
13.5	4.51E-01
15.0	4.13E-01
16.5	3.78E-01
18.0	3.46E-01
19.5	3.17E-01
21.0	2.90E-01
22.5	2.66E-01
24.0	2.43E-01
25.5	2.23E-01
27.0	2.04E-01
28.5	1.87E-01
30.0	1.71E-01



Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

This worksheet has been produced in combination with the document 'Remedial Targets Methodology: Hydrogeological risk assessment for land contamination (Environment Agency 2006).

Users of this worksheet should always refer to the User Manual to the Remedial Targets Methodology and to relevant guidance on UK legislation and policy, in order to understand how this procedure should be applied in an appropriate context.

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

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

Details to be completed for each assessment

Site Name:	NGET Tottenham		
Site Address:			
Completed by:	M Craske	Version:	x.xx
Date:	27-Oct-23		
Contaminant	Phenol		
Target Concentration (C_T)	71.7375823	mg/l	Origin of C_T: Lowest of DWS/EQS

This worksheet can be used to determine remedial targets for soils (Worksheets Level 1 Soil, Level 2 and Level 3 Soil) or to determine remedial targets for groundwater (Level 3 Groundwater). For Level 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 comparison 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 Level 1, 2 and 3 Worksheets.

Worksheet options are identified by brown background and employ a pull-down menus. Data entry are identified as blue background.

Data origin / justification should be noted in cells coloured yellow and fully documented in subsequent reports.

Data carried forward from an earlier worksheet are identified by a light green background

It is recommended that a copy of the original worksheet is saved (all data fields in the original copy are blank).

The spreadsheet also includes a porosity calculation worksheet, a soil impact calculation worksheet and a worksheet that performs some simple hydrogeological calculations.



Level 1 - Soil

Select the method of calculating the soil water
Partition Co-efficient by using the pull down menu
below

Calculate for non-polar organic chemicals

Contaminant	Phenol
Target concentration	71.7375823 mg/l

Input Parameters

Standard entry

Water filled soil porosity	θ_w	3.70E-01	fraction	Conservative value estimated from average site mo
Air filled soil porosity	θ_a	1.90E-01	fraction	Conservative value estimated from average site mo
Bulk density of soil zone material	ρ	1.60E+00	g/cm ³	Conservative Estimate for Made Ground
Henry's Law constant	H	2.62E-05	dimensionless	86

Entry if specify partition coefficient (option)

Soil water partition coefficient	Kd		l/kg	3.10E+01
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Entry for non-polar organic chemicals (option)

Fraction of organic carbon (in soil)	foc	8.00E-02	fraction	Average from uncontaminated site samples
Organic carbon partition coefficient	Koc	8.30E+01	l/kg	86

Entry for ionic organic chemicals (option)

Sorption coefficient for neutral species	$K_{oc,n}$		l/kg	
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg	
pH value	pH		pH units	
Acid dissociation constant	pKa			
Fraction of organic carbon (in soil)	foc		fraction	

Soil water partition coefficient used in Level Assessment	Kd	6.64E+00	l/kg	Calculated value
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Level 1 Remedial Target

Level 1 Remedial Target	4.93E+02	mg/kg	(for comparison with soil analyses)
	or		
	71.7375823	mg/l	(for comparison with leachate test results)

Site being assessed:	NGET Tottenham
Completed by:	M Craske
Date:	27-Oct-23
Version:	x.xx



Level 2 - Soil

Contaminant

Target concentration

C_T

Phenol

71.7375823

mg/l

from Level 1

from Level 1

This sheet calculates the Level 2 remedial target for soils (mg/kg) or for pore water (mg/l).

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 2 remedial target to determine the need for further action. Equations presented in 'Hydrogeological risk assessment for land contamination' (Environment Agency 2006)

Input Parameters		Variable	Value	Unit	Source of parameter value
Standard entry	Infiltration	Inf	7.40E-04	m/d	ted from EA effective infiltration mapping and 80% ha
	Area of contaminant source	A	1.25E+04	m ²	
Entry for groundwater flow below site					
	Length of contaminant source in direction of groundwater flow	L	5.00E+01	m	oximate lenght of site in direction of GW flow (north/s
	Saturated aquifer thickness	da	2.54E+00	m	hickness of Kempton Park Gravel based on BH logs +
	Hydraulic Conductivity of aquifer in which dilution occurs	K	1.00E+01	m/d	WP 2013 value for KPG
	Hydraulic gradient of water table	i	2.00E-03	fraction	etween site and off site locations near Pymmes brook
	Width of contaminant source perpendicular to groundwater flow	w	2.50E+02	m	ate site area perpendicular to GW flow (north-east/so
	Background concentration of contaminant in groundwater beneath site	Cu	0.00E+00	mg/l	
Define mixing zone depth by specifying or calculating depth (using pull down list)			Calculate		default condition
	Enter mixing zone thickness	Mz		m	
	Calculated mixing zone thickness	Mz	2.54E+00	m	

Calculated Parameters

Dilution Factor	DF	2.37E+00	
Level 2 Remedial Target		1.70E+02	mg/l
		or	
		1.17E+03	mg/kg
For comparison with measured pore water concentration. This assumes Level 1 Remedial Target is based on Target Concentrati			
For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water			

Additional option

Calculation of impact on receptor

Concentration of contaminant in contaminated discharge (entering receptor)	Cc	0.00E+00	mg/l	
Calculated concentration within receptor (dilution only)		0.00E+00	mg/l	0

Site being assessed:	NGET Tottenham
Completed by:	M Craske
Date:	27-Oct-23
Version:	x.xx

Remedial Targets Worksheet , Release 3.2

Level 3 - Soil

See Note



Input Parameters	Variable	Value	Unit	Source
Contaminant		Phenol		from Level 1
Target Concentration	C _T	0.0077	mg/l	from Level 1
Dilution Factor	DF	2.37E+00		from Level 2

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

Ogata Banks	Equations in HRA publication
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Select nature of decay rate (click on brown cell below, then on pull-down menu)

Approach for simulating degradation of pollutants: Apply degradation rate to dissolved pollutants only

Variable	Value	Unit	Source of parameter value
Soil leachate concentration as mg/l			
Enter source concentration	0.1	mg/l	
Enter soil leachate concentration	1.00E+02	days	
Half life for degradation of contaminant in water	6.93E-03	days ⁻¹	calculated
Calculated decay rate	2.50E+02	m	from Level 2
Width of plume in aquifer at source	2.54E+00	m	from Level 2
Plume thickness in aquifer at source	1.80E+00	g/cm ³	Literature estimate for RTD
Bulk density of aquifer materials	2.00E-01	fraction	Literature estimate for RTD
Effective porosity of aquifer	3.46E-03	fraction	from Level 2 (adjusted)
Hydraulic gradient	1.00E+01	m/d	from Level 2
Hydraulic conductivity of saturated aquifer	3.00E+01	m	Default for aquifer protection
Distance (lateral) to compliance point perpendicular to flow direction		m	default condition
Distance (depth) to compliance point perpendicular to flow direction		m	default condition
Time since pollutant entered groundwater	9.99E+99	days	time variant options only
Parameters values determined from options			
Partition coefficient	3.32E-01	l/kg	see options
Longitudinal dispersivity	3.000	m	see options
Transverse dispersivity	0.300	m	see options
Vertical dispersivity	0.000	m	see options

Parameter values should be checked against Level 1 and 2

Calculated Parameters

Variable			
Groundwater flow velocity	v	1.73E-01	m/d
Retardation factor	R _f	3.99E+00	fraction
Decay rate used	λ	1.74E-03	d ⁻¹
Hydraulic gradient used in aquifer flow down-gradient	i	3.46E-03	fraction
Rate of contaminant flow due to retardation	u	4.33E-02	m/d
Ratio of Compliance Point to Source Concentration	C _{ED} /C ₀	3.38E-01	fraction
Attenuation factor (C ₀ /C _{ED})	AF	2.96E+00	fraction
Soil leachate concentration	Co	1.00E-01	

Remedial Targets

Level 3 Remedial Target	5.41E-02	mg/l	For comparison with measured pore water concentration.
Ogata Banks	3.72E-01	mg/kg	This assumes Level 1 Remedial Target is based on Target Concentration.
Distance to compliance point	30	m	For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water partitioning equation.
Ratio of Compliance Point to Source Concentration	C _{ED} /C ₀	3.38E-01	fraction

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

Enter method of defining partition co-efficient (using pull down list)

Calculate for non-polar organic chemicals

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 4.00E-03 fraction

Organic carbon partition coefficient Koc 8.30E+01 l/kg

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

Fraction of organic carbon in aquifer foc fraction

Soil water partition coefficient Kd 3.32E-01 l/kg

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

User defined values for dispersivity

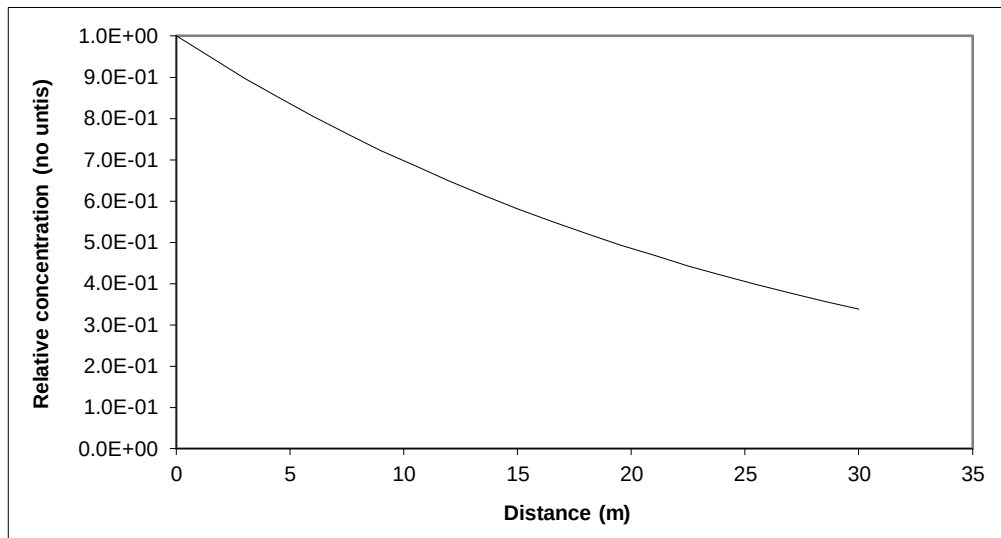
	Enter value	Calc value	Xu & Eckstein
Longitudinal dispersivity ax	3.00E+00	3.00E+00	2.13E+00 m
Transverse dispersivity az	3.00E-01	3.00E-01	2.13E-01 m
Vertical dispersivity ay	1.00E-99	3.00E-02	2.13E-02 m

Note values of dispersivity must be > 0

Xu & Eckstein (1995) report ax = 0.83(log₁₀x)^{2.414}; az = ax/10, ay = ax/100 are assumed

Note

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



Note: 'Relative concentration' is the ratio of calculated concentration at a given position compared to the source concentration. The calculations assume plume disperses from the top of the aquifer. An alternative solution assuming the centre of the plume is located at the mid-depth of the aquifer is presented in the calculation sheets.

Calculated (relative) concentrations for distance-concentration graph

Ogata Banks

From calculation sheet

Distance	Relative concentration (No units)	Concentration mg/l
0	1.0E+00	4.21E-02
1.5	9.47E-01	3.99E-02
3.0	8.97E-01	3.78E-02
4.5	8.50E-01	3.58E-02
6.0	8.05E-01	3.39E-02
7.5	7.62E-01	3.21E-02
9.0	7.22E-01	3.04E-02
10.5	6.84E-01	2.88E-02
12.0	6.48E-01	2.73E-02
13.5	6.14E-01	2.59E-02
15.0	5.81E-01	2.45E-02
16.5	5.50E-01	2.32E-02
18.0	5.21E-01	2.20E-02
19.5	4.94E-01	2.08E-02
21.0	4.68E-01	1.97E-02
22.5	4.43E-01	1.87E-02
24.0	4.20E-01	1.77E-02
25.5	3.97E-01	1.67E-02
27.0	3.76E-01	1.59E-02
28.5	3.57E-01	1.50E-02
30.0	3.38E-01	1.42E-02

This sheet calculates the Level 3 remedial target for soils(mg/kg) or for pore water (mg/l), based on the distance to the receptor or compliance located down hydraulic gradient of the source Three solution methods are included, the preferred option is Ogata Banks.By setting a long travel time (e.g. 9E99) it will give the steady state solution, which should always be used when calculating remedial targets.

