1994

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November 1994

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Acknowledgments

The author is indebted to Jason Garner and Sreenivas Kesaraju for their assistance in performing many of the computer simulations which were required for the modeling in this report.

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Chapter I. Development of a Generic Pathway System (GPS)

1-1. Introduction

Efforts to base soil cleanup standards on human health risks from contaminated soil often desire to incorporate some of the physical, chemical and biological processes occurring during contaminant migration. In general, these processes lead to reductions in contaminant concentration, hence a reduction in risks to human health, as distance from contaminated soil increases. In defining generic contaminant levels in soils, levels which are acceptable under a wide range of conditions, it can be very difficult to incorporate these processes because only a few site characteristics can be considered in the analysis and uncertainty in many others must be accommodated.

The focus of this report is identifying and quantifying in a generic way the processes which occur during contaminant migration, and then applying them to model the reduction in concentration which might occur during contaminant transport. Many aspects of contaminant behavior in natural systems must be considered in such an evaluation including: 1) contaminant chemistry; 2) contaminant reaction; and, 3) contaminant transport. The processes which appear to be most important to developing generic standards will be included in a model system, the generic pathway system (GPS), to describe petroleum constituent transport from underground storage tanks. The GPS presented here is based on a review of the literature and, as such, must still be validated with data from actual sites.

1-2. Contaminant Chemistry

In this analysis, contaminant chemistry will be described using equilibrium partitioning of individual organic compounds between soil solids, water and air. The extent to which a soil contaminant exists in phases which can migrate from contaminated soil, such as water or air, will determine its mobility. Contaminants which reside in the soil will, in general, not all leave the soil in response to a single infiltration event or volatilize instantly, but rather, will move into percolating fluid or partition into soil air in ratios which are specific to the contaminant and soil. Contaminant partitioning relationships are also important in contaminant migration. Contaminant association with stationary phases (e.g., the soil solid phase), reduces the rate of migration within a moving phase.

Equilibrium partitioning assumes that contaminant distribution between soil and moving phases is rapid in comparison to fluid transport and chemical reaction.

This is probably a good assumption for the neutral organic molecules which are of concern in many sites, and should be conservative with respect to the concentrations which would be predicted in the moving phase. Further, if the analysis is restricted to low concentrations of contaminants, linear partition relationships can be employed.

The distribution of a contaminant between solution and air can be described by a partition coefficient, in this case termed the Henry's constant:

$$H=\frac{P_a}{C_w} \tag{1}$$

where P_a is the partial pressure of the contaminant in the air phase and C_w is the concentration in the water phase. It is often useful to express the partitioning between phases as a ratio of concentrations (mass per unit volume of the phase). If the vapor concentration of the contaminant is ideal, the ratio can be expressed:

$$K_H=\frac{C_{air}}{C_w}=\frac{H}{RT} \tag{2}$$

The partition of the contaminant between soil and water can also be described using a linear partition coefficient. This seems to be a good approximation at low concentrations, e.g. half-solubility, of contaminant (Chiou et al., 1983), although certain types of geological materials can have nonlinear partition relationships (Weber et al., 1992). The quantity of contaminant which actually resides on the soil can then be expressed as a function of the concentration in the solution using:

$$C_s=K_D C_w \tag{3}$$

where: C_s is the concentration of contaminant in soil expressed as mass of contaminant per unit mass of dry soil (e.g., mg/kg); C_w is the concentration of contaminant in solution (e.g., mg/l); and K_D is the linear distribution coefficient (units depend on those selected for C_s and C_w, e.g., mg/kg/mg/l or l/kg).

Experimental measurements of contaminant distribution between soil and water have shown that the distribution coefficient (K_D) usually relates to the organic matter content of the soil (higher organic matter soils have larger K_D) and properties of the contaminant (less water-soluble organic contaminants have larger K_D). Using the organic carbon content of the soil as a measure of the organic matter content, a carbon-normalized distribution coefficient can be defined:

where f_{OC} is the mass fraction of the dry soil which is organic carbon, typical values for soil range from 0.05 down to 0.001 (representing 5% down to 0.1% organic carbon

$$K_{OC}=\frac{K_D}{f_{OC}} \quad (4)$$

by weight) and K_{OC} is the organic carbon-normalized distribution coefficient. K_{OC} has the same dimensions as K_D, but is often listed without units. In that case, the units are most likely l/kg or equivalently, cm^3/gm.

K_D for a contaminant in a soil can then be calculated using a K_{OC} obtained from literature compilations and the f_{OC} of the soil. Including the K_{OC} and f_{OC}, Equation 3 can be rewritten:

$$C_s=f_{OC}K_{OC}C_w \quad (5)$$

As can be seen from Equation 5, the concentration of contaminant on the soil is related to properties of the soil (f_{OC}), the compound (K_{OC}), and the solution (C_w). As Equation 5 is written, C_s is only that portion of the contaminant which is bound to the soil particles. In any soil system, other portions of the contaminant will also be present in the fluid and vapor phase.

The presence of a pure or mixed organic liquid (e.g., benzene or gasoline, respectively) in the system is an additional phase where the contaminant may reside. Distribution of the contaminant between an organic phase and an adjacent aqueous or vapor phase is described by the solubility or the vapor pressure of the compound, respectively. In the presence of mixed organic phases, the concentrations in air and water adjacent will not be those of the pure organic compounds, but will be most likely be lower (Lyman et al., 1991). To estimate the concentrations in the aqueous or air phases at equilibrium, the solubility or vapor pressure can be scaled by the mole fraction of the contaminant in the organic phase. Concentrations in water might also be increased over that described by their solubility in the presence of water-soluble organic compounds such as methanol (Poulsen et al., 1992). Because the focus of this analysis will be low concentrations of petroleum components in water and air, pure and mixed phase relationships of these compounds will not be considered further.

Partition relationships can also be used to determine the distribution of contaminants in reported soil concentrations. Soil is composed of solid, liquid and vapor phases and, as can be seen in the partitioning relations, contaminants can reside in each of these phases. The total concentration of a contaminant (mass of contaminant per mass of dry soil), C_T, can be related to the concentrations in the different phases by:

Where C_T represents the total concentration of contaminant in the soil sample

$$C_T\rho_b=\theta_w C_w+\theta_a C_a+\rho_b C_s \qquad (6)$$

(contaminant in the air, water and sorbed onto solid phase of the soil) expressed per unit mass of dry soil, Θ_a is the air-filled porosity, and Θ_w is the water filled porosity, ρ_b is the dry bulk density or the mass of dry soil per unit of the total volume of soil/water/air. Both porosities are defined as the fractions of the total soil volume which is air or fluid-filled.

Similarly, total concentrations can be converted to a common concentration using linear partition relationships. The total soil concentration, C_T, can be related to the concentration in the fluid phase, C_W, by substituting partition relationships into Equation 6:

$$C_T\rho_b=\theta_w C_w+\theta_a K_H C_w+\rho_b K_{OC} f_{OC} C_w \qquad (7)$$

These equations are useful for examining the distribution of contaminant under different conditions. For example, when the quantity of organic carbon in the soil is 2%, which might be typical for a surface soil, most of the benzene exists sorbed by the soil; however, if the concentration of organic carbon is 0.1%, which might be typical for a subsoil, less than half the benzene is actually sorbed by the soil. This is an important relationship because the soil sorbed form of the contaminant is likely to be stationary, and as a result, greater soil f_{OC} leads to slower migration of contaminants.

In the absence of any reaction or transport considerations, Equation 7 (or variations thereof) can be used to establish total soil concentrations which represent equilibrium with required solution concentrations. For instance, if the benzene concentration in the soil water is assumed to be 0.005 mg/l, and Θ_w = 0.4, Θ_a=0 (saturated) and the soil f_{OC} is 0.001, then the total soil concentration (C_T) which could be present in a saturated soil would be 0.0017 mg benzene/kg dry soil. If the soil organic carbon is greater, a larger percentage of the C_T remains in the solid phase and total soil concentrations could be increased. For a f_{OC} of 0.01, the soil concentration corresponding to a soil water concentration of 0.005 mg/l would be 0.005 mg/kg. These are levels of benzene which have been employed in some soil standards, and while they limit water concentrations to a drinking water standard, they do not include any additional mechanisms for concentration reduction which might be expected to occur during transport to potential receptors.

1-3. Contaminant Reaction

Many organic contaminants can be degraded through abiotic and biotic reactions. In particular, the petroleum hydrocarbons appear quite amenable to biological degradation. The absence of benzene in a recent California ground water quality survey was attributed to biodegradation (Hadley and Armstrong, 1991). Because the focus here is on organic contaminants, degradation processes will be limited to reactions which alter the contaminant molecule. The rate and extent of biodegradation reflects a host of factors, including: concentration, biomass concentration, temperature, pH, and availability of inorganic nutrients and electron acceptors, and microbial adaptation, all of which cannot be easily included in generic models.

The biodegradation of organic contaminants will be included in this analysis with a rate law, a relationship which describes a time rate of change in contaminant concentration. One such rate law which has found application in the description of biological degradation is first-order in contaminant:

$$\frac{dC}{dt}=-kC \tag{8}$$

where C is the concentration of the contaminant and k is the first order rate constant. The rate constant for biodegradation will relate to the quantity of microorganisms and concentration of other reactants which are necessary. The time to halve the concentration is often referred to as the half-life, $t_{1/2}$. In a first-order rate law, the half-life can be related to the rate constant independent from the concentration of the contaminant:

$$t_{\frac{1}{2}}=\frac{0.693}{k} \tag{9}$$

Consequently, using a contaminant half-life is the same as defining a first-order rate constant. First-order or half-life representations of biodegradation rates can be included in most models of contaminant transport, but they may not always be the most appropriate description of the process. In those cases where the first-order rate expression is not a useful description of the rate, the half-life is, in general, not independent of concentration.

