Domenico Analytical Solute Transport Model	Management Option 1
LDEQ Risk Evaluation/Corrective Action Prog	
Revision date: 07/10/2002	T CIT
Run date: 10/16/2003	
Null date. 10/10/2003	
General assumptions:	
1. A single continuous source of one chemi	cal compound dissolved
in the groundwater. No NAPL.	car compound arbsorved
2. No initial groundwater contamination.	
3. Chemical compound is non-reactive.	
4. No biodegradation or retardation occuri	20
5. Groundwater flow is in one direction.	119.
6. Saturated zone is homogeneous and isotr	
7. Contaminant plume is a planar source sp	
laterally in two directions and vertica	
8. The point "X" is behind the point where	"X = v * time since spill".
9. Longitudinal, transverse, and vertical	groundwater dispersivities
are based on ASTM E 1739-95 example.	
10. The DAF is based on the estimated contain	minant concentration (Cxi)
at the center line of the plume.	
Example Calculation of the Groundwater Dilu	tion Attenuation Factor
Site-specific inputs:	
2000 (ft) = X = distance downgradient f	rom source.
5 (ft) = Sd = vertical depth of plum	
of affected groundwate.	r plume or the full
thickness of the ground	
Defaults:	
148 (ft) = Sw = groundwater plume widt	h nernendicular to
groundwater flow.	n perpendicular ec
groundwater from:	
30 (ft/yr) = Dv = K*i = Darcy groundw	ater velocity
0.36 (dimensionless) = 0 = soil porosit	
83.33333 (ft/yr) = Dv / O = v = linear Darc	
00.0000   (IC/YI)	y groundwater transport verocity.
200 (f+) = 7 + 0 1 = 7 - 7 1 1   7	anoundrator dispersionits
200 (ft) = $X * 0.1 = Ax = longitudinal$	
66.66667 (ft) = $Ax / 3 = Ay = transverse gr$	
10 (ft) = $Ax / 20 = Az = vertical grown$	undwater dispersivity.
1 (dimensionless) = Ri = retardation	
0 (yr-1) = Yi = first-order degradat	ion constant for constituent i.
Model equation:	
(Csi/Cxi) = DAF = 1/[EXP(X/(2*Ax) * (1-SQF)]	RT(1+(4*Yi*Ax*Ri/v))))
	) * Erf(Sd/(2*SQRT(Az*X)))]
= 440.0095 (dimensionless)	

			1			
		Managemer	nt Option	1 DF for	0.5 acre	
X (ft) = distance		(dimensionless)				
downgradient from						
source =	Sd	= 5 ft	10 ft	15 ft	20 ft	
0 - 50		1.5	1	1	1	
50 - 100		2.6	1.5	1.2	1.1	
100 - 150		4.1	2.1	1.6	1.3	
150 - 250		8.4	4.3	3	2.3	
250 - 500		29	15	9.8	7.4	
500 - 750		63	32	21	16	
750 - 1000		111	57	37	28	
1000 - 1250		173	86	58	43	
1250 - 1500		248	124	83	62	
1500 - 1750		337	169	113	84	
1750 - 2000		440	220	147	110	

LDEQ	nico	Analytical	Solute T	ransport	Model	Managemer	t Option	2	
D = '		c Evaluatio							
Kevi	sion	date: 07/1	0/2002						
Run	date	10/16/2003							
Gene	ral a	assumptions	:						
		ngle contin		ce of one	chemical	compound	dissolve	C	
		ne groundwa							
2.	No in	nitial grou	ndwater c	ontaminat	ion.				
3.	Chem	ical compou	nd is non	-reactive					
4.	Groun	ndwater flo	w is in o	ne direct	ion.				
5.	Satu	rated zone	is homoge	neous and	isotropi	С.			
		aminant plu	_		_		rally		
		nitely in t							
		direction.				_	=		
		point "X" i	s behind	the point	where "X	= v * ti:	me since	spill".	