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 3 remedial target to determine the need for further action.

Note if contaminant is not subject to first order degradation, then set half life as 9.9E+99.

Site being assessed:	NGET Tottenham
Completed by:	M Craske
Date:	#####
Version:	x.xx

R&D Publication 20 Remedial Targets Worksheet, Release 3.2

Level 3 - Groundwater

See Note

Input Parameters (using pull down menu)

Contaminant	Phenol	from Level 1
Target Concentration	C _T 7.70E-03	mg/l from Level 1

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

Ogata Banks	Equations in HRA publication
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Approach for simulating vertical dispersion: Simulate vertical dispersion in 1 direction

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

Approach for simulating degradation of pollutants: Apply degradation rate to dissolved pollutants only

Initial contaminant concentration in groundwater at plume core	C ₀	1.00E+00	mg/l	Source of parameter value
Half life for degradation of contaminant in water	t _{1/2}	1.00E+02	days	Based on site data
Calculated decay rate	λ	6.93E-03	days ⁻¹	
Width of plume in aquifer at source (perpendicular to flow)	Sz	2.50E+02	m	
Plume thickness at source	Sy	2.54E+00	m	
Saturated aquifer thickness	da	2.54E+00	m	Average thickness of Kempton Park Grave
Bulk density of aquifer materials	ρ	1.80E+00	g/cm ³	Literature estimate for RTD
Effective porosity of aquifer	n	2.00E-01	fraction	Literature estimate for RTD
Hydraulic gradient	i	2.00E-03	fraction	Based on average of site-specific GW measurements (SSE groundwater flow) - 0.0005 - 0.002 between
Hydraulic conductivity of aquifer	K	1.00E+01	m/d	WP 2013 value for KPG
Distance to compliance point	x	3.00E+01	m	Longitudinal dispersivity
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	Transverse dispersivity
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	Vertical dispersivity
Time since pollutant entered groundwater	t	9.99E+99	days	Note values of dispersivity must be > 0
Parameters values determined from options				For calculated value, assumes ax = 0.1 * x, az = 0.01 * x, ay = 0.001 * x
Partition coefficient	Kd	3.32E-01	l/kg	Xu & Eckstein (1995) report ax = 0.83(log ₁₀ x) ^{2.414} ; az = ax/10, ay = ax/100 are assumed
Longitudinal dispersivity	ax	3.00E+00	m	
Transverse dispersivity	az	3.00E-01	m	
Vertical dispersivity	ay	1.00E-99	m	

Calculated Parameters

Groundwater flow velocity	v	1.00E-01	m/d
Retardation factor	Rf	3.99E+00	fraction
Decay rate used	λ	1.74E-03	d ⁻¹
Rate of contaminant flow due to retardation	u	2.51E-02	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C _{ED}	1.71E-01	mg/l
Attenuation factor (one way vertical dispersion, CO/CED)	AF	5.85E+00	

Remedial Targets

Remedial Target	4.51E-02	mg/l	For comparison with measured groundwater concentration.
Ogata Banks			
Distance to compliance point	30	m	
Concentration of contaminant at compliance point after	C _{ED} /C ₀ 1.71E-01	mg/l	Ogata Banks
	1.0E+100	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)

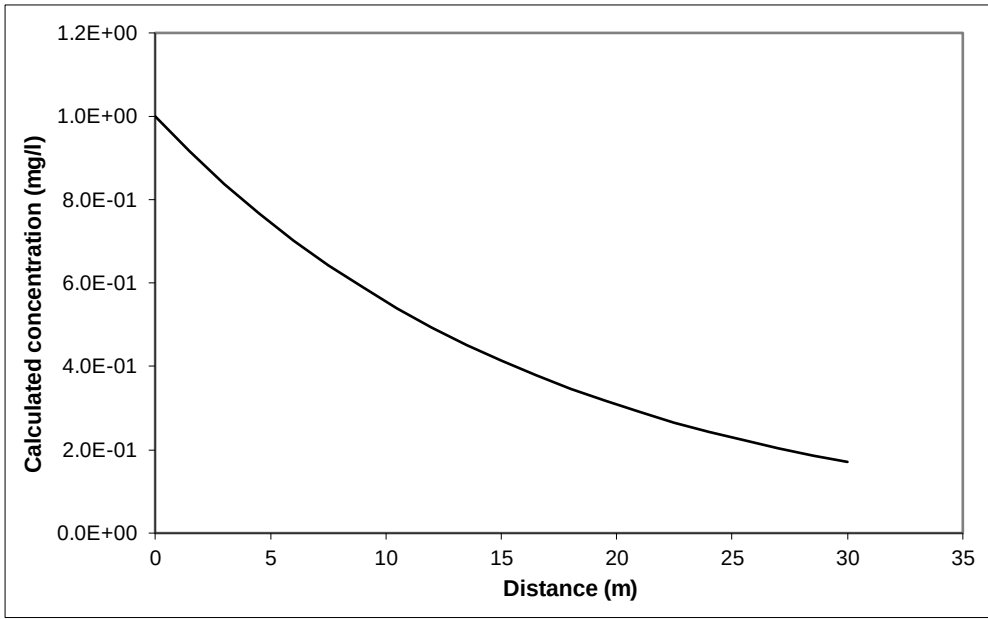
Calculate for non-polar organic chemicals

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	4.00E-03 fraction
Organic carbon partition coefficient	Koc	8.30E+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	
Fraction of organic carbon in aquifer	foc	fraction
Soil water partition coefficient	Kd	3.32E-01 l/kg

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

User defined values for dispersivity

Longitudinal dispersivity	ax	3.00E+00	3.00E+00	2.13E+00	m
Transverse dispersivity	az	3.00E-01	3.00E-01	2.13E-01	m
Vertical dispersivity	ay	1.00E-99	3.00E-02	2.13E-02	



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

Note

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

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

The measured groundwater concentration should be compared with the Level 3 remedial target to determine the need for further action. Note if contaminant is not subject to first order degradation, then set half life as 9.0E+99.

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

Calculated concentrations for distance-concentration graph

Ogata Banks From calculation sheet

Distance	Concentration
	mg/l
0	1.0E+00
1.5	9.15E-01
3.0	8.38E-01
4.5	7.67E-01
6.0	7.02E-01
7.5	6.43E-01
9.0	5.89E-01
10.5	5.39E-01
12.0	4.93E-01
13.5	4.51E-01
15.0	4.13E-01
16.5	3.78E-01
18.0	3.46E-01
19.5	3.17E-01
21.0	2.90E-01
22.5	2.66E-01
24.0	2.43E-01
25.5	2.23E-01
27.0	2.04E-01
28.5	1.87E-01
30.0	1.71E-01



Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

This worksheet has been produced in combination with the document 'Remedial Targets Methodology: Hydrogeological risk assessment for land contamination (Environment Agency 2006).

Users of this worksheet should always refer to the User Manual to the Remedial Targets Methodology and to relevant guidance on UK legislation and policy, in order to understand how this procedure should be applied in an appropriate context.

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

<u>Details to be completed for each assessment</u>			
Site Name:	NGET Tottenham		
Site Address:			
Completed by:	M Craske	Version:	x.xx
Date:	27-Oct-23		
Contaminant	Total Ammonium		
Target Concentration (C_T)	1.2420397 mg/l	Origin of C_T:	Lowest of DWS/EQS

This worksheet can be used to determine remedial targets for soils (Worksheets Level 1 Soil, Level 2 and Level 3 Soil) or to determine remedial targets for groundwater (Level 3 Groundwater). For Level 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 comparison 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 Level 1, 2 and 3 Worksheets.

Worksheet options are identified by brown background and employ a pull-down menus. Data entry are identified as blue background.

Data origin / justification should be noted in cells coloured yellow and fully documented in subsequent reports.

Data carried forward from an earlier worksheet are identified by a light green background

It is recommended that a copy of the original worksheet is saved (all data fields in the original copy are blank).

The spreadsheet also includes a porosity calculation worksheet, a soil impact calculation worksheet and a worksheet that performs some simple hydrogeological calculations.



Level 1 - Soil

Select the method of calculating the soil water
Partition Co-efficient by using the pull down menu
below

User specified value for partition coefficient

Contaminant	Total Ammonium
Target concentration	C _T 1.2420397 mg/l

Input Parameters

Standard entry

Water filled soil porosity	θ _w	3.70E-01	fraction	Conservative value estimated from average site mo
Air filled soil porosity	θ _a	1.90E-01	fraction	Conservative value estimated from average site mo
Bulk density of soil zone material	ρ	1.60E+00	g/cm ³	Conservative Estimate for Made Ground
Henry's Law constant	H	7.81E-05	dimensionless	81

This sheet calculates the Level 1 remedial target for soils(mg/kg) based on a selected target concentration and theoretical calculation of soil water partitioning. Three options are included for determining the partition coefficient. The measured soil concentration as mg/kg should be compared with the Level 1 remedial target to determine the need for further action.

Entry if specify partition coefficient (option)

Soil water partition coefficient	K _d	1.00E+00	l/kg	9.60E+01
----------------------------------	----------------	----------	------	----------

Entry for non-polar organic chemicals (option)

Fraction of organic carbon (in soil)	f _{oc}		fraction	GI average, uncontaminated samples
Organic carbon partition coefficient	K _{oc}		l/kg	86

Entry for ionic organic chemicals (option)

Sorption coefficient for neutral species	K _{oc,n}		l/kg	
Sorption coefficient for ionised species	K _{oc,i}		l/kg	
pH value	pH		pH units	
Acid dissociation constant	pK _a			
Fraction of organic carbon (in soil)	f _{oc}		fraction	

Soil water partition coefficient used in Level Assessment	K _d	1.00E+00	l/kg	Specified value
---	----------------	----------	------	-----------------

Level 1 Remedial Target

Level 1 Remedial Target	1.53E+00	mg/kg	(for comparison with soil analyses)
	or		
	1.2420397	mg/l	(for comparison with leachate test results)

Site being assessed:	NGET Tottenham
Completed by:	M Craske
Date:	27-Oct-23
Version:	x.xx



Level 2 - Soil

Contaminant
Target concentration C_T **Total Ammonium** from Level 1
1.2420397 mg/l from Level 1

This sheet calculates the Level 2 remedial target for soils (mg/kg) or for pore water (mg/l).

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 2 remedial target to determine the need for further action. Equations presented in 'Hydrogeological risk assessment for land contamination' (Environment Agency 2006)

Input Parameters	Variable	Value	Unit	Source of parameter value
Standard entry				
Infiltration	Inf	7.40E-04	m/d	Estimated from EA effective infiltration mapping and 80% ha
Area of contaminant source	A	1.25E+04	m ²	Length x width of site (50x250) Not used in calculation
Entry for groundwater flow below site				
Length of contaminant source in direction of groundwater flow	L	5.00E+01	m	Approximate length of site in direction of GW flow (north/south)
Saturated aquifer thickness	da	2.54E+00	m	Thickness of Kempton Park Gravel based on BH logs +
Hydraulic Conductivity of aquifer in which dilution occurs	K	1.00E+01	m/d	WP 2013 value for KPG
Hydraulic gradient of water table	i	2.00E-03	fraction	Between site and off site locations near Pymmes brook
Width of contaminant source perpendicular to groundwater flow	w	2.50E+02	m	Approximate site area perpendicular to GW flow (north-east/south-west)
Background concentration of contaminant in groundwater beneath site	Cu	0.00E+00	mg/l	Not used in calculation
Define mixing zone depth by specifying or calculating depth (using pull down list)		Calculate		default condition
Enter mixing zone thickness	Mz		m	
Calculated mixing zone thickness	Mz	2.54E+00	m	

Calculated Parameters

Dilution Factor	DF	2.37E+00		
Level 2 Remedial Target		2.95E+00	mg/l	For comparison with measured pore water concentration. This assumes Level 1 Remedial Target is based on Target Concentration
		or		
		3.63E+00	mg/kg	For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water

Additional option

Calculation of impact on receptor

Concentration of contaminant in contaminated discharge (entering receptor)	Cc	0.00E+00	mg/l	
Calculated concentration within receptor (dilution only)		0.00E+00	mg/l	0

Site being assessed:	NGET Tottenham
Completed by:	M Craske
Date:	27-Oct-23
Version:	x.xx

Remedial Targets Worksheet , Release 3.2

Level 3 - Soil

See Note



Input Parameters	Variable	Value	Unit	Source
Contaminant		Total Ammonium		from Level 1
Target Concentration	C _T	0.26	mg/l	from Level 1
Dilution Factor	DF	2.37E+00		from Level 2