The biological degradation of benzene demonstrates the difficulty in the generic application of first-order rate laws to this natural process. Benzene can be biologically degraded under aerobic (oxygen present) conditions and a field study which examined the degradation of benzene in a shallow alluvial aquifer in Mississippi (Boggs et al., 1993) found benzene disappearance which followed a first order rate law, with a half-life of 69-87 days. In the absence of oxygen (anaerobic), benzene biodegradation may be much slower (Hutchins et al., 1991; Barker et al., 1987). Barboro et al (1992) report that benzene did not degrade after 300 days within a leachate plume where oxygen was not detected. The aerobic decomposition of organic compounds consumes oxygen, and because the relatively low solubility of oxygen limits concentrations in the groundwater to less than 10 ppm, degradation of large quantities of benzene and other organic compounds may lead to oxygen depletion and limit the biodegradation rate. Under those conditions, the first-order rate law may no longer be appropriate. Tucker and Zavala (1992), for example, used a zero-order rate law when oxygen-limitation might slow the biodegradation of BTEX.

1-4. Contaminant Transport

Contaminant transport includes any process which acts to move contaminant from the soil to the receptor. It can involve movement within a phase, such as diffusion in soil vapor or groundwater, and movement with a phase, such as transport in moving water. During transport, other processes can act to alter concentration. In addition to the previously described contaminant distribution and contaminant reaction, contaminant mixing with cleaner water or air will dilute contaminant concentration. The extent of such dilution will be determined by a complex site-specific conditions, but they can be estimated with different mathematical models.

In unsaturated soil, when no freely moving organic phase is present, contaminants may migrate by diffusion and transport in moving air and water. Diffusion is a process where contaminant concentrations change in response to gradients in contaminant concentration. Because contaminants migrate in the direction of decreasing concentration, contamination below a soil surface can lead to movement of the contaminants to the surface. Water and air moving through a soil profile can also acquire and move contaminants. Mathematical descriptions of these processes can be complex. McGinley (1993) presented several methods by which contaminant movement in the unsaturated zone can be described. A variety of software packages are also available which incorporate solution algorithms of varying complexity to describe contaminant behavior in the unsaturated zone.

If contaminants enter the saturated zone, they can mix and flow with groundwater. Generic soil standards based on potential groundwater impact have been developed by approximating saturated zone dilution through "mixing zones", where a mass balance characterizes the extent of dilution (EPA, 1989). Although not a rigorous depiction of the processes which occur at the interface between the unsaturated and saturated zones, such models permit quantifying the potential dilution in a very simple way. The concentration of contaminant in the mixing zone will reflect dilution of soil pore water with the saturated zone water. As the quantity of groundwater in the mixing zone is increased, by increasing the depth of the mixing zone or the flow of the groundwater, the extent of dilution increases.

Once contaminants have entered the saturated zone, they can also move with flowing groundwater, although the rate at which they are transported will depend on the velocity of flow and the extent to which the contaminants are sorbed by the solid phases. Groundwater transport of contaminant may act to reduce concentrations due to dilution and perhaps degradation. In natural systems, these reactions take place through a three-dimensional plume, the extent of which relates to physical properties of the fluid distribution and flow conditions. Solution of differential equations characterizing fluid movement in the saturated zone can be used to determine the extent to which this impacts concentrations. Numerous references are available which detail approaches to characterizing contaminant transport, but for purposes of this discussion, contaminant transport through both advective (fluid flow) and dispersion (mixing and diffusion) can be coupled with reaction in three dimensions through the differential equation:

$$\frac{\partial C}{\partial t}=D_x\frac{\partial^2 C}{\partial x^2}+D_y\frac{\partial^2 C}{\partial y^2}+D_z\frac{\partial^2 C}{\partial z^2}-v_x\frac{\partial C}{\partial x}-\frac{\rho_b}{\theta_w}\frac{\partial C_s}{\partial t}-kC \qquad (10)$$

in which the transport is characterized by the average flow velocity in the longitudinal direction, v_x, and coefficients of hydrodynamic dispersion in the longitudinal, D_x, transverse, D_y, and vertical, D_z, directions. Both reaction and sorption are described by the rate constant, k, and the soil concentration of contaminant, C_s, respectively. In those cases where flow is not in three dimensions, D_y and/or D_z can be set to zero. If flow is only in the longitudinal direction (x), the resulting one dimensional equation is analogous to advective/dispersive flow through a pipe. Equation 10 can be solved for different boundary and initial conditions and provide descriptions of contaminant migration and alteration. The important parameters which must be defined include the flow velocity, dispersion coefficients, and degradation rate constant, shown here for a first order reaction. Whereas values for these parameters can be estimated, it is also important for a generic standard that the sensitivity of the results to those values be known.

The extent to which contaminants will be degraded in the saturated zone depends on the kinetics of the degradation (e.g., the half life in a first order rate law) and the length of time they spend in the system. Because the rate of contaminant transport relates both to the extent of partitioning to subsurface solid phases and the flow velocity, it is often convenient to use a linear partition coefficient to calculate a retardation factor:

$$R = 1 + \frac{\rho_b}{\theta_w} K_{oc} f_{oc} \tag{11}$$

which represents the ratio of the groundwater flow velocity, v_x, to the contaminant velocity, v_c:

$$v_c = \frac{v_x}{R} \tag{12}$$

As a result, those contaminants which strongly partition to the solid phase will have large retardation factors. Depending on the properties of an aquifer and the hydraulic gradient which drives the flow, a wide range in flow velocities can be observed in natural systems. In a site specific analysis, information on the flow velocity can be used, in a generic model, both the range of values which is possible and the sensitivity of the results to the selection should be considered.

Dispersion reflects the molecular and physical spreading the contaminant plume in the saturated zone. The dispersion will be related to the velocity of the contaminant:

$$D_x = \alpha_x v_x \tag{13}$$

$$D_y = \alpha_y v_x \tag{14}$$

where the dispersivities, α_x and α_y, have dimensions of length. It is difficult to estimate dispersivity and recent evidence indicates that the value of this parameter seems to increase with observation distance. Fetter (1993) presents a figure from the literature which demonstrates the apparent increase in dispersivity with the scale of measurement. From a generic standard standpoint, including dispersivity in a model may act to increase or decrease what might be an acceptable concentration of contaminant left in the soil depending on the form of the model and conditions under which it is applied. It is important that the sensitivity of the model towards selection of this parameter be understood.

1-5. Generic Pathway System

The Generic Pathway System (GPS) was developed to establish reasonable bounds of contaminant concentration which would derive from most contaminated soils. The GPS links several simple models of contaminant migration in both the soil and groundwater. The GPS was designed to permit conservative description of the processes and pathways for dissolved contaminants and allow linear scaling of soil concentrations to media concentrations. Linear scaling is useful in relating existing or future soil standards to desired media concentration at receptors. Unfortunately, such linear scaling also leads to a limitations in the application of this system. For example, although both linear partitioning and first order degradation permit linear scaling across any concentration range, they limit the applicability of the model to situations with low concentrations of contaminants.

An analysis of the pathway from soil concentration to concentration in different media at the point of receptor contact was developed using a adjustments to account for the different processes which occur during transport. Surface soil concentration, surface volatilization, and soil pore water concentrations beneath contaminated soil were simulated using a model, SESOIL. SESOIL is a one-dimensional soil compartment model which can provide estimates of pollutant movement in the soil (Hetrick et al., 1989). Although validation of the SESOIL model for petroleum compounds was not found in the literature, several states (California, Oregon, Wisconsin, New Hampshire) have used SESOIL to predict contaminant migration for soil standards (State of California, 1989; Anderson, 1992; Science Technology Management, Inc, 1993). The model combines a moisture balance with chemical-specific information on volatilization and soil sorption (using linear partitioning) and degradation reactions. Moisture routing in the model is accommodated with a water budget analysis and local weather conditions input by the user.

The concentration of contaminants once they have entered the saturated zone was modeled using the time and mixing which might occur during transport from soil through the saturated zone. The GPS uses a mixing zone and longitudinal and transverse transport in the saturated zone. SESOIL simulations or mathematical expressions are used to determine a concentration adjustment for each of these four steps. The result is a single adjustment factor reflecting the contributions of each of these components in the path.

The GPS becomes equations or model simulations for contaminant concentration or quantities in three different pathways:

1) **Concentration of contaminant at soil surface**, C_{SS} (mg/kg), resulting from buried contaminated soil of concentration C_T (mg/kg):

$$C_{SS}=f_{SS}C_T \qquad (15)$$

where: f_{SS} is the soil surface multiplier which is determined using SESOIL.

2) **Quantity of contaminant leaving soil surface**, M_{SS} (mg/day), resulting from buried contaminated soil of concentration C_T (mg/kg):

$$M_{SS}=f_{SV}C_T \tag{16}$$

where: f_{SV} is the soil surface volatilization multiplier determined using SESOIL.