		DAF is base							
		ne center l						·	
				_					
Two	possi	ible model	cases exi	st:					
(1)	_	plume's ve			is assum	ed to be	th∈		
		ckness of t							
		plume's ve	_			he full			
		s of the gr							
01120		01 0110 91		5 5 2 4 5 4 111 7					
Exam	mle (	Calculation	s of the	 Groundwat	er Diluti	on Attenu	ation Fac	toı	
	P-0 (						402011 240	001	
Site									
		(Default							
	ific	(Default							
		(Default value)							
inpu		value)	$(f+) = S_1$	y = ground	dwater nl:	me width	nernendi	cular to	
		value)	(ft) = Sv				perpendi	cular to	
		value)		ground	dwater fl	OW.			avtont
		value)		ground d = verti	dwater flocal depth	ow. of plume	(measure	d vertical	extent
		value)		ground d = verticon of af	dwater flocal depth	ow. of plume oundwater	(measured	d vertical	. extent
		value) 148	(ft) = So	ground d = vertion of after thicks	dwater flocal depth fected graness of the	ow. of plume oundwater he groundw	(measured plume or water stra	d vertical	extent
		value)  148  5	(ft) = So	ground d = vertic of af thick = thicknow	dwater flocal depth fected graness of the ess of graness of granes	ow. of plume oundwater ne groundwoundwater	(measured plume or water stratum.	d vertical the full atum).	extent
		value)  148  5	(ft) = So	ground d = vertic of af thick = thicknow	dwater flocal depth fected graness of the ess of graness of granes	ow. of plume oundwater ne groundwoundwater	(measured plume or water stratum.	d vertical the full atum).	. extent
		value)  148  5  10  2000	(ft) = So (ft) = H (ft) = X	ground d = vertion of after thicks = thicks = distance	dwater flocal depth fected graness of the cess of granes downgranes downgrane	ow. of plume oundwater ne groundv oundwater adient fro	(measured plume or water stratum.	d vertical the full atum).	. extent
		value)  148  5  10 2000	(ft) = So (ft) = H (ft) = X (ft/yr) =	ground d = vertion of af thick: = thicknote = distant	dwater flocal depth fected graness of the cess of granes downgranes i = Darcy	of plume oundwater he groundwater adient fro	(measured plume or water stratum. om source ter velocities)	d vertical the full atum).	. extent
		value)  148  5  10 2000  30 0.36	(ft) = So (ft) = H (ft) = X (ft/yr) = (dimension	ground d = vertic of af thick: = thickne = distane = Dv = K* onless) =	dwater flocal depth fected graness of the ce downgrate i = Darcy O = soil	of plume oundwater ne groundwater adient from groundwater groundwater groundwater porosity	(measured plume or water stratum. om source ter velocater stratum.	d vertical the full atum).	
		value)  148  5  10 2000	(ft) = So (ft) = H (ft) = X (ft/yr) = (dimension	ground d = vertic of af thick: = thickne = distane = Dv = K* onless) =	dwater flocal depth fected graness of the second granes of the second gr	of plume oundwater he groundwater adient from groundwater porosity ear Darcy	(measured plume or water stratum. om source ter velocater stratum.	d vertical the full atum).	
		148 5 10 2000 30 0.36 83.3333333	(ft) = So (ft) = H (ft) = X (ft/yr) = (dimensional (ft/yr) =	ground d = vertion of af thicks = thicks = distance = Dv = K* onless) = = Dv / O:	dwater flocal depth fected graness of the seas of granes of gr	of plume oundwater he groundwater adient from groundwater porosity ear Darcy ocity.	(measured plume or water stratum. om source ter velocity groundward or stratum.	d vertical the full atum).	
		value)  148  5  10 2000  30 0.36 83.3333333	(ft) = So (ft) = H (ft) = X (ft/yr) = (dimensional (ft/yr) = (ft) = Ax	ground d = vertic of af thicks = thickne = distane = Dv = K* onless) = = Dv / O	dwater flocal depth fected graness of the seas of granes o	ow.  of plume oundwater he groundwater adient fro groundwat porosity ear Darcy ocity. roundwater	(measured plume or water stratum. om source ter velocity groundward r dispers	d vertical the full atum).  ity.  ter transgrivity.	
		value)  148  5  2000  30 0.36 83.3333333  200 66.6666667	(ft) = So (ft) = H (ft) = X (ft/yr) = (dimensional (ft/yr) = (ft) = As (ft) = As	ground d = vertic of af thick: = thickne = distane = Dv = K* onless) = = Dv / O:  x = longing y = trans	dwater flocal depth fected graness of the sess of granes of the sess of	ow.  of plume oundwater ne groundwater adient fro groundwate porosity ear Darcy ocity. roundwater undwater	(measured plume or water stratum. om source ter velocity groundward dispersive dispersive plume or dispersive dispersive plume or dispersive dispersive plume or dispersive dispersive plume or dispersive dispersive dispersive plume or dispersive dispersive dispersive dispersive plume or dispersive	d vertical the full atum).  ity.  ter transp ivity. ity.	