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

Ogata Banks	Equations in HRA publication
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Select nature of decay rate (click on brown cell below, then on pull-down menu)

Approach for simulating degradation of pollutants:

Apply degradation rate to dissolved pollutants only

Variable	Value	Unit	Source of parameter value
Soil leachate concentration as mg/l			
Enter soil leachate concentration	0.1	mg/l	
Half life for degradation of contaminant in water	t _{1/2}	2.19E+03 days	81
Calculated decay rate	λ	3.17E-04 days ⁻¹	calculated
Width of plume in aquifer at source	Sz	2.50E+02 m	from Level 2
Plume thickness in aquifer at source	Sy	2.54E+00 m	from Level 2
Bulk density of aquifer materials	ρ	1.80E+00 g/cm ³	Literature estimate for RTD
Effective porosity of aquifer	n	2.00E-01	Literature estimate for RTD
Hydraulic gradient	i	3.46E-03	from Level 2 (adjusted)
Hydraulic conductivity of saturated aquifer	K	1.00E+01 m/d	from Level 2
Distance (lateral) to compliance point perpendicular to flow direction	x	3.00E+01 m	Default for aquifer protection
Distance (depth) to compliance point perpendicular to flow direction	z		default condition
Time since pollutant entered groundwater	t	9.99E+99 days	default condition
Parameters values determined from options			
Partition coefficient	Kd	1.00E+00 l/kg	see options
Longitudinal dispersivity	ax	3.000 m	see options
Transverse dispersivity	az	0.300 m	see options
Vertical dispersivity	ay	0.000 m	see options

Parameter values should be checked against Level 1 and 2

Calculated Parameters

Variable			
Groundwater flow velocity	v	1.73E-01 m/d	
Retardation factor	Rf	1.00E+01	fraction
Decay rate used	λ	3.17E-05 d ⁻¹	
Hydraulic gradient used in aquifer flow down-gradient	i	3.46E-03	fraction
Rate of contaminant flow due to retardation	u	1.73E-02 m/d	
Ratio of Compliance Point to Source Concentration	C _{ED} /C ₀	9.47E-01	fraction
Attenuation factor (C ₀ /C _{ED})	AF	1.06E+00	fraction
Soil leachate concentration	Co	1.00E-01	

Remedial Targets

Level 3 Remedial Target	6.52E-01 mg/l	For comparison with measured pore water concentration.
Ogata Banks	or	This assumes Level 1 Remedial Target is based on Target Concentration.
	8.02E-01 mg/kg	For comparison with measured soil concentration. This
Distance to compliance point	30 m	assumes Level 1 Remedial Target calculated from soil-water partitioning equation.
Ratio of Compliance Point to Source Concentration	C _{ED} /C ₀	9.47E-01 fraction
		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

Enter method of defining partition co-efficient (using pull down list)

User specified value for partition coefficient

Entry if specify partition coefficient (option)

Soil water partition coefficient Kd 1.00E+00 l/kg

Entry for non-polar organic chemicals (option)

Fraction of organic carbon in aquifer foc fraction

Organic carbon partition coefficient Koc l/kg

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

Fraction of organic carbon in aquifer foc fraction

Soil water partition coefficient Kd 1.00E+00 l/kg

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

User defined values for dispersivity

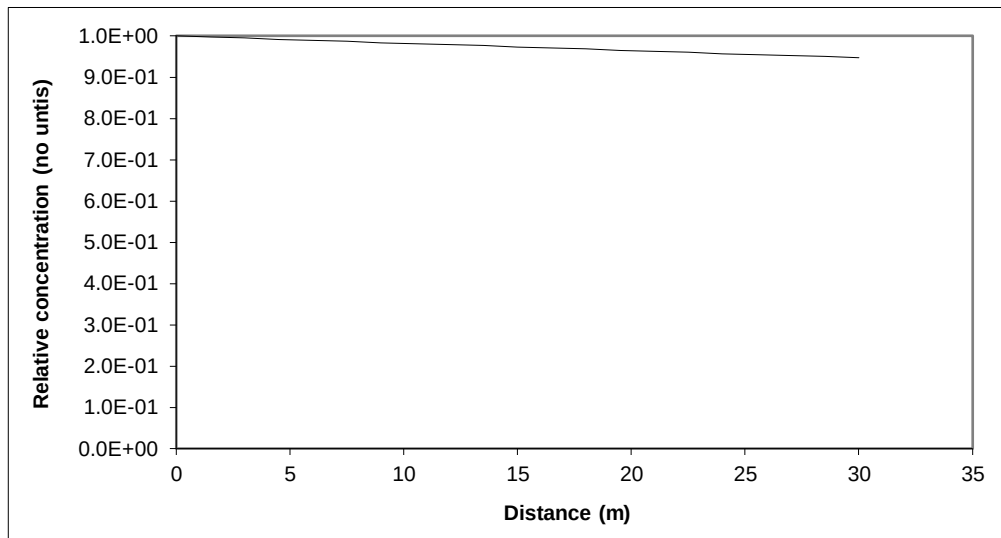
	Enter value	Calc value	Xu & Eckstein
Longitudinal dispersivity ax	3.00E+00	3.00E+00	2.13E+00 m
Transverse dispersivity az	3.00E-01	3.00E-01	2.13E-01 m
Vertical dispersivity ay	1.00E-99	3.00E-02	2.13E-02 m

Note values of dispersivity must be > 0

Xu & Eckstein (1995) report ax = 0.83(log₁₀x)^{2.414}; az = ax/10, ay = ax/100 are assumed

Note

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



Note: 'Relative concentration' is the ratio of calculated concentration at a given position compared to the source concentration. The calculations assume plume disperses from the top of the aquifer. An alternative solution assuming the centre of the plume is located at the mid-depth of the aquifer is presented in the calculation sheets.

Calculated (relative) concentrations for distance-concentration graph

Ogata Banks

From calculation sheet

Distance	Relative concentration (No units)	Concentration mg/l
0	1.0E+00	4.21E-02
1.5	9.97E-01	4.20E-02
3.0	9.95E-01	4.19E-02
4.5	9.92E-01	4.18E-02
6.0	9.89E-01	4.17E-02
7.5	9.86E-01	4.16E-02
9.0	9.84E-01	4.14E-02
10.5	9.81E-01	4.13E-02
12.0	9.78E-01	4.12E-02
13.5	9.76E-01	4.11E-02
15.0	9.73E-01	4.10E-02
16.5	9.70E-01	4.09E-02
18.0	9.68E-01	4.08E-02
19.5	9.65E-01	4.07E-02
21.0	9.62E-01	4.06E-02
22.5	9.60E-01	4.04E-02
24.0	9.57E-01	4.03E-02
25.5	9.55E-01	4.02E-02
27.0	9.52E-01	4.01E-02
28.5	9.49E-01	4.00E-02
30.0	9.47E-01	3.99E-02

This sheet calculates the Level 3 remedial target for soils(mg/kg) or for pore water (mg/l), based on the distance to the receptor or compliance located down hydraulic gradient of the source Three solution methods are included, the preferred option is Ogata Banks.By setting a long travel time (e.g. 9E99) it will give the steady state solution, which should always be used when calculating remedial targets.

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 3 remedial target to determine the need for further action.

Note if contaminant is not subject to first order degradation, then set half life as 9.9E+99.

Site being assessed:	NGET Tottenham
Completed by:	M Craske
Date:	#####
Version:	x.xx

R&D Publication 20 Remedial Targets Worksheet, Release 3.2

Level 3 - Groundwater

See Note

Input Parameters (using pull down menu)

Variable Value Unit Source

Contaminant Total Ammonium from Level 1
Target Concentration C_T 2.60E-01 mg/l from Level 1

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

Ogata Banks

Equations in HRA publication

Approach for simulating vertical dispersion:

Simulate vertical dispersion in 1 direction

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

Approach for simulating degradation of pollutants:

Apply degradation rate to dissolved pollutants only

Source of parameter value

Initial contaminant concentration in groundwater at plume core C₀ 1.00E+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 2.50E+02 m
Plume thickness at source Sy 2.54E+00 m
Saturated aquifer thickness da 2.54E+00 m
Bulk density of aquifer materials ρ 1.80E+00 g/cm³
Effective porosity of aquifer n 2.00E-01 fraction
Hydraulic gradient i 2.00E-03 fraction
Hydraulic conductivity of aquifer K 1.00E+01 m/d
Distance to compliance point x 3.00E+01 m
Distance (lateral) to compliance point perpendicular to flow direction z 0.00E+00 m
Distance (depth) to compliance point perpendicular to flow direction y 0.00E+00 m
Time since pollutant entered groundwater t 9.99E+99 days

Parameters values determined from options

Partition coefficient Kd 1.00E+00 l/kg see options
Longitudinal dispersivity ax 3.00E+00 m see options
Transverse dispersivity az 3.00E-01 m see options
Vertical dispersivity ay 1.00E-99 m see options

Calculated Parameters Variable

Groundwater flow velocity v 1.00E-01 m/d
Retardation factor Rf 1.00E+01 fraction
Decay rate used λ 3.17E-05 d⁻¹
Rate of contaminant flow due to retardation u 1.00E-02 m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion C_{ED} 9.10E-01 mg/l
Attenuation factor (one way vertical dispersion, CO/CED) AF 1.10E+00

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

User specified value for partition coefficient

Entry if specify partition coefficient (option)

Soil water partition coefficient Kd 1.00E+00 l/kg
Entry for non-polar organic chemicals (option)
Fraction of organic carbon in aquifer foc fraction
Organic carbon partition coefficient Koc 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
Fraction of organic carbon in aquifer foc fraction

Soil water partition coefficient Kd 1.00E+00 l/kg

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

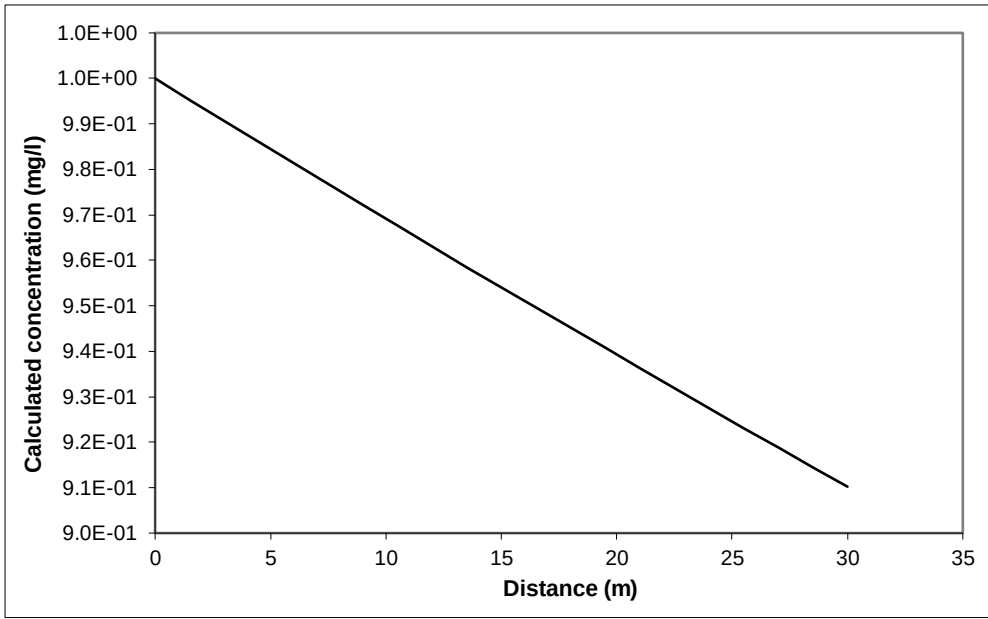
User defined values for dispersivity

Based on average of site-specific GW measurements (SSE groundwater flow) - 0.0005 - 0.002 between

Longitudinal dispersivity ax 3.00E+00 m
Transverse dispersivity az 3.00E-01 m
Vertical dispersivity ay 1.00E-99 m

Note values of dispersivity must be > 0

For calculated value, assumes ax = 0.1 * x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report ax = 0.83(log₁₀x)^{2.414}; az = ax/10, ay = ax/100 are assumed



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

Note

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

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

The measured groundwater concentration should be compared with the Level 3 remedial target to determine the need for further action. Note if contaminant is not subject to first order degradation, then set half life as 9.0E+99.