3) **Concentration of contaminant in groundwater**, C_W (mg/l), resulting from buried contaminated soil of concentration C_T (mg/kg):

$$C_W=f_{GW}C_T=f_u\ f_v\ f_h\ f_t\ C_T \tag{17}$$

where: f_{GW} is the groundwater multiplier which is determined using a four component model incorporating:

f_u, the unsaturated soil multiplier, is determined using SESOIL. This first adjustment factor is not dimensionless and it converts the soil concentration to the maximum percolate concentration. Using SESOIL with linear partitioning and first-order degradation rate law results in adjustments which are independent of concentration (with the low concentration limitation).

f_v, the vertical mixing zone multiplier, is determined using a relationship between the rate of moisture infiltration, P (cm/month), and the rate of groundwater flow into a mixing zone, v (m/d):

$$f_m=\frac{P\ L_x}{P\ L_x\ +\ v_x\theta D_M(100)} \tag{18}$$

where L_x is the length of the UST pit (meters), θ is the porosity in the saturated zone, and D_M is the depth of the mixing zone (meters).

f_h, the horizontal transport multiplier, is determined from a solution to a groundwater flow equation which considers a finite planar source with a constant concentration. This is a conservative approach to accomodate, at least partially, the uncertainty surrounding the actual depth of the contaminated zone at the site. An extended pulse approximation to the advective/dispersive/reactive equation which is presented by Domenico (1987) can be used to simulate the saturated zone transport. The following expression:

$$f_h = \exp\left[\frac{x}{2\alpha_x}\left(1 - \sqrt{\frac{1+4k\alpha_x}{v_c}}\right)\right] \tag{19}$$

can be developed from Domenico and Schwartz (1990) (Equation 17.22, page 649) at long times when the complimentary error function term becomes large and approaches 2 (see also Equation 9 in Domenico, 1987) and the dispersivity in the vertical direction approaches zero. In Equation 19, x is the distance from the UST pit to the point where the concentration is to be evaluated, α_x is the dispersivity in the direction of groundwater flow, k is the first-order degradation constant for the contaminant, and v_c is the contaminant velocity obtained by dividing the groundwater velocity by the retardation factor (Equation 12). Because the solution describes a steady-state, one-dimensional situation with biodegradation, increasing the dispersivity will increase the concentration of contaminant at a particular distance from the source.

f_t, the transverse transport multiplier, describes mixing which leads to dilution in directions perpendicular, but in the same horizontal plane as the groundwater flow (transverse). The extent to which it impacts the concentration of the contaminant can be calculated using the following expression:

$$f_t = erf\left(\frac{L_y}{4\sqrt{\alpha_y x}}\right) \tag{20}$$

from Domenico (1987) for the concentration at the center point of the plume. L_y is the dimension of the site perpendicular to the flow, α_y is the dispersivity in that direction, and x is the distance from the site at which the multiplier is to be evaluated.

In application, soil concentrations (in mg/kg) are multiplied by f_{GW} and f_{SS} to obtain the corresponding concentrations in groundwater (in mg/l) and surface soil (in mg/kg), respectively. In the case of surface volatilization, soil concentrations are multiplied by f_{SV} to obtain the maximum flux of contaminant out of the soil surface (in mg/day).

The GPS does not include any time-varying components which would lead to time-varying concentrations at the receptor, and does not include an "upper" value where other assumptions (e.g., biological degradation half-life, solubility effects) may no longer be appropriate. The time-independence of the model is conservatively evaluated by using the maximum concentration values, but the upper limit must be evaluated using other appropriate means to identify a reasonable end-point for model applicability (i.e., the maximum soil concentration).

As indicated above, the GPS multipliers are independent of concentration over the low ranges. It was shown that SESOIL simulations from one to ten mg/kg of soil contamination leads to soil pore water concentrations which were multiples of the soil concentration. Such linearity is anticipated because both linear partitioning and first-order degradation are concentration-independent relationships. If soil concentrations reach levels where the pore water concentrations approach the solubility of the compound, SESOIL will restrict the soil pore water to the solubility. In that case, water concentrations predicted using the multiplier obtained at 1 mg/kg would be higher than those obtained from SESOIL simulations preformed at the higher soil concentration. Of course, as mentioned above, the limitations of first-order rate expressions and linear partitioning must also be considered at high soil and water concentrations for both SESOIL results and the groundwater pathway simulations.

To explore the impact of high concentration on SESOIL simulations, a series of xylene simulations at different total soil concentrations were performed using some assumed parameter values for soil and climate. The results shown in Figure 1-1 for 1, 10, 100 and 500 mg/kg indicate the implications of the solubility limitation. At 1 and 10 mg/kg, the maximum soil percolate concentration at the base of the contaminated zone is just over 2.5 mg/l and 25 mg/l, respectively, and the concentration drops off fairly rapidly. For the 100 and 500 mg/kg, the maximum predicted xylene concentration is 175 mg/l (the solubility used in the simulation) and remains at the concentration until the xylene in the contaminated zone becomes reduced.

The concentration adjustment factors developed using the modeling technique described are simple relationships between soil contamination and media impacts. As is generally the case with this type of model, the methodology is not intended for characterizing an individual site but rather, to compare the impact of different concentration-altering processes in a generic scenario.

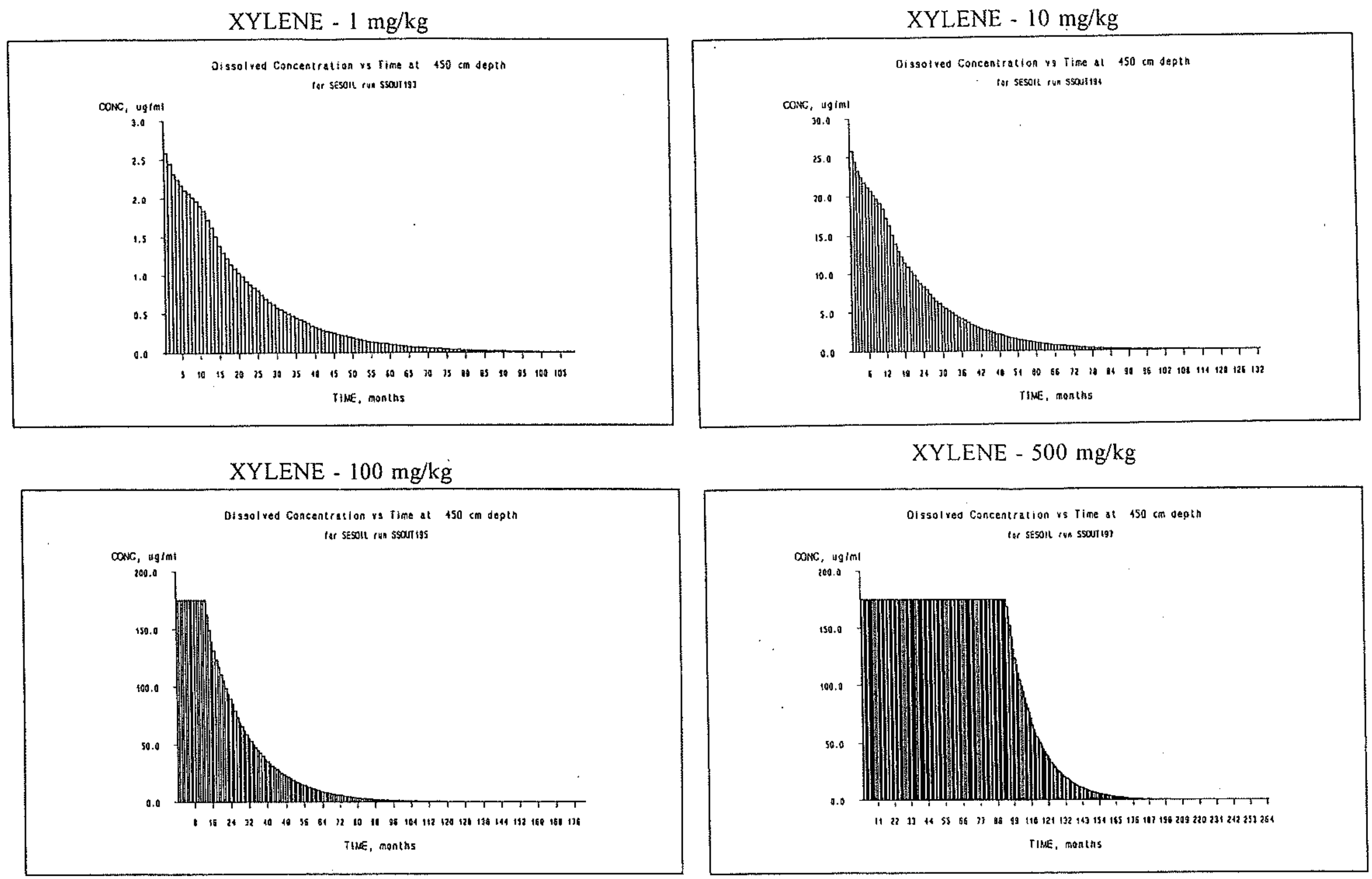

FIGURE 1-1. Simulated concentrations of xylene in soil percolate at the base of a three meter contaminated zone for different initial concentrations of xylene (shown above each figure). Sandy soil with an organic carbon content of 0.1% assumed.

Chapter 2. Application to Kentucky Petroleum Underground Storage Tanks.

2-1. Introduction

The Generic Pathway System (GPS) described in Chapter 1 combines numerical and analytical models to develop relationships between contaminated soil and potential contaminant concentrations in different media. This chapter is the application of the GPS for developing concentration reduction multipliers which can be used to model how processes occurring during migration can reduce contaminant concentrations for the residual levels of organic contaminants which remain after petroleum underground storage tank removal.

2-2. Generic Pathway System

As described in Chapter 1, the Generic Pathway System combines a soil model (i.e., SESOIL) with dilution and transport adjustments which are independent of concentration as long as the limiting assumptions regarding their development are insured. The model evaluates three different conditions:

1) **Concentration of contaminant at soil surface**, C_{SS} (mg/kg), resulting from buried contaminated soil of concentration C_T (mg/kg):

$$C_{SS}=f_{SS}C_T \tag{21}$$

where f_{SS} is the soil surface multiplier and is determined using SESOIL.