_		value)  148  5  2000  30 0.36 83.3333333  200 66.6666667	(ft) = So (ft) = H (ft) = X (ft/yr) = (dimensional (ft/yr) = (ft) = Ax	ground d = vertic of af thick: = thickne = distane = Dv = K* onless) = = Dv / O:  x = longing y = trans	dwater flocal depth fected graness of the sess of granes of the sess of	ow.  of plume oundwater ne groundwater adient fro groundwate porosity ear Darcy ocity. roundwater undwater	(measured plume or water stratum. om source ter velocity groundward dispersive dispersive plume or dispersive dispersive plume or dispersive dispersive plume or dispersive dispersive plume or dispersive dispersive dispersive plume or dispersive dispersive dispersive dispersive plume or dispersive	d vertical the full atum).  ity.  ter transp ivity. ity.	
-		value)  148  5  10 2000  30 0.36 83.3333333  200 66.6666667 10	(ft) = So (ft) = H (ft) = X (ft/yr) = (dimensional (ft/yr) = (ft) = Ax (ft) = Ax	ground d = vertic of af thicks = thickne = distance = Dv = K* onless) = = Dv / O = constance = constan	dwater flocal depth fected graness of the seas of grane downgrane i = Darcy O = soil = v = lin tudinal grane ground groun	of plume oundwater ne groundwater adient from groundwater porosity ear Darcy ocity. roundwater adwater distance of the control	(measured plume or water stratum. om source ter velocing groundward dispersivity spersivity	d vertical the full atum).  ity.  ter transpivity.  ity.	port
-		value)  148  5  10 2000  30 0.36 83.3333333  200 66.6666667 10	(ft) = So (ft) = H (ft) = X (ft/yr) = (dimensional (ft/yr) = (ft) = As (ft) = As (ft) = As (dimensional (dimensional (dimensiona) (dimensiona) (dimensional (dimensiona) (dimensional (dimensiona) (dimension	ground d = vertic of af thicks = thickne = distance = Dv = K* onless) = = Dv / O = constance = vertic onless) = = vertic onless) =	dwater flocal depth fected graness of the seas of granes of granes of granes of the seas of th	of plume oundwater he groundwater adient from groundwater porosity ear Darcy ocity. Toundwater adwater disagradation	(measured plume or water stratum. om source ter velocity groundward dispersivity spersivity factor of	d vertical the full atum).  ity.  ity.  ter transprivity.  ity.  y.  constitue	port
-		value)  148  5  10 2000  30 0.36 83.3333333  200 66.6666667 10	(ft) = So (ft) = H (ft) = X (ft/yr) = (dimensional (ft/yr) = (ft) = Ax (ft) = Ax	ground d = vertic of af thicks = thicks = distance = Dv = K* onless) = = Dv / O: x = longing y = trans z = vertic onless) = Yi = fir	dwater flocal depth fected graness of the seas of granes of granes of granes of the seas of th	of plume oundwater he groundwater adient from groundwater porosity ear Darcy ocity. Toundwater dwater distantion indegradation indegradation	(measured plume or water stratum. om source ter velocity groundward dispersivity spersivity factor of	d vertical the full atum).  ity.  ity.  ter transprivity.  ity.  y.  constitue	port

44.								
	plume's ve							
	thickness							
I	g in the ve			_		Erf term		
containir	ng Sd is rem	moved from	n the Dom	enico mod	el.			
	ation when							
(Csi/Cxi)	= DAF =				1+(4*Yi*A:	x*Ri/v)))	)	
		* Erf(Sw/						
	=	8.776006	(dimension	onless)				
<b>(2)</b> The	plume's ver	rtical der	oth is le	ss than t	he full			
thickness	of the gro	oundwater	stratum.	The dis	tance ove	r which		
vertical	spreading o	can occur	is limit	ed to the	thicknes	s of th€		
groundwat	ter stratum	. The ho	rizontal	distance	over whic	h vertica	]	
spreading	g can occur	is approx	kimated b	y Xp = ((	H-Sd)^2)/	Az.		
Xp equati	on:							
2.5	(ft) = Xp =	= (H-Sd)^2	2/Az					
2000	(ft) = X =	distance	downgrad	ient from	source			
Model equ	lation when	X < or =	Xp:					
	= DAF =			(1-SQRT (	1+(4*Yi*A	x*Ri/v)))	)	
					Erf(Sd/(2			
	=	440.0095	(dimension	onless)				
Model equ	lation when	X > Xp:						
(Csi/Cxi)	= DAF =	1/[EXP(X/	(2*Ax) *	(1-SQRT(	1+(4*Yi*A	x*Ri/v)))	)	
		* Erf(Sw/	(4*SQRT(A	Ay*X))) *	Erf(Sd/(2	2*SQRT(Az	*Xp)))]	
	=	16.86073	(dimension	onless)				
ŗ.	1							