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

Calculated concentrations for distance-concentration graph

Ogata Banks

From calculation sheet

Distance	Concentration
	mg/l
0	1.0E+00
1.5	9.95E-01
3.0	9.91E-01
4.5	9.86E-01
6.0	9.81E-01
7.5	9.77E-01
9.0	9.72E-01
10.5	9.68E-01
12.0	9.63E-01
13.5	9.59E-01
15.0	9.54E-01
16.5	9.50E-01
18.0	9.45E-01
19.5	9.41E-01
21.0	9.36E-01
22.5	9.32E-01
24.0	9.28E-01
25.5	9.23E-01
27.0	9.19E-01
28.5	9.15E-01
30.0	9.10E-01

Remedial Targets

Remedial Target	2.86E-01	mg/l	For comparison with measured groundwater concentration.
Ogata Banks			

Distance to compliance point 30 m

Concentration of contaminant at compliance point after C_{ED}/C₀ 9.10E-01 mg/l
1.0E+100 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.





Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

This worksheet has been produced in combination with the document 'Remedial Targets Methodology: Hydrogeological risk assessment for land contamination (Environment Agency 2006).

Users of this worksheet should always refer to the User Manual to the Remedial Targets Methodology and to relevant guidance on UK legislation and policy, in order to understand how this procedure should be applied in an appropriate context.

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

<u>Details to be completed for each assessment</u>			
Site Name:	NGET Tottenham		
Site Address:			
Completed by:	M Craske	Version:	x.xx
Date:	27-Oct-23		
Contaminant	Total Ammonium		
Target Concentration (C_T)	1.2420397 mg/l	Origin of C_T:	Lowest of DWS/EQS

This worksheet can be used to determine remedial targets for soils (Worksheets Level 1 Soil, Level 2 and Level 3 Soil) or to determine remedial targets for groundwater (Level 3 Groundwater). For Level 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 comparison 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 Level 1, 2 and 3 Worksheets.

Worksheet options are identified by brown background and employ a pull-down menus. Data entry are identified as blue background.

Data origin / justification should be noted in cells coloured yellow and fully documented in subsequent reports.

Data carried forward from an earlier worksheet are identified by a light green background

It is recommended that a copy of the original worksheet is saved (all data fields in the original copy are blank).

The spreadsheet also includes a porosity calculation worksheet, a soil impact calculation worksheet and a worksheet that performs some simple hydrogeological calculations.



Level 1 - Soil

Select the method of calculating the soil water
Partition Co-efficient by using the pull down menu
below

User specified value for partition coefficient

Contaminant	Total Ammonium
Target concentration	C _T 1.2420397 mg/l

Input Parameters

Standard entry

Water filled soil porosity	θ _w	3.70E-01	fraction	Conservative value estimated from average site mo
Air filled soil porosity	θ _a	1.90E-01	fraction	Conservative value estimated from average site mo
Bulk density of soil zone material	ρ	1.60E+00	g/cm ³	Conservative Estimate for Made Ground
Henry's Law constant	H	7.81E-05	dimensionless	81

Entry if specify partition coefficient (option)

Soil water partition coefficient	K _d	1.00E+00	l/kg	9.60E+01
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Entry for non-polar organic chemicals (option)

Fraction of organic carbon (in soil)	f _{oc}		fraction	GI average, uncontaminated samples
Organic carbon partition coefficient	K _{oc}		l/kg	86

Entry for ionic organic chemicals (option)

Sorption coefficient for neutral species	K _{oc,n}		l/kg	
Sorption coefficient for ionised species	K _{oc,i}		l/kg	
pH value	pH		pH units	
Acid dissociation constant	pK _a			
Fraction of organic carbon (in soil)	f _{oc}		fraction	

Soil water partition coefficient used in Level Assessment	K _d	1.00E+00	l/kg	Specified value
---	----------------	----------	------	-----------------

Level 1 Remedial Target

Level 1 Remedial Target	1.53E+00	mg/kg	(for comparison with soil analyses)
	or		
	1.2420397	mg/l	(for comparison with leachate test results)

Site being assessed:	NGET Tottenham
Completed by:	M Craske
Date:	27-Oct-23
Version:	x.xx



Level 2 - Soil

Contaminant Target concentration C_T **Total Ammonium** from Level 1
1.2420397 mg/l from Level 1

This sheet calculates the Level 2 remedial target for soils (mg/kg) or for pore water (mg/l).

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 2 remedial target to determine the need for further action. Equations presented in 'Hydrogeological risk assessment for land contamination' (Environment Agency 2006)

Input Parameters		Variable	Value	Unit	Source of parameter value
Standard entry	Infiltration	Inf	7.40E-04	m/d	ted from EA effective infiltration mapping and 80% ha
	Area of contaminant source	A	1.25E+04	m ²	
Entry for groundwater flow below site					
	Length of contaminant source in direction of groundwater flow	L	5.00E+01	m	oximate lenght of site in direction of GW flow (north/s
	Saturated aquifer thickness	da	2.54E+00	m	hickness of Kempton Park Gravel based on BH logs +
	Hydraulic Conductivity of aquifer in which dilution occurs	K	1.00E+01	m/d	WP 2013 value for KPG
	Hydraulic gradient of water table	i	2.00E-03	fraction	etween site and off site locations near Pymmes brook
	Width of contaminant source perpendicular to groundwater flow	w	2.50E+02	m	ate site area perpendicular to GW flow (north-east/so
	Background concentration of contaminant in groundwater beneath site	Cu	0.00E+00	mg/l	
Define mixing zone depth by specifying or calculating depth (using pull down list)			Calculate		default condition
	Enter mixing zone thickness	Mz		m	
	Calculated mixing zone thickness	Mz	2.54E+00	m	

Calculated Parameters

Dilution Factor	DF	2.37E+00		
Level 2 Remedial Target		2.95E+00	mg/l	For comparison with measured pore water concentration. This assumes Level 1 Remedial Target is based on Target Concentrati
		or		
		3.63E+00	mg/kg	For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water

Additional option

Calculation of impact on receptor

Concentration of contaminant in contaminated discharge (entering receptor)	Cc	0.00E+00	mg/l	
Calculated concentration within receptor (dilution only)		0.00E+00	mg/l	0

Site being assessed:	NGET Tottenham
Completed by:	M Craske
Date:	27-Oct-23
Version:	x.xx

Remedial Targets Worksheet , Release 3.2

Level 3 - Soil

See Note



Input Parameters	Variable	Value	Unit	Source
Contaminant		Total Ammonium		from Level 1
Target Concentration	C _T	0.26	mg/l	from Level 1
Dilution Factor	DF	2.37E+00		from Level 2

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

Ogata Banks	Equations in HRA publication
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Select nature of decay rate (click on brown cell below, then on pull-down menu)

Approach for simulating degradation of pollutants:

Apply degradation rate to dissolved pollutants only

Variable	Value	Unit	Source of parameter value
Soil leachate concentration as mg/l			
Enter soil leachate concentration	0.1	mg/l	
Half life for degradation of contaminant in water	t _{1/2}	2.19E+03 days	81
Calculated decay rate	λ	3.17E-04 days ⁻¹	calculated
Width of plume in aquifer at source	Sz	2.50E+02 m	from Level 2
Plume thickness in aquifer at source	Sy	2.54E+00 m	from Level 2
Bulk density of aquifer materials	ρ	1.80E+00 g/cm ³	Literature estimate for RTD
Effective porosity of aquifer	n	2.00E-01	Literature estimate for RTD
Hydraulic gradient	i	3.46E-03	from Level 2 (adjusted)
Hydraulic conductivity of saturated aquifer	K	1.00E+01 m/d	from Level 2
Distance (lateral) to compliance point perpendicular to flow direction	x	3.00E+01 m	Default for aquifer protection
Distance (depth) to compliance point perpendicular to flow direction	z		default condition
Time since pollutant entered groundwater	t	9.99E+99 days	default condition
Parameters values determined from options			
Partition coefficient	Kd	1.00E+00 l/kg	see options
Longitudinal dispersivity	ax	3.000	m see options
Transverse dispersivity	az	0.300	m see options
Vertical dispersivity	ay	0.000	m see options

Parameter values should be checked against Level 1 and 2

Calculated Parameters

Variable			
Groundwater flow velocity	v	1.73E-01	m/d
Retardation factor	Rf	1.00E+01	fraction
Decay rate used	λ	3.17E-05	d ⁻¹
Hydraulic gradient used in aquifer flow down-gradient	i	3.46E-03	fraction
Rate of contaminant flow due to retardation	u	1.73E-02	m/d
Ratio of Compliance Point to Source Concentration	C _{ED} /C ₀	9.47E-01	fraction
Attenuation factor (C ₀ /C _{ED})	AF	1.06E+00	fraction
Soil leachate concentration	Co	1.00E-01	

Remedial Targets

Level 3 Remedial Target	6.52E-01	mg/l	For comparison with measured pore water concentration.
Ogata Banks	or		This assumes Level 1 Remedial Target is based on Target Concentration.
	8.02E-01	mg/kg	For comparison with measured soil concentration. This
Distance to compliance point	30	m	assumes Level 1 Remedial Target calculated from soil-water partitioning equation.
Ratio of Compliance Point to Source Concentration	C _{ED} /C ₀	9.47E-01	fraction 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

Enter method of defining partition co-efficient (using pull down list)

User specified value for partition coefficient

Entry if specify partition coefficient (option)

Soil water partition coefficient Kd 1.00E+00 l/kg

Entry for non-polar organic chemicals (option)

Fraction of organic carbon in aquifer foc fraction

Organic carbon partition coefficient Koc 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

Fraction of organic carbon in aquifer foc fraction

Soil water partition coefficient Kd 1.00E+00 l/kg

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

User defined values for dispersivity

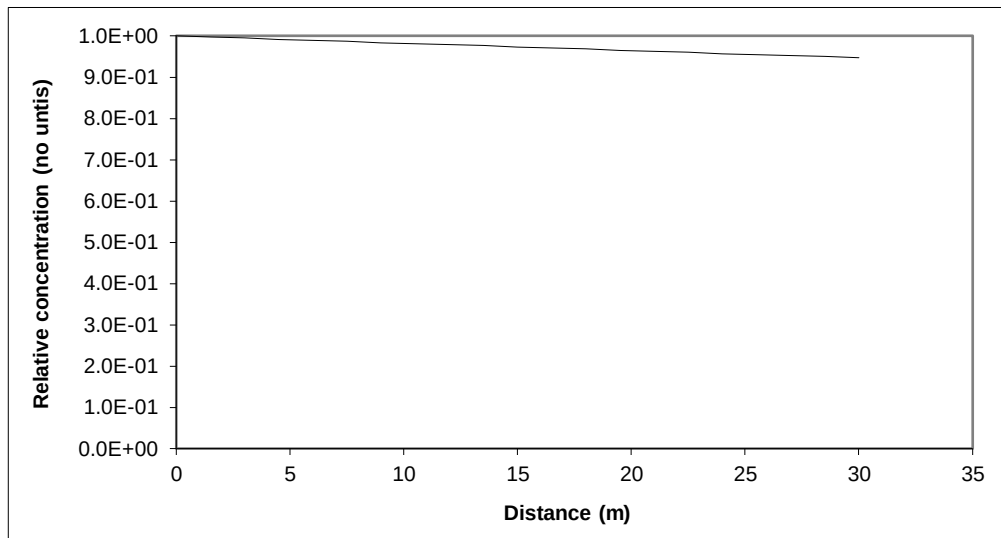
	Enter value	Calc value	Xu & Eckstein
Longitudinal dispersivity ax	3.00E+00	3.00E+00	2.13E+00 m
Transverse dispersivity az	3.00E-01	3.00E-01	2.13E-01 m
Vertical dispersivity ay	1.00E-99	3.00E-02	2.13E-02 m

Note values of dispersivity must be > 0

Xu & Eckstein (1995) report ax = 0.83(log₁₀x)^{2.414}; az = ax/10, ay = ax/100 are assumed

Note

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



Note: 'Relative concentration' is the ratio of calculated concentration at a given position compared to the source concentration. The calculations assume plume disperses from the top of the aquifer. An alternative solution assuming the centre of the plume is located at the mid-depth of the aquifer is presented in the calculation sheets.