2) **Quantity of contaminant leaving soil surface**, M_{SS} (mg/day), resulting from buried contaminated soil of concentration C_T (mg/kg):

$$M_{SS}=f_{SV}C_T \tag{22}$$

where: f_{SV} is the soil surface volatilization multiplier and is determined using SESOIL.

3) **Concentration of contaminant in groundwater**, C_W (mg/l), resulting from buried contaminated soil of concentration C_T (mg/kg):

$$C_W=f_{GW}C_T=f_u\ f_v\ f_h\ f_t\ C_T \tag{23}$$

where f_{GW} is the groundwater multiplier which is determined using a four component model incorporating a unsaturated soil multiplier, f_u, using SESOIL; the vertical mixing zone multiplier, f_v, which relates the rate of moisture infiltration and the rate of groundwater flow into a mixing zone; the horizontal transport multiplier, f_h, determined from a steady-state solution to the advective/dispersive/reactive equation for a finite planar source with a constant concentration; and, the transverse transport multiplier, f_t, which describes mixing perpendicular to, but in the same plane as, the groundwater flow. The model details and formula used for these component multipliers are detailed in Chapter 1.

2-3. Parameter Values and Concentration Multipliers

Application of the GPS requires that values be assigned to a variety of variables. In the following example, a generic underground storage tank is described and a series of different subsurface conditions are assumed to arrive at three different tank scenarios. In Figures 2-1 and 2-2, the elevation of the generic site is shown. This was based on a review of site characteristics in Kentucky (Sendlein et al., 1993) and previously developed generic models (Anderson, 1991; Odencrantz et al., 1992).

A base set of parameter values was formulated based on hydrogeologic and soil conditions and the sensitivity of the model to certain assumptions. These parameter values are shown in Tables 2-1 through 2-4. The parameter set above constitutes the base case from which the multipliers were determined. The sensitivity of the multipliers to the selection of these parameters is examined in the following chapter. The original model simulations for downward migration of contaminants were based on the "Model Input" scaling shown in Figure 2-2, but subsequent incorporation into proposed soil standards was based on the "Adjusted" scaling shown in the Figure. The "Adjusted" form was shown to be conservative with respect to downward migration, most likely because those simulations allow less upward volatilization to occur.

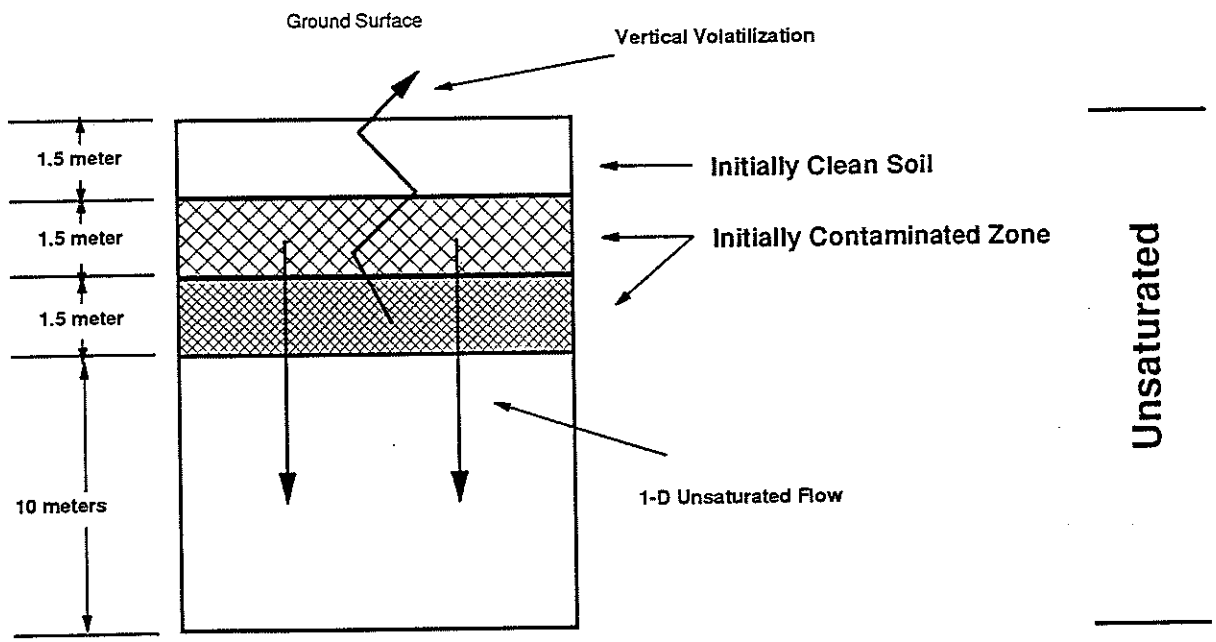

FIGURE 2-1. Hypothetical underground storage tank pit used for upward vertical unsaturated soil modeling.

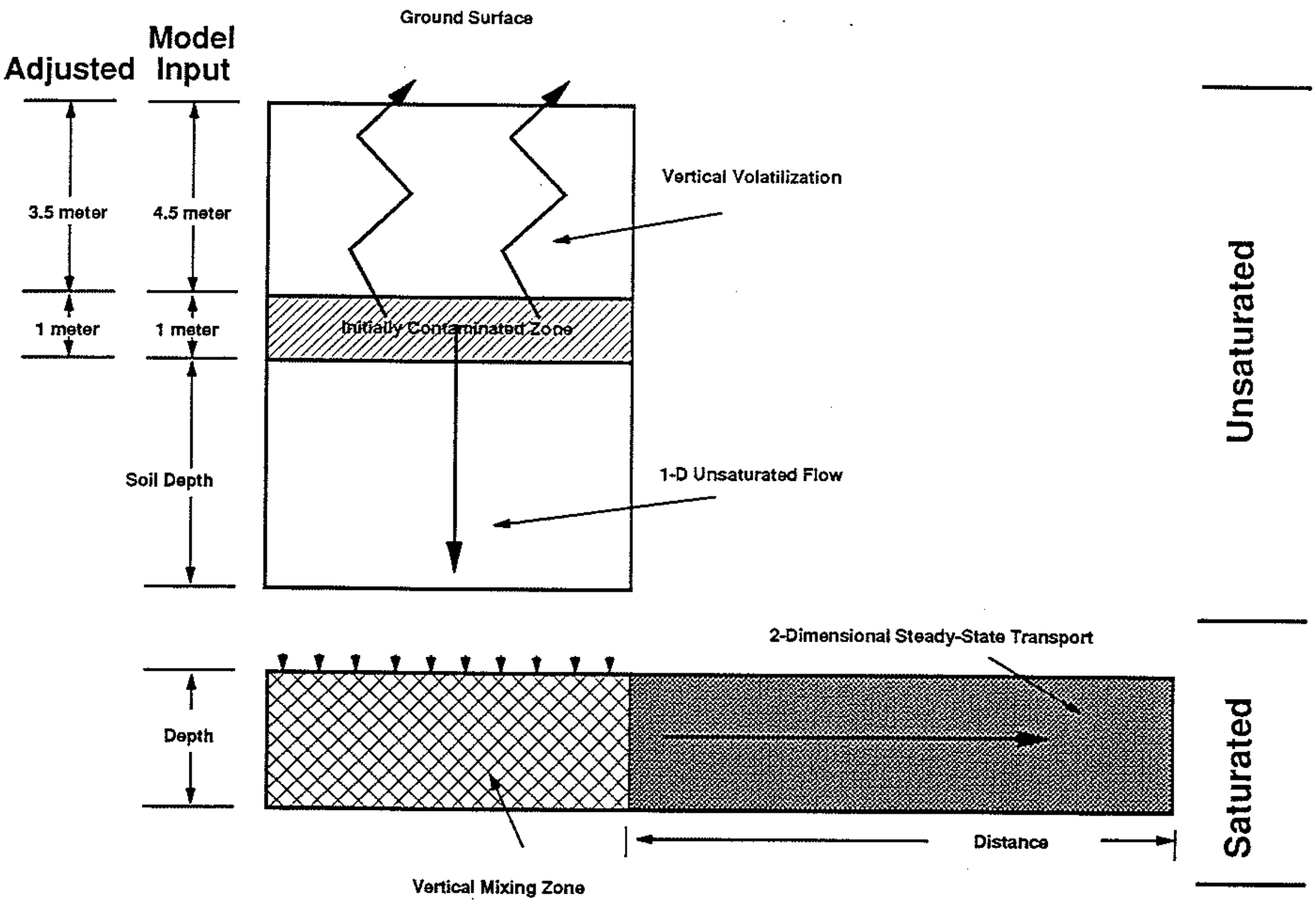

FIGURE 2-2. Hypothetical underground storage tank pit used for downward vertical and horizontal saturated zone transport of contaminants.