Calculated (relative) concentrations for distance-concentration graph

Ogata Banks

From calculation sheet

Distance	Relative concentration (No units)	Concentration mg/l
0	1.0E+00	4.21E-02
1.5	9.97E-01	4.20E-02
3.0	9.95E-01	4.19E-02
4.5	9.92E-01	4.18E-02
6.0	9.89E-01	4.17E-02
7.5	9.86E-01	4.16E-02
9.0	9.84E-01	4.14E-02
10.5	9.81E-01	4.13E-02
12.0	9.78E-01	4.12E-02
13.5	9.76E-01	4.11E-02
15.0	9.73E-01	4.10E-02
16.5	9.70E-01	4.09E-02
18.0	9.68E-01	4.08E-02
19.5	9.65E-01	4.07E-02
21.0	9.62E-01	4.06E-02
22.5	9.60E-01	4.04E-02
24.0	9.57E-01	4.03E-02
25.5	9.55E-01	4.02E-02
27.0	9.52E-01	4.01E-02
28.5	9.49E-01	4.00E-02
30.0	9.47E-01	3.99E-02

This sheet calculates the Level 3 remedial target for soils(mg/kg) or for pore water (mg/l), based on the distance to the receptor or compliance located down hydraulic gradient of the source Three solution methods are included, the preferred option is Ogata Banks.By setting a long travel time (e.g. 9E99) it will give the steady state solution, which should always be used when calculating remedial targets.

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 3 remedial target to determine the need for further action.

Note if contaminant is not subject to first order degradation, then set half life as 9.9E+99.

Site being assessed:	NGET Tottenham
Completed by:	M Craske
Date:	#####
Version:	x.xx

R&D Publication 20 Remedial Targets Worksheet, Release 3.2

Level 3 - Groundwater

See Note

Input Parameters (using pull down menu)

Contaminant	Total Ammonium	from Level 1
Target Concentration	C _T 2.60E-01	mg/l from Level 1

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

Ogata Banks	Equations in HRA publication
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Approach for simulating vertical dispersion:

Simulate vertical dispersion in 1 direction

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

Approach for simulating degradation of pollutants:

Apply degradation rate to dissolved pollutants only

Initial contaminant concentration in groundwater at plume core	C ₀	1.00E+00	mg/l	Source of parameter value
Half life for degradation of contaminant in water	t _{1/2}	2.19E+03	days	Based on site data
Calculated decay rate	λ	3.17E-04	days ⁻¹	
Width of plume in aquifer at source (perpendicular to flow)	Sz	2.50E+02	m	
Plume thickness at source	Sy	2.54E+00	m	
Saturated aquifer thickness	da	2.54E+00	m	Average thickness of Kempton Park Grave
Bulk density of aquifer materials	ρ	1.80E+00	g/cm ³	Literature estimate for RTD
Effective porosity of aquifer	n	2.00E-01	fraction	Literature estimate for RTD
Hydraulic gradient	i	2.00E-03	fraction	Based on average of site-specific GW measurements (SSE groundwater flow) - 0.0005 - 0.002 between
Hydraulic conductivity of aquifer	K	1.00E+01	m/d	WP 2013 value for KPG
Distance to compliance point	x	3.00E+01	m	Longitudinal dispersivity
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	Transverse dispersivity
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	Vertical dispersivity
Time since pollutant entered groundwater	t	9.99E+99	days	Note values of dispersivity must be > 0
Parameters values determined from options				For calculated value, assumes ax = 0.1 * x, az = 0.01 * x, ay = 0.001 * x
Partition coefficient	Kd	1.00E+00	l/kg	Xu & Eckstein (1995) report ax = 0.83(log ₁₀ x) ^{2.414} ; az = ax/10, ay = ax/100 are assumed
Longitudinal dispersivity	ax	3.00E+00	m	
Transverse dispersivity	az	3.00E-01	m	
Vertical dispersivity	ay	1.00E-99	m	

Calculated Parameters

Groundwater flow velocity	v	1.00E-01	m/d
Retardation factor	Rf	1.00E+01	fraction
Decay rate used	λ	3.17E-05	d ⁻¹
Rate of contaminant flow due to retardation	u	1.00E-02	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C _{ED}	9.10E-01	mg/l
Attenuation factor (one way vertical dispersion, CO/CED)	AF	1.10E+00	

Remedial Targets

Remedial Target	2.86E-01	mg/l	For comparison with measured groundwater concentration.
Ogata Banks			
Distance to compliance point	30	m	
Concentration of contaminant at compliance point after	C _{ED} /C ₀ 9.10E-01	mg/l	Ogata Banks
	1.0E+100	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)

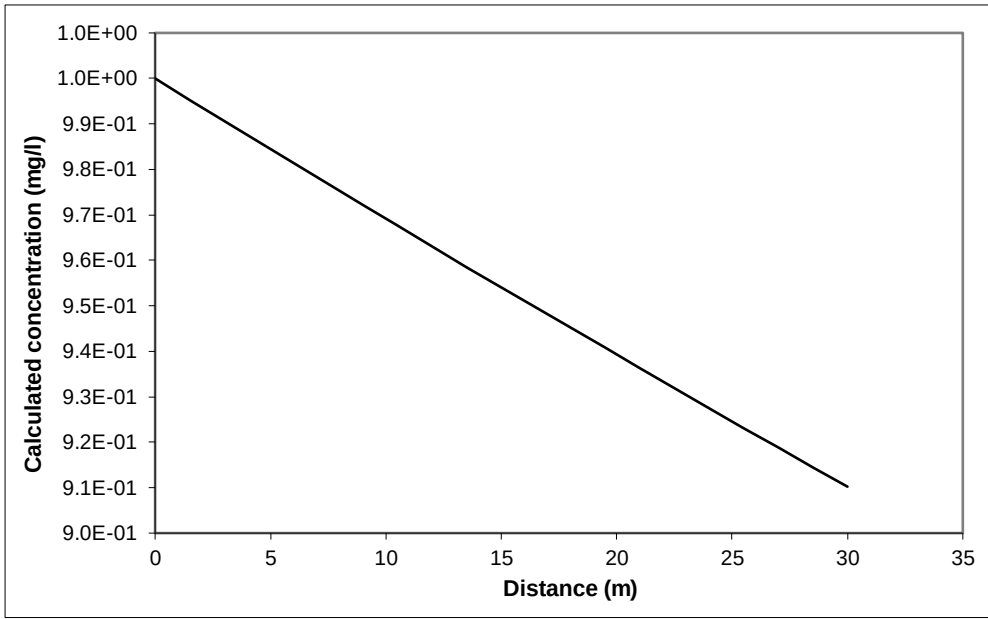
User specified value for partition coefficient

Entry if specify partition coefficient (option)		
Soil water partition coefficient	Kd	1.00E+00 l/kg
Entry for non-polar organic chemicals (option)		
Fraction of organic carbon in aquifer	foc	fraction
Organic carbon partition coefficient	Koc	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	
Fraction of organic carbon in aquifer	foc	fraction
Soil water partition coefficient	Kd	1.00E+00 l/kg

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

User defined values for dispersivity

Enter value	Calc value Xu & Eckstein	m
ax	3.00E+00	3.00E+00 2.13E+00 m
az	3.00E-01	3.00E-01 2.13E-01 m
ay	1.00E-99	3.00E-02 2.13E-02 m



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

Note

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

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

The measured groundwater concentration should be compared with the Level 3 remedial target to determine the need for further action. Note if contaminant is not subject to first order degradation, then set half life as 9.0E+99.

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

Site being assessed:	NGET Tottenham
Completed by:	M Craske
Date:	#####
Version:	x.xx

Calculated concentrations for distance-concentration graph

Ogata Banks From calculation sheet

Distance	Concentration
	mg/l
0	1.0E+00
1.5	9.95E-01
3.0	9.91E-01
4.5	9.86E-01
6.0	9.81E-01
7.5	9.77E-01
9.0	9.72E-01
10.5	9.68E-01
12.0	9.63E-01
13.5	9.59E-01
15.0	9.54E-01
16.5	9.50E-01
18.0	9.45E-01
19.5	9.41E-01
21.0	9.36E-01
22.5	9.32E-01
24.0	9.28E-01
25.5	9.23E-01
27.0	9.19E-01
28.5	9.15E-01
30.0	9.10E-01



Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

This worksheet has been produced in combination with the document 'Remedial Targets Methodology: Hydrogeological risk assessment for land contamination (Environment Agency 2006).

Users of this worksheet should always refer to the User Manual to the Remedial Targets Methodology and to relevant guidance on UK legislation and policy, in order to understand how this procedure should be applied in an appropriate context.

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

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

<u>Details to be completed for each assessment</u>			
Site Name:	NGET Tottenham		
Site Address:			
Completed by:	M Craske	Version:	x.xx
Date:	27-Oct-23		
Contaminant	Total Cyanide		
Target Concentration (C_T)	2.078719763	mg/l	Origin of C_T: Lowest of DWS/EQS

This worksheet can be used to determine remedial targets for soils (Worksheets Level 1 Soil, Level 2 and Level 3 Soil) or to determine remedial targets for groundwater (Level 3 Groundwater). For Level 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 comparison 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 Level 1, 2 and 3 Worksheets.

Worksheet options are identified by brown background and employ a pull-down menus. Data entry are identified as blue background.

Data origin / justification should be noted in cells coloured yellow and fully documented in subsequent reports.

Data carried forward from an earlier worksheet are identified by a light green background

It is recommended that a copy of the original worksheet is saved (all data fields in the original copy are blank).

The spreadsheet also includes a porosity calculation worksheet, a soil impact calculation worksheet and a worksheet that performs some simple hydrogeological calculations.



Level 1 - Soil

Select the method of calculating the soil water
Partition Co-efficient by using the pull down menu
below

User specified value for partition coefficient

Contaminant	Total Cyanide
Target concentration	C _T 2.078719763 mg/l

Input Parameters

Standard entry

Water filled soil porosity	θ _w	3.70E-01	fraction
Air filled soil porosity	θ _a	1.90E-01	fraction
Bulk density of soil zone material	ρ	1.60E+00	g/cm ³
Henry's Law constant	H	4.18E-11	dimensionless

Conservative value estimated from average site mo
Conservative value estimated from average site mo
Conservative Estimate for Made Ground
0

This sheet calculates the Level 1 remedial target for soils(mg/kg) based on a selected target concentration and theoretical calculation of soil water partitioning. Three options are included for determining the partition coefficient. The measured soil concentration as mg/kg should be compared with the Level 1 remedial target to determine the need for further action.

Entry if specify partition coefficient (option)

Soil water partition coefficient	K _d	9.90E+00	l/kg
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9.60E+01

Entry for non-polar organic chemicals (option)

Fraction of organic carbon (in soil)	f _{oc}		fraction
Organic carbon partition coefficient	K _{oc}		l/kg

GI average, uncontaminated samples
86

Entry for ionic organic chemicals (option)

Sorption coefficient for neutral species	K _{oc,n}		l/kg
Sorption coefficient for ionised species	K _{oc,i}		l/kg
pH value	pH		pH units
Acid dissociation constant	pK _a		
Fraction of organic carbon (in soil)	f _{oc}		fraction

Soil water partition coefficient used in Level Assessment	K _d	9.90E+00	l/kg	Specified value
---	----------------	----------	------	-----------------

Level 1 Remedial Target

Level 1 Remedial Target	2.11E+01	mg/kg	(for comparison with soil analyses)
	or		
	2.078719763	mg/l	(for comparison with leachate test results)

Site being assessed:	NGET Tottenham
Completed by:	M Craske
Date:	27-Oct-23
Version:	x.xx

Remedial Targets Worksheet , Release 3.2

Level 3 - Soil

See Note



Input Parameters	Variable	Value	Unit	Source
Contaminant		Total Cyanide		from Level 1
Target Concentration	C _T	0.05	mg/l	from Level 1
Dilution Factor	DF	2.37E+00		from Level 2

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

Ogata Banks	Equations in HRA publication
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Select nature of decay rate (click on brown cell below, then on pull-down menu)

Approach for simulating degradation of pollutants:

Apply degradation rate to dissolved pollutants only

Variable	Value	Unit	Source of parameter value
Soil leachate concentration as mg/l			
Enter source concentration	0.1	mg/l	
Enter soil leachate concentration			
Half life for degradation of contaminant in water	t _{1/2}	3.65E+02 days	80
Calculated decay rate	λ	1.90E-03 days ⁻¹	calculated
Width of plume in aquifer at source	Sz	2.50E+02 m	from Level 2
Plume thickness in aquifer at source	Sy	2.54E+00 m	from Level 2
Bulk density of aquifer materials	ρ	1.80E+00 g/cm ³	Literature estimate for RTD
Effective porosity of aquifer	n	2.00E-01 fraction	Literature estimate for RTD
Hydraulic gradient	i	3.46E-03 fraction	from Level 2 (adjusted)
Hydraulic conductivity of saturated aquifer	K	1.00E+01 m/d	from Level 2
Distance (lateral) to compliance point perpendicular to flow direction	x	3.00E+01 m	Default for aquifer protection
Distance (depth) to compliance point perpendicular to flow direction	z		default condition
Time since pollutant entered groundwater	t	9.99E+99 days	default condition
Parameters values determined from options			
Partition coefficient	Kd	9.90E+00 l/kg	see options
Longitudinal dispersivity	ax	3.000 m	see options
Transverse dispersivity	az	0.300 m	see options
Vertical dispersivity	ay	0.000 m	see options

Parameter values should be checked against Level 1 and 2

Calculated Parameters

Variable			
Groundwater flow velocity	v	1.73E-01 m/d	
Retardation factor	Rf	9.01E+01 fraction	
Decay rate used	λ	2.11E-05 d ⁻¹	
Hydraulic gradient used in aquifer flow down-gradient	i	3.46E-03 fraction	
Rate of contaminant flow due to retardation	u	1.92E-03 m/d	
Ratio of Compliance Point to Source Concentration	C _{ED} /C ₀	7.27E-01 fraction	
Attenuation factor (C ₀ /C _{ED})	AF	1.38E+00 fraction	
Soil leachate concentration	Co	1.00E-01	

Remedial Targets

Level 3 Remedial Target	1.63E-01 mg/l		For comparison with measured pore water concentration.
Ogata Banks	or		This assumes Level 1 Remedial Target is based on Target Concentration.
	1.65E+00 mg/kg		For comparison with measured soil concentration. This
Distance to compliance point	30 m		assumes Level 1 Remedial Target calculated from soil-water partitioning equation.
Ratio of Compliance Point to Source Concentration	C _{ED} /C ₀	7.27E-01 fraction	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

Enter method of defining partition co-efficient (using pull down list)

User specified value for partition coefficient

Entry if specify partition coefficient (option)

Soil water partition coefficient Kd 9.90E+00 l/kg

Entry for non-polar organic chemicals (option)

Fraction of organic carbon in aquifer foc fraction

Organic carbon partition coefficient Koc 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

Fraction of organic carbon in aquifer foc fraction

Soil water partition coefficient Kd 9.90E+00 l/kg

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

User defined values for dispersivity

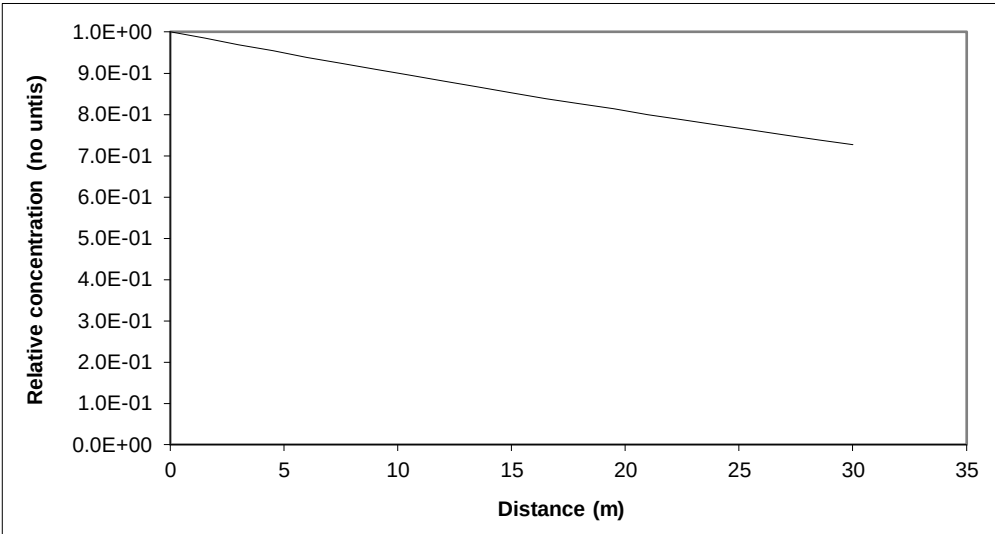
	Enter value	Calc value	Xu & Eckstein
Longitudinal dispersivity ax	3.00E+00	3.00E+00	2.13E+00 m
Transverse dispersivity az	3.00E-01	3.00E-01	2.13E-01 m
Vertical dispersivity ay	1.00E-99	3.00E-02	2.13E-02 m

Note values of dispersivity must be > 0

Xu & Eckstein (1995) report ax = 0.83(log₁₀x)^{2.414}; az = ax/10, ay = ax/100 are assumed

Note

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



Note: 'Relative concentration' is the ratio of calculated concentration at a given position compared to the source concentration. The calculations assume plume disperses from the top of the aquifer. An alternative solution assuming the centre of the plume is located at the mid-depth of the aquifer is presented in the calculation sheets.

Calculated (relative) concentrations for distance-concentration graph

Ogata Banks

From calculation sheet

Distance	Relative concentration (No units)	Concentration mg/l
0	1.0E+00	4.21E-02
1.5	9.84E-01	4.15E-02
3.0	9.69E-01	4.08E-02
4.5	9.53E-01	4.02E-02
6.0	9.38E-01	3.95E-02
7.5	9.23E-01	3.89E-02
9.0	9.09E-01	3.83E-02
10.5	8.94E-01	3.77E-02
12.0	8.80E-01	3.71E-02
13.5	8.66E-01	3.65E-02
15.0	8.52E-01	3.59E-02
16.5	8.39E-01	3.53E-02
18.0	8.26E-01	3.48E-02
19.5	8.12E-01	3.42E-02
21.0	8.00E-01	3.37E-02
22.5	7.87E-01	3.32E-02
24.0	7.74E-01	3.26E-02
25.5	7.62E-01	3.21E-02
27.0	7.50E-01	3.16E-02
28.5	7.38E-01	3.11E-02
30.0	7.27E-01	3.06E-02

This sheet calculates the Level 3 remedial target for soils(mg/kg) or for pore water (mg/l), based on the distance to the receptor or compliance located down hydraulic gradient of the source Three solution methods are included, the preferred option is Ogata Banks.By setting a long travel time (e.g. 9E99) it will give the steady state solution, which should always be used when calculating remedial targets.

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 3 remedial target to determine the need for further action.

Note if contaminant is not subject to first order degradation, then set half life as 9.9E+99.

Site being assessed:	NGET Tottenham
Completed by:	M Craske
Date:	#####
Version:	x.xx

R&D Publication 20 Remedial Targets Worksheet, Release 3.2

Level 3 - Groundwater

See Note

Input Parameters (using pull down menu)

Contaminant	Total Cyanide	from Level 1
Target Concentration	C _T 5.00E-02	mg/l from Level 1

Ogata Banks

Equations in HRA publication

Approach for simulating vertical dispersion:

Simulate vertical dispersion in 1 direction

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

Approach for simulating degradation of pollutants:

Apply degradation rate to dissolved pollutants only

Initial contaminant concentration in groundwater at plume core	C ₀	1.00E+00	mg/l	Source of parameter value
Half life for degradation of contaminant in water	t _{1/2}	3.65E+02	days	Based on site data
Calculated decay rate	λ	1.90E-03	days ⁻¹	
Width of plume in aquifer at source (perpendicular to flow)	Sz	2.50E+02	m	
Plume thickness at source	Sy	2.54E+00	m	
Saturated aquifer thickness	da	2.54E+00	m	Average thickness of Kempton Park Grave
Bulk density of aquifer materials	ρ	1.80E+00	g/cm ³	Literature estimate for RTD
Effective porosity of aquifer	n	2.00E-01	fraction	Literature estimate for RTD
Hydraulic gradient	i	2.00E-03	fraction	Based on average of site-specific GW measurements (SSE groundwater flow) - 0.0005 - 0.002 between
Hydraulic conductivity of aquifer	K	1.00E+01	m/d	WP 2013 value for KPG
Distance to compliance point	x	3.00E+01	m	Longitudinal dispersivity
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	Transverse dispersivity
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	Vertical dispersivity
Time since pollutant entered groundwater	t	9.99E+99	days	Note values of dispersivity must be > 0
Parameters values determined from options				For calculated value, assumes ax = 0.1 * x, az = 0.01 * x, ay = 0.001 * x
Partition coefficient	Kd	9.90E+00	l/kg	Xu & Eckstein (1995) report ax = 0.83(log ₁₀ x) ^{2.414} ; az = ax/10, ay = ax/100 are assumed
Longitudinal dispersivity	ax	3.00E+00	m	
Transverse dispersivity	az	3.00E-01	m	
Vertical dispersivity	ay	1.00E-99	m	

Calculated Parameters

Groundwater flow velocity	v	1.00E-01	m/d
Retardation factor	Rf	9.01E+01	fraction
Decay rate used	λ	2.11E-05	d ⁻¹
Rate of contaminant flow due to retardation	u	1.11E-03	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C _{ED}	5.82E-01	mg/l
Attenuation factor (one way vertical dispersion, CO/CED)	AF	1.72E+00	

Remedial Targets

Remedial Target	8.58E-02	mg/l	For comparison with measured groundwater concentration.
Ogata Banks			
Distance to compliance point	30	m	
Concentration of contaminant at compliance point after	C _{ED} /C ₀	5.82E-01	mg/l
		1.0E+100	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)

User specified value for partition coefficient

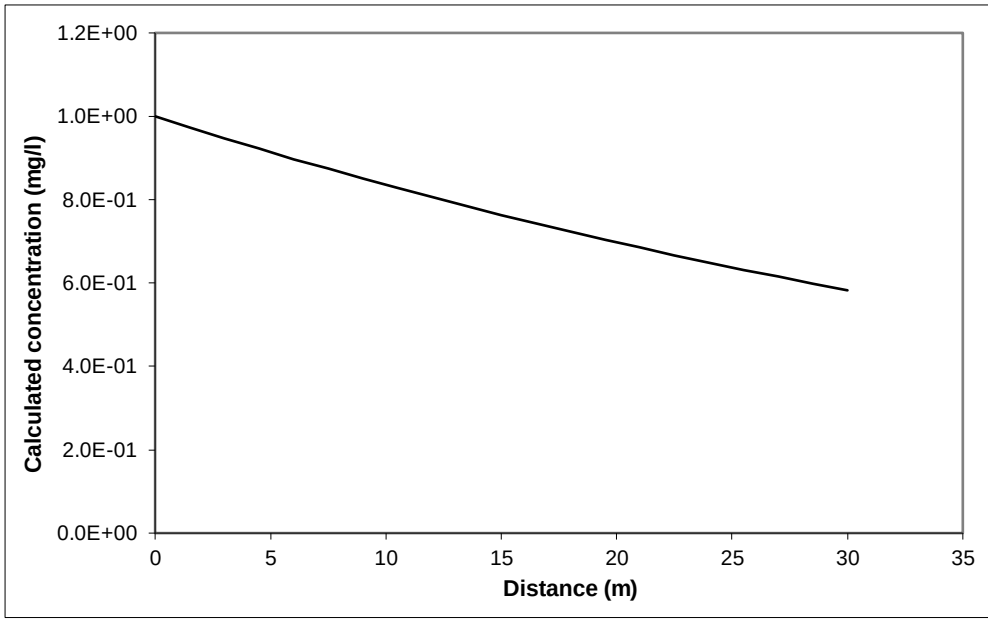
Entry if specify partition coefficient (option)		
Soil water partition coefficient	Kd	9.90E+00 l/kg
Entry for non-polar organic chemicals (option)		
Fraction of organic carbon in aquifer	foc	fraction
Organic carbon partition coefficient	Koc	l/kg
Entry for ionic organic chemicals (option)		
Sorption coefficient 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	
Fraction of organic carbon in aquifer	foc	fraction
Soil water partition coefficient	Kd	9.90E+00 l/kg

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

User defined values for dispersivity

Longitudinal dispersivity	ax	3.00E+00	3.00E+00	2.13E+00	m
Transverse dispersivity	az	3.00E-01	3.00E-01	2.13E-01	m
Vertical dispersivity	ay	1.00E-99	3.00E-02	2.13E-02	

Note values of dispersivity must be > 0
For calculated value, assumes ax = 0.1 * x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report ax = 0.83(log₁₀x)^{2.414} ; az = ax/10, ay = ax/100 are assumed



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

Note

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

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

The measured groundwater concentration should be compared with the Level 3 remedial target to determine the need for further action. Note if contaminant is not subject to first order degradation, then set half life as 9.0E+99.