TABLE 2-1 CHEMICAL PROPERTIES*

Parameter	Values			
	Benzene	Toluene	Ethylbenzene	Xylene
K_{OC} (cm^3/g)	83	270	575	302
Diffusion Coefficient (cm^2/s)	0.109	0.100	0.093	0.093
Henry's Constant (m^3-atm/mole)	0.00550	0.00668	0.00343	0.00572
Solubility (mg/l)	1780	535	161	171
Molecular Weight	78.1	78.1*(92)	106	106

*Many values adopted from Anderson (1992)

** Toluene molecular weight is 92, but 78.1 used in some calculations.

TABLE 2-2 UNSATURATED ZONE TRANSPORT (SESOIL)

Parameter	Value	
	Volatilization/ Surface Soil Pathway	Groundwater Pathway
Contaminated Zone Thickness	3.0 meter	1.0 meter
Contaminated Zone Burial Depth	1.5 meter	4.5 meter
Depth to Saturated Zone	14.5 meter	4.5-23.5 meter
Contaminated Zone Area	1.2×10^6 cm^2	
Soil Bulk Density	1.60 gm/cm^3	
Intrinsic Permeability Sand	10^{-7} cm^2	
Silt	10^{-9} cm^2	
Clay	10^{-10} cm^2	
Disconnectedness Index	4.5	
Organic Carbon Content	0.1%	
Porosity	0.40	
Precipitation/Temperature	Lexington, KY	
SESOIL VOLF (Volatilization)	1.0	0.2

TABLE 2-3 MIXING ZONE PARAMETER VALUES (ONLY GROUNDWATER PATH)

Parameter			
	Table I	Table II	Table III
Mixing Zone Depth	1.0 m	0.5 m	0.5 m
Groundwater Flow Rate	10.0 m/d	0.1 m/d	0.1 m/d
Saturated Zone Porosity	0.40	0.40	0.40
Unsaturated Zone Infiltration	10.0 cm/month	10.0 cm/month	10.0 cm/month
Horizontal Extent of Site	12.2 m	12.2 m	12.2 m

TABLE 2-4 SATURATED ZONE PARAMETER VALUES (GROUNDWATER PATH)

Parameter			
	Table I	Table II	Table III
Groundwater Flow Rate	10.0 m/d	0.1 m/d	0.1 m/d
Longitudinal Dispersivity	100 m	100 m	100 m
Transverse Dispersivity	0 m	1 m	1 m
Contaminant Half-Life	7 day	100 day	700 day
Transverse Extent of Site	12.2 m	12.2 m	12.2 m

Surface Soil Concentration Multiplier, f_{SS}

Upward diffusion of contaminants at a tank site can lead to contaminant accumulation in the soil surface. SESOIL was used to determine the quantity of contaminants at the surface which result from buried contaminated soil. The surface soil concentration was determined by summing the contaminant in all three phases (soil, water and air) and normalizing for the dry mass of the soil.

The resulting adjustment factor, f_{SS}, for computing soil concentrations for any concentration of contaminated soil is shown in Table 2-5.

Table 2-5. BTEX SOIL SURFACE CONCENTRATION MULTIPLIERS [1]

Extent of Contamination (refer to Figure 2-1)	B/T/E/X f_{SS} (mg/kg/mg/kg)		
	Sand	Silt	Clay
Entire 4.5 meter UST Pit Contaminated	1.0/ 1.0/ 1.0/ 1.0	1.0/ 1.0/ 1.0/ 1.0	1.0/ 1.0/ 1.0/ 1.0
3.0 m contaminated below 1.5 m initially clean soil	0.050/ 0.061/ 0.057/ 0.062	0.055/ 0.046/ 0.049/ 0.045	0.001/ 0.001/ 0.0007/ 0.0004

[1] Upper 30 cm

The accuracy of SESOIL for predicting volatilization of contaminants from the subsurface has not been explicitly tested. When SESOIL was used to develop soil standards in Oregon, the predicted volatilization was reduced through a factor, VOLF, in the model (Anderson, 1992). The simulations described here did not use a reduced volatilization multiplier when examining the vapor phase transport pathway, but did reduce the multiplier when the groundwater impact was being evaluated.

Surface Soil Volatilization Rate, f_{SV}

The quantity of contaminant leaving the soil surface above buried contamination was modeled using SESOIL. The maximum volatilization is predicted to occur within several months for benzene in sand (McGinley, 1993). A similar simulation for a finer grained soils (silt and clay) leads to a slightly delayed migration to the surface and a lower maximum volatilization. The maximum monthly quantity of benzene volatilized was converted to an average daily quantity and is shown in Table 2-6 as the volatilization multipliers.

Table 2-6. BTEX SOIL SURFACE VOLATILIZATION MULTIPLIERS

Extent of Contamination (refer to Figure 1)	B/T/E/X f_{SV} (mg/day/mg/kg)[1]		
	Sand	Silt	Clay
3.0 m contaminated below 1.5 m initially clean soil	4530/ 2552/ 643/ 1704	1054/ 863/ 294/ 674	0.74/ 0.63/ 0.14/ 0.17

(1) Site area of $1.2x10^6 cm^2$

Ground Water Concentrations, f_{GW}

The groundwater concentration multiplier, f_{GW}, incorporates four components of a groundwater pathway: unsaturated zone, mixing zone, horizontal transport, and transverse dispersion. The effect of different parameter values on the unsaturated soil and transverse dispersion components of f_{GW} can be examined individually and the results used to adjust either that component multiplier or the total multiplier, but the mixing zone and horizontal transport components are most usefully examined together because they are inversely sensitive to the selection of groundwater flow velocity.

Unsaturated Soil

The model SESOIL was used to determine the impact that unsaturated soil had on contaminant concentrations in soil water. Simulations were used to obtain a soil pore water concentration at the base of the soil column for a unit level of contamination. These can be multiplied by other levels of contamination to determine the corresponding concentration or can become part of the composite groundwater concentration multiplier. For the modeling scenario examined, the concentration maximums occur over a narrow time period, after which the concentration decreases.

The parameter values shown in Table 2-1 summarize the SESOIL input. Normal monthly precipitation and temperature for Lexington, KY were based on the mean for 1935-1970 and McGinley (1993) presents the original SESOIL climate input file. Only fluid-phase biodegradation was used in the SESOIL model and both 100 day and 700 day half lives were considered. Because this application was screening-level, parameter value selections for soil porosity, organic carbon content, intrinsic permeability and pore disconnectedness were not based on a rigorous sensitivity analysis, but reasonable values were selected.

Contaminant volatilization can reduce the quantity of contaminant in the soil, and subsequently reduce the maximum percolate concentration. SESOIL accounts for upward volatilization, but in this application, only partial upward volatilization of the contaminant was permitted. This conservative use of the model was suggested by several users (Anderson, 1992; A. Nold, USEPA, personal communication, 1993). A reduced volatilization index (VOLF in the SESOIL model) of 0.2 was used.

Vertical Mixing and Horizontal Transport

The maximum concentration of a contaminant in the soil percolate was assumed to represent the fluid concentration which enters the saturated zone. Fluid entering the saturated zone was assumed to mix with saturated zone water and then be transported horizontally. Parameter values selected for the vertical mixing zone are shown in Table 2-2. Although local climatic conditions and runoff may reduce (or increase) the local infiltration at a site, for purposes of this analysis, an annual rainfall of 120 cm was assumed and considered to entirely move into the saturated zone (an average of 10 cm/month). Site dimensions were assumed to be those of the large site described by Sendlein et al. (1993). The mathematical description of horizontal transport away from the site in the saturated zone employed a steady-state solution to the advective/dispersive/reactive equation. In this model, the only reduction in solution concentration with distance arises from degradation because the source concentration is assumed to remain constant. Half-life of contaminant and groundwater flow rate determine the extent to which the contaminant concentration

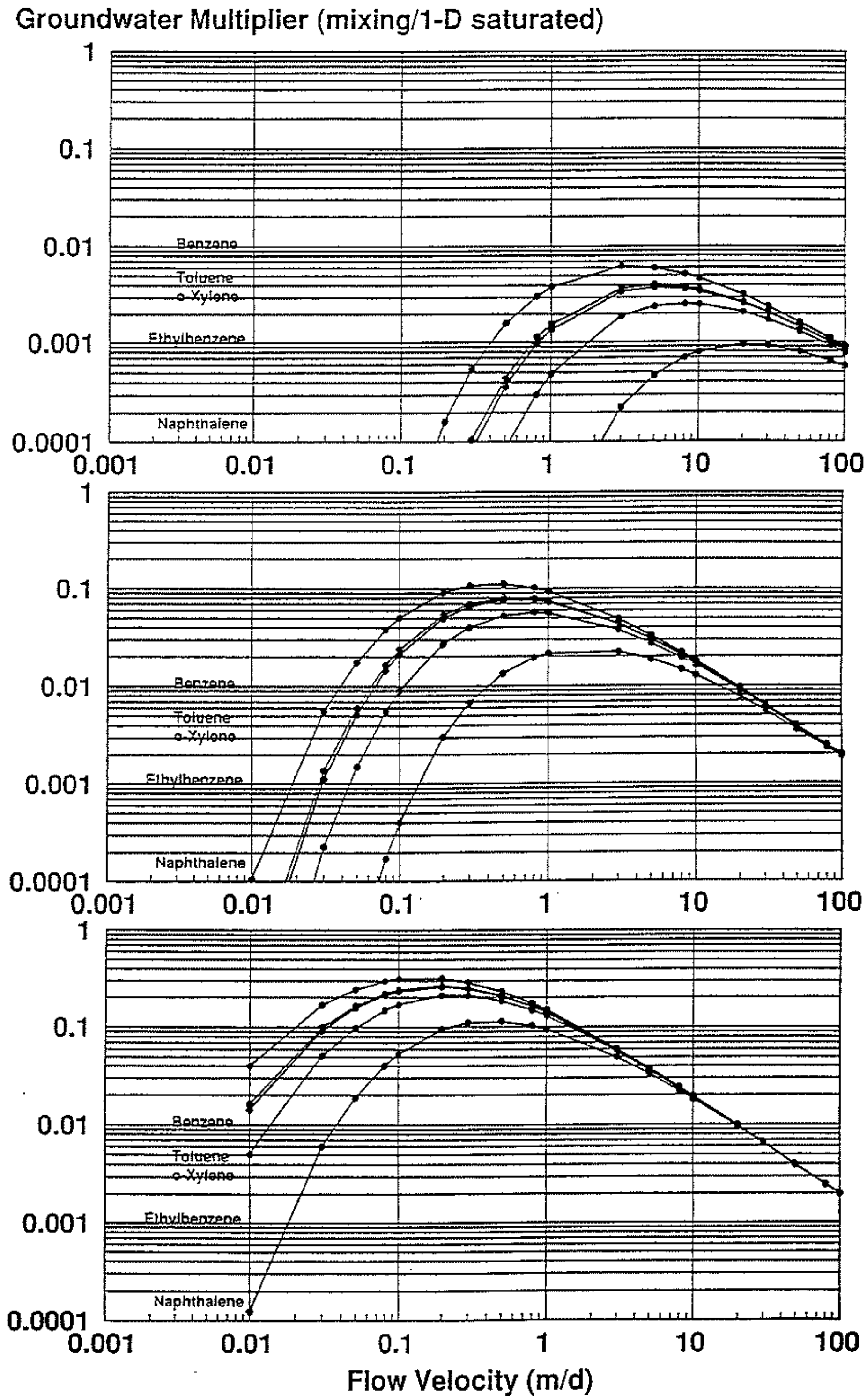

FIGURE 2-3. Senstivity of mixing zone/saturated zone multiplier to the groundwater flow rate for the different saturated zone regimes (Table 1- upper, Table II- middle, Table III- lower).