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

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration
	mg/l
0	1.0E+00
1.5	9.73E-01
3.0	9.47E-01
4.5	9.22E-01
6.0	8.98E-01
7.5	8.74E-01
9.0	8.50E-01
10.5	8.28E-01
12.0	8.06E-01
13.5	7.84E-01
15.0	7.63E-01
16.5	7.43E-01
18.0	7.23E-01
19.5	7.04E-01
21.0	6.85E-01
22.5	6.67E-01
24.0	6.49E-01
25.5	6.32E-01
27.0	6.15E-01
28.5	5.98E-01
30.0	5.82E-01

Appendix E. Level 3 Screening

E.1. Baseline



Assessment Criteria :		Manual SSAC															
CaCO (mg/l):		0.00		pH		0.00											
Calcium (mg/l):		0.00		DOC (mg/l)		0.00		Catchment area: Avon/Hants									
Constituents	Unit	Limit of Detection	Generic Assessment Criteria	Number of Samples	Minimum Value	Maximum Value	Number of Exceedences	Locations of Exceedences									
									Location								
									Sample ID								
									Depth								
									Date								
Strata		MG		MG		MG		MG		ALV		ALV					
Zone		Onsite/Dry		Onsite/Dry		Onsite/Dry		Onsite/Dry		Onsite/Dry		Onsite/Dry					
Ammoniacal Nitrogen as NH4		mg/l	<0.03	1.2420397	5	<0.05	2.4	2	BH23-04; BH23-05								
Total Cyanide		mg/l	<0.005	2.078719763	5	<0.05	0.15	0									
Chloride		mg/l	<0.3	1046.138823	5	0.7	20	0									
Metals																	
Dissolved Lead		mg/l	<0.0004	0.037158851	5	<0.0004	0.0042	0									
Organics																	
Naphthalene		mg/l	<0.000014	0.133863705	5	<0.000014	0.077	0									
Anthracene		mg/l	<0.000013	0.000559009	5	<0.000013	0.00029	0									
Fluoranthene		mg/l	<0.000012	3.56772E-05	5	<0.000012	0.013	2	BH12; BH23-05								
Benzo(a)pyrene		mg/l	<0.000016	7.55282E-07	5	<0.000016	0.00217	1	BH12								
Benzene		mg/l	<0.001	0.008808843	5	<0.001	1.9	1	BH23-04								
Ethylbenzene		mg/l	<0.002	0.29804784	5	<0.001	0.017	0									
Phenol		mg/l	<0.0005	71.7375823	5	<0.0005	0.13	0									

[illegible]

Manual SSAC																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																														
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Constituents	Unit	Limit of Detection	Generic Assessment Criteria	Number of Samples	Minimum Value	Maximum Value	Number of Exceedances	Locations of Exceedances																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																						
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3	07/06/2023	06/07/2023	14/02/2013	27/02/2013	11/05/2023	07/06/2023	06/07/2023	14/02/2013	27/02/2013	11/05/2023	07/06/2023	06/07/2023	14/02/2013	27/02/2013	11/05/2023	07/06/2023	06/07/2023	14/02/2013	27/02/2013	11/05/2023	07/06/2023	06/07/2023	14/02/2013	27/02/2013	11/05/2023	07/06/2023	06/07/2023	14/02/2013	27/02/2013	11/05/2023	07/06/2023	06/07/2023	14/02/2013	27/02/2013	11/05/2023	07/06/2023	06/07/2023	14/02/2013	27/02/2013	11/05/2023	07/06/2023	06/07/2023	14/02/2013	27/02/2013	11/05/2023	07/06/2023	06/07/2023	14/02/2013	27/02/2013	11/05/2023	07/06/2023	06/07/2023	14/02/2013	27/02/2013	11/05/2023	07/06/2023	06/07/2023	14/02/2013	27/02/2013	11/05/2023	07/06/2023	06/07/2023	14/02/2013	27/02/2013	11/05/2023	07/06/2023	06/07/2023	14/02/2013	27/02/2013	11/05/2023	07/06/2023	06/07/2023	14/02/2013	27/02/2013	11/05/2023	07/06/2023	06/07/2023	14/02/2013	27/02/2013	11/05/2023	07/06/2023	06/07/2023	14/02/2013	27/02/2013	11/05/2023	07/06/2023	06/07/2023	14/02/2013	27/02/2013	11/05/2023	07/06/2023	06/07/2023	14/02/2013	27/02/2013	11/05/2023	07/06/2023	06/07/2023	14/02/2013	27/02/2013	11/05/2023	07/06/2023	06/07/2023	14/02/2013	27/02/2013	11/05/2023	07/06/2023	06/07/2023	14/02/2013	27/02/2013	11/05/2023	07/06/2023	06/07/2023	14/02/2013	27/02/2013	11/05/2023	07/06/2023	06/07/2023	14/02/2013	27/02/2013	11/05/2023	07/06/2023	06/07/2023	14/02/2013	27/02/2013	11/05/2023	07/06/2023	06/07/2023	14/02/2013	27/02/2013	11/05/2023	07/06/2023	06/07/2023	14/02/2013	27/02/2013	11/05/2023	07/06/2023	06/07/2023	14/02/2013	27/02/2013	11/05/2023	07/06/2023	06/07/2023	14/02/2013	27/02/2013	11/05/2023

Level 4 Screening

F.1. Baseline

Assessment Criteria :		Manual SSAC																								
☐ Use MRL Values?																										
Constituent	Unit	Limit of Detection	Generic Assessment Criteria	Number of Samples	Minimum Value	Maximum Value	Number of Exceedances	Locations of Exceedances	Strata	Zone	Location															
											Sample ID															
											Depth															
											Date															
											Onsite / Unsat On															

Manual SSAC																																										
Assessment Criteria :		CaCO (mg/l): 0.00		pH 0.00																																						
		Calcium (mg/l): 0.00		DOC (mg/l) 0.00		Catchment area: Avon/Hants																																				
Constituents	Unit	Limit of Detection	Generic Assessment Criteria	Number of Samples	Minimum Value	Maximum Value	Number of Exceedances	Location																																		
								Sample ID	BH11	BH11	BH11	BH11	BH12	BH12	BH12	BH12	BH12-01	BH12-02D	BH12-02D	BH12-03	BH12-04	BH12-04	BH12-04	BH12-04	BH12-04	BH12-04	BH12-05	BH12-05	BH12-05	BH12-05	BH12-05	BH12-06	BH12-06	BH12-06	BH12-06	BH23-03	BH23-04	BH23-04	BH23-04	BH23-05	WS12-01	WS12-01
								Depth			4.0m	4.00m			6.00m	6.00m	6m	3m	BH12-01	BH12-02D	BH12-02D		5.0m	5m	5m			5.00m	6m	6m		5.50m	5.5m			0.8m	3.0m	4.00m	4m	BH23-05	WS12-01	WS12-01
								Date	20/05/2013	28/05/2013	10/05/2023	07/06/2023	20/05/2013	28/05/2013	11/05/2023	07/06/2023	06/07/2023	08/06/2023	14/02/2013	27/02/2013	14/02/2013	10/05/2023	08/06/2023	06/07/2023	14/02/2013	27/02/2013	11/05/2023	08/06/2023	06/07/2023	14/02/2013	28/02/2013	07/06/2023	04/07/2023	14/02/2013	28/02/2013	10/05/2023	10/05/2023	07/06/2023	06/07/2023	10/05/2023	11/05/2023	06/07/2023
								Strata	RTD	RTD	RTD	RTD	RTD	RTD	RTD	RTD	RTD	MG/RTD	ALV/RTD/LC	ALV/RTD/LC	ALV/RTD/LC	ALV/RTD/LC	ALV/RTD/LC	ALV/RTD/LC	ALV/RTD/LC	ALV/RTD/LC	ALV/RTD/LC	ALV/RTD/LC	ALV/RTD/LC	ALV/RTD/LC	ALV/RTD/LC	ALV/RTD/LC	ALV/RTD/LC	ALV/RTD/LC	ALV/RTD/LC	MG	MG	MG	MG	MG	MG	MG
Locations of Exceedances																																										
Zone																																										
Ammoniacal Nitrogen as NH4								38.03 53.99 31 0.16 31.94 0.68 18 25 33 2.04 17.19 86.9 20 23 27 34.53 41.27 5.6 6.3 7.6 24.51 24.67 5.5 5.4 7.63 7.21 1.5 92 1.4 110 0.59 45 64																																		
Total Cyanide Chloride								0.096 0.186 <0.05 <0.05 0.283 0.01 0.4 <0.05 0.34 0.02 0.059 0.227 <0.05 0.06 0.12 0.163 0.132 0.12 0.07 0.1 0.103 0.097 <0.05 <0.05 0.129 0.177 0.15 0.97 <0.05 0.9 1.3 0.53 0.57																																		
BOD5								348.7 302.3 77 78 273.6 25.1 1000 860 820 201.7 364.3 160 160 160 150 347.6 333.5 220 200 210 267.3 276.5 180 190 172.6 156.9 21 62 61 62 21 280 260																																		
PAH MS																																										
Naphthalene								11.01729 1.04926 0.31 <0.0001 0.90838 0.3805 <0.0001 0.038 0.047 98 0.34992 2.37346 30.25784 0.0071 0.2 0.021 0.016 0.03118 <0.0001 <0.0001 <0.0001 0.00063 <0.000014 0.0028 <0.0001 0.05523 0.01189 <0.0001 0.034 0.2 0.047 0.13 0.66																																		
Anthracene								0.14432 0.00289 <0.0001 <0.0001 0.00145 0.00046 <0.0001 <0.0001 <0.0001 5.5 0.0017 0.00331 0.16777 <0.0001 0.0039 0.00069 0.00242 0.0017 <0.0001 <0.0001 <0.0001 0.00057 <0.000013 <0.0001 <0.0001 0.00076 0.00024 <0.0001 <0.0001 0.002 <0.0001 <0.0001 0.0099																																		
Fluoranthene								0.1278 0.00301 <0.0001 <0.0001 0.00042 0.00005 <0.0001 <0.0001 <0.0001 4.9 <0.0012 0.00099 0.1292 <0.0001 <0.0001 <0.0001 0.00151 0.00079 <0.0001 <0.0001 <0.0001 0.00022 <0.000012 <0.0001 <0.0001 0.00049 0.00015 <0.0001 0.0019 0.0079 0.00065 <0.0001 0.0087																																		
Benzo(a)pyrene								0.06516 0.00071 <0.0001 <0.0001 <0.000016 <0.000016 <0.0001 <0.0001 <0.0001 <0.0001 <0.0016 <0.00032 0.0374 <0.0001 <0.0001 <0.0001 0.00003 <0.00032 <0.0001 <0.0001 <0.0001 <0.000016 <0.000016 <0.0001 <0.0001 <0.000016 <0.000016 <0.0001 <0.0001 <0.0001 <0.0001 <0.0001 <0.0001																																		
Benzene								68.2 6.2043 5.6 <0.001 18.8443 4.9479 <0.001 5 <0.001 110 3.084 27.537 - <0.001 <0.001 7.1 25.656 12.353 0.0031 <0.001 0.0031 4.521 <0.001 0.0077 <0.001 <0.001 <0.001 0.004 32 55 67 0.0023 26 12																																		
Ethylbenzene								0.75 0.1871 0.61 <0.001 3.9405 0.3252 <0.001 0.085 <0.001 4.5 0.066 0.294 - <0.001 <0.001 <0.001 0.492 0.356 <0.001 <0.001 <0.001 0.036 <0.002 <0.001 <0.001 <0.002 <0.002 <0.001 <0.001 <0.002 <0.002 <0.001 <0.001 <0.002 <0.002 <0.001 <0.001 <0.002 <0.002																																		
Phenol								0.2522 0.0757 0.064 <0.005 0.2501 0.1307 0.006 0.049 0.005 12 0.0153 1.3121 0.1832 1.7 0.037 <0.001 <0.001 0.018 0.2019 0.1872 <0.005 <0.005 <0.005 0.0325 <0.005 <0.005 0.0013 0.0179 <0.005 4 3.8 4.2 0.006 0.25 0.23																																		

[illegible]

Appendix G. Minutes from Meeting with AtkinsRéalis and the Environment Agency

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MEETING NOTES

Stage 3a of The National Grid (North London Reinforcement Project)

SUBJECT:	MEETING PLACE:	DATE AND TIME:	MINUTES BY:
Discharge of Requirement 11 Contaminated Land and Groundwater	Teams	3 p.m., 14/12/23	KL / LI

Environment Agency – EA

AtkinsRéalis – AR

Attendants:

- Lloyd, George (GL) – EA
- Devonshire, Rob (RD) – EA
- Durrant, Clay (CD) – EA
- Liu, Karen Hanyang (KHL) – AR
- Ilyas, Lauren (LI) – AR
- Duncan Cartwright (DC) – AR
- Bristow, Katie (KB) – AR

Next steps

- AtkinsRéalis to confirm and communicate program of works and Development Consent Order (DCO) expiry date;
- AtkinsRéalis to revise detailed quantitative risk assessment (DQRA) to include the full removal of the slab;
- AtkinsRéalis to finalise phase 1 remediation strategy with EA’s comments in mind;
- EA to confirm capacity for document review in January; and
- AtkinsRéalis to submit documents for DCO submission in February2024. These shall be sent to the EA for comment via the statutory process.

NOTE TO RECIPIENTS:
These meeting notes record AtkinsRéalis understanding of the meeting and intended actions arising therefrom. Your agreement that the notes form a true record of the discussion will be assumed unless adverse comments are received in writing within five days of receipt.

MEETING NOTES

Site context

- Meeting set up to kickstart engagement process with between AtkinsRéalis and EA, that is explicitly detailed in Requirement 11 of the DCO;
- Flagged that consultation with EA is required at each stage;
- Going through stage 3a preparatory works, stage 3b construction works – DCO expires next year, therefore seeking partial discharge of Requirement 11 (Contaminated Land) to start demolition and Phase 1 remediation works in 2024;
- Site surfaced in concrete with no areas of vegetation. The geology comprises Made Ground, Alluvium, Kempton Park Gravels, underlain by London Clay. Pymmes Brook 30m to the east.
- Going through site history
 - Range of historical developmental across the site – engineering works, depot and currently a building and plumbers merchant, and steel fabricators.
 - Infilled ponds – south and central (no. 10) was a former sludge pit.

RD: Note that material in the infilled ponds could be regarded as controlled waste and would need to be controlled with waste legislation. It would not be possible to excavate material and reuse on site, would need to excavate and recover under an environmental permit, or excavate the material and recover elsewhere. **This is something to consider.**

LI: At this stage, our intention is to treat the impacted material and non-aqueous phase liquid (NAPL) in the infilled pond in-situ. We have no plans to excavate this material and re-use it at the site.

Hydrogeological Conceptual Site Model

KB: Pymmes Brook is considered to be a receptor.

CD: Would agree with this.

KB: Due to impact identified in the Secondary A Aquifer, the River Terrace Deposits have been assumed to be a pathway rather than a receptor.

RD: The Secondary A Aquifer should be a receptor.

CD: May be worth waiting for the wording of the report, but it may need to be altered.

KB: The Secondary A Aquifer will be added as a receptor to ensure completeness to the report; however, it is acknowledged that this will not change the assessment. It should be noted that the Meridian Water Assessment (the site to the north) did not include the Secondary A Aquifer as a receptor.

DQRA Modelling Approach

KB: Level 3 and 4 modelled and discussed in the report. Level 3 compliance point of 30 m used in assessment. No aquifer testing carried out, a 10 m/d hydraulic conductivity assumed for the River Terrace Deposits (RTD).

MEETING NOTES

CD: This premise for the modelling is reasonable.

KB: Taking a more conservative approach, we could have used 50m but used RTD as receptor. Modifying our assessment would not significantly change the outcome of the DQRA.

RD: Query on groundwater level data publicly available from the Meridian Water site (site to the north) to define hydraulic gradient. Suggest it could be used in assessment. NOTE: this was considered in the assessment – the value they have used is based on literature values.

CD: Expressed concerns about the use of a Level 4 assessment leaving out critical information and impacting final remediation solutions. The use of Level 4 could be used to just remove certain features, receptors (dilution in the river etc.), but used in a robust methodology is acceptable.

KB: Both Levels 3 and 4 used in assessment as a comparison. With Level 4, a number of the organics are no longer a risk but the benzene still is. As such, use of the level 4 assessment does not modify the recommendations for remediation or the proposed scope.

CD: Place the risks into context in the report to help steer and target remediation effort within the realms of what is reasonably practical to do.

KB: This is why level 3 is fully analysed, and not just level 4. We wanted to put both into context in the report

DC: The same approach was taken with the Meridian Water site (site to the north), focussing on the Pymmes Brook as the relevant receptor, using level 4 to help define source zones which were then targeted for remediation. We are applying the same approach for this site.

DQRA Conclusions

DC: Dissolved phase exceedances seem to be close to where we have the identified NAPL, leads us to conclude that NAPL is going to be the target for remediation.

RD: Can the source areas be left in situ without being excavated?

LI: Yes, plans at this stage to deal with dense non aqueous phase liquid (DNAPL) are to keep backfilled material in situ and treat via recovery or injection. This is pending further investigation, likely pilot trials and a detailed options appraisal.

Remediation Strategy

- Phase 1 – remediation
 - Excavations of cable corridors;
 - Seeking partial discharge of Requirement 11 sub-requirements that are needed, so the buildings can be demolished to allow preparatory works to continue; and
 - Re-use soil and aggregate generated from slab removal in line with Wrap Quality Protocol and waste guidance.

MEETING NOTES

RD: Query on if there will be any importation of soils or material under Definition of Waste Code of Practice (DoWCoP) or will material be re-used on site of origin only?

LI: Hoping for re-use of site-won material, depends on how much suitable aggregate can be created.

RD: Cannot use remediation target level for importation, need to show material level clean and naturally occurring under DoWCoP. It is therefore a lot easier to reuse on site.

LI: Planning to reuse as much as possible. The whole site is surfaced in concrete and this should generate sufficient materials to be reused for the cable corridors.

DC: The only other import source would be WRAP Protocol material – either clean naturally occurring or re use material on site, distinction between those two would have specific criteria for use appropriate to waste regulations.

RD: Advise to avoid environmental permitting at the moment, where possible.

DC: Phase 1 works in the north where there is no DNAPL works. Remedial works there will interact with DNAPL and should not create problems for stage 2 remediation works.

LI: We are removing materials that are impacted, the excavation will remove contamination from site and treat it.

▪ Phase 2 – Enablement

- Further intrusive investigation needed.
- Waiting for the whole slab to be removed, looking to do works in the north of site to delineate shallow contamination in the north. Boreholes are planned in the south of the site to delineate and define the DNAPL. This is required to design the remediation.
- Will need to carry out pilot trials to assess physical properties and recoverability of DNAPL, reduce uncertainties to enable design of Phase 2 remediation. We shall seek advice from EA throughout with more detailed design and options appraisal.

▪ Phase 2 – Remediation

- With the above in mind, design to address the rest of the PCLs and gross contamination, hoping what we have planned will allow us to put together a robust remediation.
- Reduce risk as much as possible.

CD: Slab being removed may open the site up to infiltration. Has there been consideration that this could mobilise contamination and how will this be managed?

KB: DQRA will include comments on this.

LI: It was our initial intention to leave the slab down until the remediation phases. There have been changes to the demolition plans and now we plan on removing the entire slab to facilitate the enablement phase further investigation as detailed earlier.

RD: Could techniques such as smooth rolling be incorporated to reduce infiltration?

MEETING NOTES

DC: Will look into that, thanks for raising – also need to look at long term risk and recovery for re-uses of the slabs.

RD: Double check if there are infiltration requirements in the DCO wording. Mainly to help us feel more comfortable with that aspect in terms of infiltration.

GL: There is no mention of it in the DCO.

RD: No waste destined for disposal should be stockpiled for 12 months. Treating material in situ in line with mobile treatment permit too. Ensure it is agreed and cannot be in place for more than 12 months, otherwise a site-based permit may be required.

LI: The timescales for delivery of this project mean that no material will be left on site for 12 months.

Programme of Works

CD: Is there a Gantt chart setting out programme of work – might be useful to share.

RD: What are the DCO expiry dates and how urgent is it.

DC: Exploring what does starting actually mean, what does it mean for us in terms of groundwater assessment and remediation works?

Put some milestones against these works, to be in a position where we're not chasing a DCO deadline, on site before expiry, focus on getting strategies agreed, will need to internally go back and confirm,

LI: Cables not being laid until 2025.

DC: AtkinsRéalis need to demonstrate that we have consulted with the EA before submission, to develop strategies that will be produced later in the year.

LI: Will confirm with our internal planning team to get a steer on what the local planning authority (LPA) requires from the EA.

AOB:

GL: To confirm that the team has capacity in the coming months to get started with review.

CD: Nothing here causing a great deal of concern. There is complex contamination but the methods of dealing with it exist and we do not see it being an issue. There should be ways to move it forward ease and I am feeling positive about this.

RD: My recommendation would be to avoid digging up the contamination, keep everything under ground. Deal with the DNAPL in situ.

Meeting Minutes

PROJECT NAME	Stage 3a of The National Grid (North London Reinforcement Project)	DATE	14/12/2023
REFERENCE	NE/2023/136505		
ATTENDEES	EA: George Lloyd, Clay Durrant, Rob Devonshire Applicant: Lauren Ilyas, Katie Bristow,		
MEETING SUBJECT	To discuss requirement the discharge of Requirement 11 1. Site Context and Proposed Development 2. Site Setting 3. Ground Investigations 4. Hydrogeological Conceptual Site Model 5. DQRA Modelling Approach 6. DQRA Conclusions 7. Proposed Remediation		

1	<u>Intro</u> Construction at the site in 2025 The scheme is NL Reinforcement Project. The scheme runs from Waltham Cross to Hackney to upgrade existing substations. Atkins Realis supporting National Grid with preparatory work for the site. <u>Site context</u> Stage 3A - preparatory work to demolish building onsite and undertake remediation to get the site suitable for use. 3B will be construction works. DCO expires next year (been in place since 2014). Looking to seek partial discharge of requirements to carry out demolition works. Site just to the south of Meridian Water, Pymmes Brook 30m to East Currently building and plumbing merchants and steel fabricators Previously been a bus depot - keep an eye out for this on planning docs. Ponds onsite that have been previously infilled contain impacted material and product, one was previously a sludge pit.
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2	RD: Infill pits - if they have been backfilled and the material is not chemically suitable for use it could be regarded as controlled waste and will need to be managed in line with the waste legislation. Would not be able to be excavated and used. Would need to be recovered under a permit or taken off site for disposal elsewhere.
3	<u>Evidence of contamination</u> Lots of contamination was found. Impacted made ground, superficial deposits and groundwater on site. Ponds on site show presence of DNAPL in center and south of site
4	<u>Hydrogeological Conceptual site model</u> Pymmes brook has been taken as a receptor. RD: Secondary Aquifer within the RTD would be a receptor. CD: May be worth waiting to see what the wording of the reports is. Wording may need to be altered
5	<u>DQRA Modelling approach</u> Level 3 and 4 used. Level 3 30m compliance point No aquifer testing has been conducted. 10m/d has been assumed for RTD. The shape of the site has created difficulty ascertaining the groundwater flow direction or flow gradient on site. CD/RD: Suggestion that Meridian water groundwater data is available publicly
6	<u>DQRA conclusions</u> <u>Level 3 conclusions:</u> Benzene exceedances associated with are observed gross contamination in RTD and made ground. Site wide ammonium <u>Level 4</u> The only thing that drops out is the organics, benzene does not drop out. Unlikely that there is an ammonium source on site, more likely from degradation of organics
7	<u>Proposed remediation</u> Deal with the dNAPL but leave the infill materials in situ. Phase 1 remediation > Phase 2 enablement> Phase 2 remediation Phase 1: demolition and then excavation in cable corridors to allow cables to be laid first then further investigation and remediation to follow.
8	<u>EA thoughts:</u> CD: Slab being removed may open the site up to infiltration. Has there been consideration that this could mobilise contamination and how will this be managed? KB: DQRA will include comments on this. RD: Could techniques such as smooth rolling be incorporated to reduce infiltration? No material should not be stockpiled on site for more than 12 months.

	Deployment cannot be in place for more than 12 months as well for the treatment.
9	Aiming to submit phase 1 remedial strategy and DQRA end of January. If preparatory work in 2024 is started, then the DCO requirements should be ok. Suggestion by RD to avoid excavating materials which will mean it does not become waste.
10	

ACTIONS	Action - Lauren to provide timeframes and deadlines - George to share minutes on letterhead - George to confirm capacity to review documents prior to LPA submission
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