is reduced. Figure 2-3 demonstrates the link between concentration reduction and ground water flow rate for the vertical mixing and horizontal transport components of the model. The peak in the curves identifies a flow velocity which has the largest multiplier (i.e., the concentration reduction is the lowest). In selecting the groundwater flow rate for the models, the relationship shown in Figure 2-3 was taken into consideration. For example, for a 700 day half-life, the groundwater flow rate which would permit the least attenuation in concentration is near 0.1 m/d, and velocities above and below that reflect greater dilution and degradation respectively. As a result, 0.1 m/d was used as the flow velocity for the Table III region. In fracture/conduit regions where a half-life of 7 days was used, a flow velocity of 10 m/d is close to the most sensitive point and for all four BTEX compounds would only differ by a factor of 2x from the maximum multiplier. In Table I, 10 m/d was the flow velocity used. In the Table II regions, where a 100 day half life was used would have the lowest concentration reduction under circumstances where the flow velocity ranges from 0.5 to 1 m/d. In Table II, a velocity of 0.1 m/d was used after it was decided that this would be a maximum flow velocity for those hydrogeologic conditions. As can be seen in the middle of Figure The mixing/1-D multiplier which is obtained at 0.1 m/d can differ by a factor of 10x or more from that at the most sensitive velocity, but is greater (i.e., less attenuation) for all velocities less than 0.1 m/d.

The relationships shown in Figure 2-3 also demonstrate that selection of a flow rate and half-life in the saturated zone may mean that other conditions are generally more conservative. For example, if actual flow velocities are from 0.001 to 0.01 m/d, a much lower actual multiplier would exist (i.e., a much greater concentration reduction would occur than was assumed in the model). Alternatively, the same, or better, level of protection would be provided even if a much longer half-life was operative in those situations.

Transverse Mixing

The final component of the groundwater pathway was a multiplier for mixing (i.e., dilution) in the plane of the groundwater flow but perpendicular to the flow direction. This step in the process attempts to characterize the spreading the contaminant plume as it moves away from the site. The mathematical form of the model which was used was presented in Equation 20. For a transverse dispersivity of 1.0 meter, component multipliers of 1.0 at 0 meter, 0.334 at 100 meter and 0.197 at 300 meter result. This adjustment was applied only to those subsurface systems where flow was assumed to occur in unconsolidated material (Table II and III). For the Table I regions where fracture/conduit flow was anticipated to be important, a transverse multiplier of 1.0 (no transverse mixing) was assumed for all distances from the source.

Total Groundwater Multipliers

Combination of the component multipliers for the different segments of the groundwater pathway results in a total groundwater multiplier. These multipliers, f_{GW}, quantify a hypothetical impact on groundwater concentrations arising from residual soil concentration at different distances. In Table 2-7, the set of multipliers corresponding to this base set of parameter values are shown. The groundwater multipliers relate the groundwater concentration (in mg/l) which would arise from 1 mg/kg of soil contamination. Alternatively, dividing the maximum permissible groundwater concentration by the multiplier would generate the corresponding soil concentration. In Appendix A, the component multipliers for the groundwater path in each of the nine cases (3 Tables and 3 Distances) are presented.

Figure 2-4 compares the concentration multipliers which result for one unsaturated soil type (sand) and the three different subsurface types. It is apparent that for subsurface regimes where conduit and fracture flow are considered to dominate (Table I), the parameter values selected leads to a relatively small multipliers at shallow depths from the surface in comparison to the other two subsurface conditions. This is primarily due to the rapid groundwater flow rate assumed which leads to dilution in the vertical mixing zone. The effect of increasing distance is not as marked in this regime because no transverse dispersion and a faster flow rate (i.e., less time for degradation) was included. Comparing the lower two graphs in Figure 2-4 demonstrates how two different contaminant half-lives, 100 day in the middle and 700 day in the lower, affect the concentration multipliers. The multipliers decrease with distance, in both the unsaturated and saturated zone, much more rapidly for the 100 day half-life case.

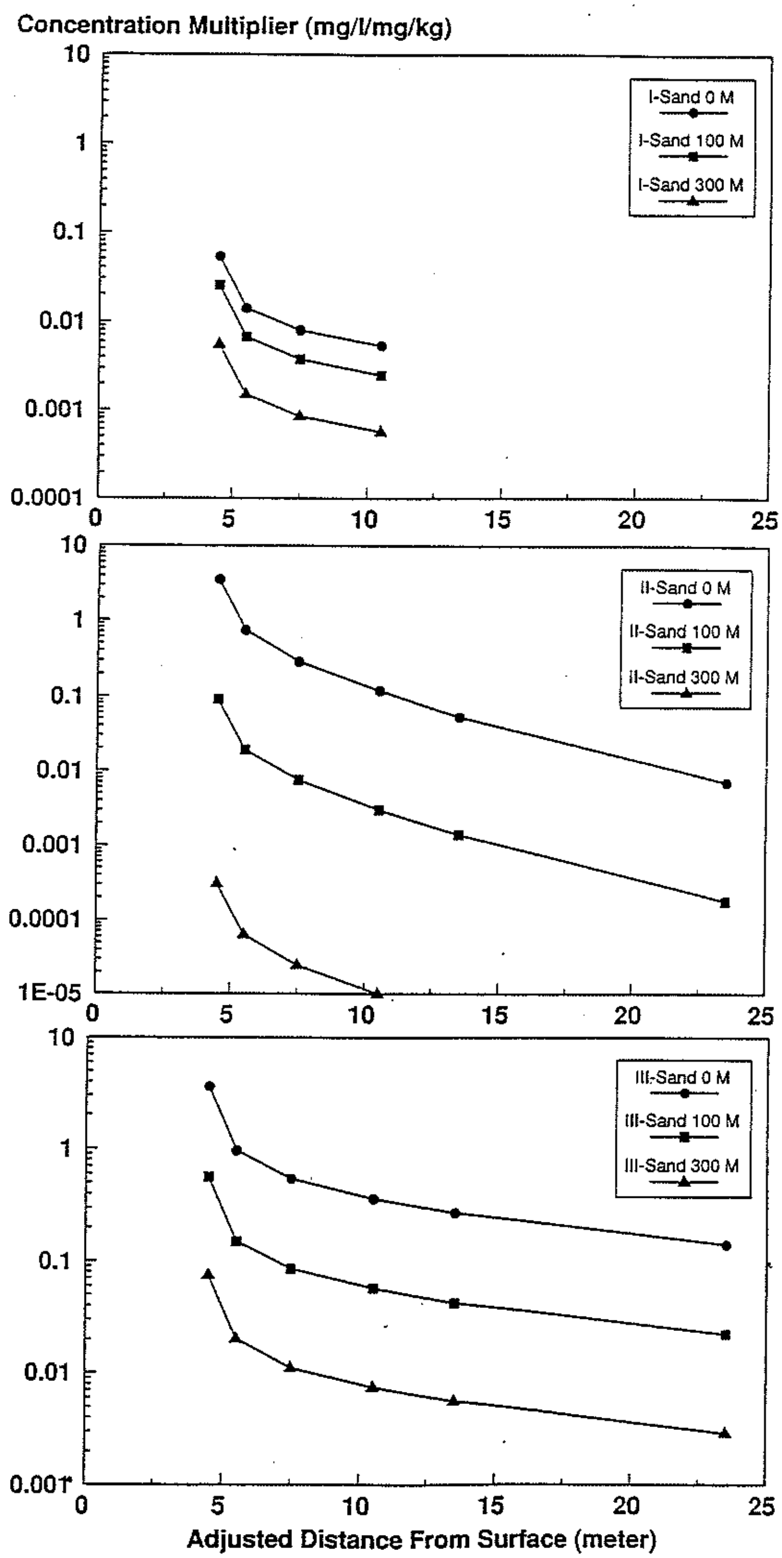

FIGURE 2-4. Groundwater concentration multipliers for sand at three different distances from UST for the three different subsurface regimes (Table I- upper, Table II- middle, Table III- lower figure).

TABLE 2-7. GROUNDWATER CONCENTRATION MULTIPLIERS FOR BASE SET OF PARAMETER VALUES

TABLE 1 MULTIPLIERS

SAND 0 Meters MULTIPLIERS

	B	T	E	X
4.5	5.3E-02	2.6E-02	1.5E-02	2.5E-02
5.5	1.4E-02	7.6E-03	4.9E-03	6.7E-03
7.5	8.0E-03	3.8E-03	3.1E-03	4.2E-03
10.5	5.4E-03	2.3E-03	2.2E-03	2.9E-03

SAND 100 Meters MULTIPLIERS

	B	T	E	X
4.5	2.5E-02	9.3E-03	3.8E-03	8.5E-03
5.5	6.7E-03	2.8E-03	1.2E-03	2.3E-03
7.5	3.8E-03	1.4E-03	8.0E-04	1.5E-03
10.5	2.5E-03	8.2E-04	5.6E-04	9.9E-04

SAND 300 Meters MULTIPLIERS

	B	T	E	X
4.5	5.6E-03	1.2E-03	2.4E-04	1.0E-03
5.5	1.5E-03	3.6E-04	7.8E-05	2.8E-04
7.5	8.4E-04	1.8E-04	5.1E-05	1.8E-04
10.5	5.6E-04	1.1E-04	3.6E-05	1.2E-04

SILT 1 Meters MULTIPLIERS

	B	T	E	X
4.5	5.3E-02	2.6E-02	1.5E-02	2.5E-02
5.5	1.5E-02	1.1E-02	6.4E-03	8.5E-03
7.5	9.9E-03	4.8E-03	3.6E-03	4.4E-03
10.5	5.0E-03	2.7E-03	2.1E-03	2.9E-03

SILT 100 Meters MULTIPLIERS

	B	T	E	X
4.5	2.5E-02	9.3E-03	3.8E-03	8.5E-03
5.5	7.3E-03	4.1E-03	1.6E-03	2.9E-03
7.5	4.7E-03	1.7E-03	9.2E-04	1.5E-03
10.5	2.3E-03	9.7E-04	5.2E-04	1.0E-03

SILT 300 Meters MULTIPLIERS

	B	T	E	X
4.5	5.6E-03	1.2E-03	2.4E-04	1.0E-03
5.5	1.6E-03	5.4E-04	1.0E-04	3.5E-04
7.5	1.0E-03	2.2E-04	5.9E-05	1.8E-04
10.5	5.2E-04	1.3E-04	3.3E-05	1.2E-04

CLAY 1 Meters MULTIPLIERS

	B	T	E	X
4.5	5.3E-02	2.6E-02	1.5E-02	2.5E-02
5.5	1.9E-02	1.2E-02	8.3E-03	1.2E-02
7.5	1.2E-02	6.3E-03	4.9E-03	7.0E-03
10.5	3.5E-03	2.1E-03	1.1E-03	2.1E-03

CLAY 100 Meters MULTIPLIERS

	B	T	E	X
4.5	2.5E-02	9.3E-03	3.8E-03	8.5E-03
5.5	8.8E-03	4.3E-03	2.1E-03	4.3E-03
7.5	5.6E-03	2.3E-03	1.2E-03	2.4E-03
10.5	1.6E-03	7.6E-04	2.7E-04	7.3E-04

CLAY 300 Meters MULTIPLIERS

	B	T	E	X
4.5	5.6E-03	1.2E-03	2.4E-04	1.0E-03
5.5	2.0E-03	5.5E-04	1.3E-04	5.1E-04
7.5	1.2E-03	3.0E-04	7.9E-05	2.9E-04
10.5	3.6E-04	9.9E-05	1.7E-05	8.7E-05

TABLE 2 MULTIPLIERS

SAND 0 Meter MULTIPLIERS

DEPTH	B	T	E	X
4.5	3.6E+00	1.7E+00	1.0E+00	1.7E+00
5.5	7.3E-01	4.2E-01	2.4E-01	3.4E-01
7.5	2.9E-01	1.3E-01	1.1E-01	1.5E-01
10.5	1.2E-01	4.8E-02	4.6E-02	6.5E-02
13.5	5.3E-02	2.1E-02	2.1E-02	2.8E-02
23.5	7.0E-03	2.2E-03	2.2E-03	2.9E-03

SAND 100 Meter MULTIPLIERS

DEPTH	B	T	E	X
4.5	9.1E-02	2.1E-02	4.5E-03	1.8E-02
5.5	1.9E-02	5.0E-03	1.1E-03	3.6E-03
7.5	7.5E-03	1.5E-03	4.9E-04	1.6E-03
10.5	3.0E-03	5.7E-04	2.1E-04	6.9E-04
13.5	1.4E-03	2.6E-04	9.6E-05	3.0E-04
23.5	1.8E-04	2.6E-05	9.9E-06	3.1E-05

SAND 300 Meter MULTIPLIERS

DEPTH	B	T	E	X
4.5	3.1E-04	1.6E-05	4.8E-07	1.1E-05
5.5	6.4E-05	3.8E-06	1.2E-07	2.2E-06
7.5	2.5E-05	1.2E-06	5.3E-08	9.4E-07
10.5	1.0E-05	4.3E-07	2.2E-08	4.2E-07
13.5	4.6E-06	1.9E-07	1.0E-08	1.8E-07
23.5	6.1E-07	2.0E-08	1.1E-09	1.8E-08

SILT 0 Meter MULTIPLIERS

DEPTH	B	T	E	X
4.5	3.6E+00	1.7E+00	1.0E+00	1.7E+00
5.5	2.1E-01	4.4E-01	1.2E-01	1.5E-01
7.5	2.5E-02	2.3E-02	1.7E-02	1.7E-02
10.5	8.0E-03	3.1E-03	2.6E-03	4.1E-03
13.5	1.0E-03	4.9E-04	4.6E-04	3.3E-04
23.5	3.3E-06	1.3E-06	6.7E-07	1.3E-06

SILT 100 Meter MULTIPLIERS

DEPTH	B	T	E	X
4.5	9.1E-02	2.1E-02	4.5E-03	1.8E-02
5.5	5.3E-03	5.3E-03	5.3E-04	1.6E-03
7.5	6.3E-04	2.8E-04	7.8E-05	1.9E-04
10.5	2.0E-04	3.8E-05	1.2E-05	4.4E-05
13.5	2.5E-05	5.8E-06	2.1E-06	3.6E-06
23.5	8.5E-08	1.6E-08	3.0E-09	1.4E-08

SILT 300 Meter MULTIPLIERS

DEPTH	B	T	E	X
4.5	3.1E-04	1.6E-05	4.8E-07	1.1E-05
5.5	1.8E-05	4.0E-06	5.6E-08	9.5E-07
7.5	2.1E-06	2.1E-07	8.3E-09	1.1E-07
10.5	6.9E-07	2.8E-08	1.2E-09	2.7E-08
13.5	8.7E-08	4.4E-09	2.2E-10	2.1E-09
23.5	2.9E-10	1.2E-11	3.2E-13	8.6E-12

CLAY 0 Meter MULTIPLIERS

DEPTH	B	T	E	X
4.5	3.6E+00	1.7E+00	1.0E+00	1.7E+00
5.5	4.0E-02	1.9E-02	1.2E-02	2.4E-02
7.5	3.3E-04	1.3E-04	9.3E-05	2.0E-04
10.5	2.7E-07	1.8E-07	6.7E-08	2.0E-07
13.5	6.7E-11	6.7E-11	6.7E-10	6.7E-11
23.5	6.7E-11	6.7E-11	6.7E-10	6.7E-11

CLAY 100 Meter MULTIPLIERS

DEPTH	B	T	E	X
4.5	9.1E-02	2.1E-02	4.5E-03	1.8E-02
5.5	1.0E-03	2.3E-04	5.4E-05	2.5E-04
7.5	8.5E-06	1.6E-06	4.2E-07	2.1E-06
10.5	6.8E-09	2.2E-09	3.0E-10	2.1E-09
13.5	1.7E-12	8.0E-13	3.0E-12	7.1E-13
23.5	1.7E-12	8.0E-13	3.0E-12	7.1E-13

CLAY 300 Meter MULTIPLIERS

DEPTH	B	T	E	X
4.5	3.1E-04	1.6E-05	4.8E-07	1.1E-05
5.5	3.5E-06	1.8E-07	5.8E-09	1.5E-07
7.5	2.9E-08	1.2E-09	4.5E-11	1.3E-09
10.5	2.3E-11	1.6E-12	3.2E-14	1.3E-12
13.5	5.8E-15	6.0E-16	3.2E-16	4.3E-16
23.5	5.8E-15	6.0E-16	3.2E-16	4.3E-16

TABLE 3 MULTIPLIERS

SAND 0 Meter MULTIPLIERS

DEPTH	B	T	E	X
4.5	3.6E+00	1.7E+00	1.0E+00	1.7E+00
5.5	9.6E-01	5.1E-01	3.3E-01	4.5E-01
7.5	5.4E-01	2.5E-01	2.1E-01	2.8E-01
10.5	3.6E-01	1.5E-01	1.5E-01	1.9E-01
13.5	2.7E-01	1.1E-01	1.1E-01	1.5E-01
23.5	1.4E-01	6.3E-02	5.8E-02	7.5E-02

SAND 100 Meter MULTIPLIERS

DEPTH	B	T	E	X
4.5	5.6E-01	2.1E-01	8.5E-02	1.9E-01
5.5	1.5E-01	6.2E-02	2.8E-02	5.2E-02
7.5	8.5E-02	3.0E-02	1.8E-02	3.3E-02
10.5	5.7E-02	1.8E-02	1.3E-02	2.2E-02
13.5	4.2E-02	1.4E-02	9.6E-03	1.7E-02
23.5	2.2E-02	7.6E-03	4.9E-03	8.6E-03

SAND 300 Meter MULTIPLIERS

DEPTH	B	T	E	X
4.5	7.4E-02	1.6E-02	3.2E-03	1.4E-02
5.5	2.0E-02	4.7E-03	1.0E-03	3.7E-03
7.5	1.1E-02	2.3E-03	6.7E-04	2.3E-03
10.5	7.4E-03	1.4E-03	4.8E-04	1.6E-03
13.5	5.5E-03	1.1E-03	3.6E-04	1.2E-03
23.5	2.9E-03	5.9E-04	1.8E-04	6.1E-04

SILT 0 Meter MULTIPLIERS

DEPTH	B	T	E	X
4.5	3.6E+00	1.7E+00	1.0E+00	1.7E+00
5.5	1.0E+00	7.7E-01	4.3E-01	5.7E-01
7.5	6.7E-01	3.2E-01	2.4E-01	3.0E-01
10.5	3.3E-01	1.8E-01	1.4E-01	2.0E-01
13.5	2.4E-01	1.2E-01	9.2E-02	1.3E-01
23.5	7.5E-02	3.5E-02	2.6E-02	3.9E-02

SILT 100 Meter MULTIPLIERS

DEPTH	B	T	E	X
4.5	5.6E-01	2.1E-01	8.5E-02	1.9E-01
5.5	1.6E-01	9.3E-02	3.6E-02	6.6E-02
7.5	1.1E-01	3.9E-02	2.1E-02	3.4E-02
10.5	5.3E-02	2.2E-02	1.2E-02	2.3E-02
13.5	3.8E-02	1.4E-02	7.8E-03	1.5E-02
23.5	1.2E-02	4.2E-03	2.2E-03	4.5E-03

SILT 300 Meter MULTIPLIERS

DEPTH	B	T	E	X
4.5	7.4E-02	1.6E-02	3.2E-03	1.4E-02
5.5	2.1E-02	7.1E-03	1.4E-03	4.7E-03
7.5	1.4E-02	3.0E-03	7.8E-04	2.4E-03
10.5	6.9E-03	1.7E-03	4.4E-04	1.6E-03
13.5	5.0E-03	1.1E-03	2.9E-04	1.1E-03
23.5	1.5E-03	3.2E-04	8.3E-05	3.2E-04

CLAY 0 Meter MULTIPLIERS

DEPTH	B	T	E	X
4.5	3.6E+00	1.7E+00	1.0E+00	1.7E+00
5.5	1.3E+00	7.9E-01	5.6E-01	8.3E-01
7.5	7.9E-01	4.3E-01	3.3E-01	4.7E-01
10.5	2.3E-01	1.4E-01	7.1E-02	1.4E-01
13.5	7.7E-02	4.7E-02	3.2E-02	4.8E-02
23.5	1.3E-02	1.3E-02	6.7E-03	1.3E-02

CLAY 100 Meter MULTIPLIERS

DEPTH	B	T	E	X
4.5	5.6E-01	2.1E-01	8.5E-02	1.9E-01
5.5	2.0E-01	9.6E-02	4.7E-02	9.6E-02
7.5	1.3E-01	5.1E-02	2.8E-02	5.5E-02
10.5	3.7E-02	1.7E-02	6.0E-03	1.6E-02
13.5	1.2E-02	5.7E-03	2.7E-03	5.6E-03
23.5	2.1E-03	1.6E-03	5.6E-04	1.5E-03

CLAY 300 Meter MULTIPLIERS

DEPTH	B	T	E	X
4.5	7.4E-02	1.6E-02	3.2E-03	1.4E-02
5.5	2.6E-02	7.3E-03	1.8E-03	6.8E-03
7.5	1.6E-02	3.9E-03	1.1E-03	3.9E-03
10.5	4.8E-03	1.3E-03	2.3E-04	1.2E-03
13.5	1.6E-03	4.4E-04	1.0E-04	3.9E-04
23.5	2.8E-04	1.2E-04	2.1E-05	1.1E-04

Chapter 3. GPS Sensitivity Analysis and Adjustment Factors.

3-1. Introduction

The GPS is a simple model for developing concentration adjustments when attempting to link buried soil contamination with the degree of attenuation which might be anticipated during migration. It permits the calculation of attenuation multipliers (or their inverse: dilution/attenuation factors) after assigning values to a range of variables. In Chapter 2, multipliers were developed for a set of base conditions corresponding to regimes of differing hydrogeologic conditions. In this Chapter, the model will be used to demonstrate how sensitive the multipliers of Chapter 2 are to several changes in the vertical extent of contamination and parameter modifications during the unsaturated zone modeling.

3-2. Background

The Generic Pathway System (GPS) is a combination of models which provide approximate concentration adjustments (or their inverse: dilution/attenuation factors) from buried soil contamination to surface or groundwater concentrations. The model was developed for application to contamination from petroleum underground storage tanks, and considers degradation and dilution to be the principal mechanisms of contaminant concentration attenuation.

The model leads to linear scaling factors which can be applied independent of concentration for low concentrations of contaminants to convert soil concentrations to water or surface concentrations. Similarly, the same multipliers could be used to determine the soil concentration corresponding to a particular water or surface concentration. The linear nature of the multipliers also permits examining the sensitivity of resulting water concentrations or soil standards to a particular parameter value by comparing the multiplier for that and different conditions. The extent to which multipliers for two different conditions differ is also the extent to which the corresponding water concentration or soil standard would differ.

In this Chapter, a comparison is made between the multipliers arrived at in Chapter 2 and a modified set of parameter values. These changes provide additional verification of the calculations presented in Chapter 2, and also provide a quick estimate the general sensitivity of the results to some of the earlier assumptions.

3-3. Modified Model System

The modified model system is shown in Figure 3-1. It is similar to the system

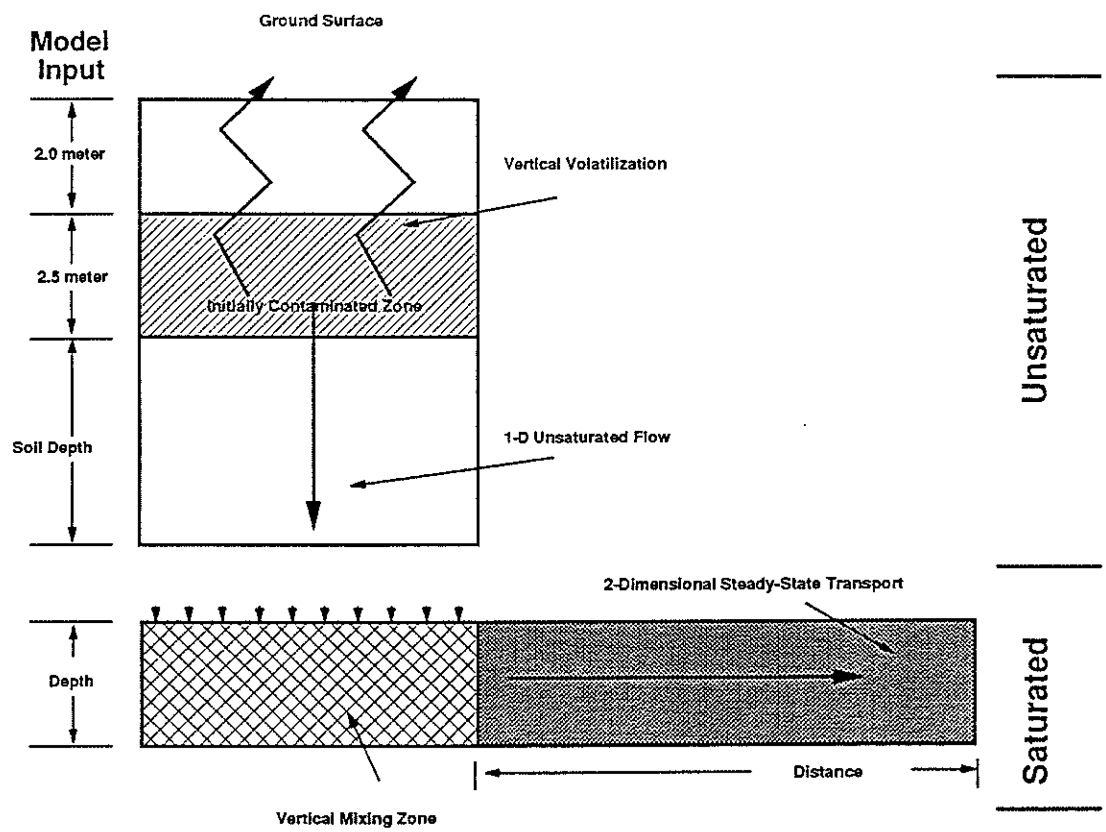

FIGURE 3-1. Modified underground storage tank model system.

used in Chapter 2 except that the depth of contamination is greater (2.5 m versus 1.0 m) and it is closer to the surface (2 m versus 3.5 m). The same contamination zone was used in both the upward and downward pathway modeling. Some SESOIL parameters, most notably, the disconnectedness index, were changed to correspond more closely with those suggested in the literature (Bonazountas and Wagner, 1984). Table 3-1 presents the unsaturated soil parameter values. Saturated zone parameter values were identical to those in Chapter 2 (Tables 2-3 and 2-4).

The effect of the modified parameter set on upward volatilization and surface soil concentration is shown in Tables 3-2 and 3-3. The differences between these results and those of Chapter 2 are relatively minor with the exception of those for the clay. It appears that the less permeable soil is much more sensitive to the disconnectedness index selected.

The results of groundwater pathway simulations performed using the modified unsaturated soil parameters are presented in Appendix B. The extent to which these modifications affect the soil multipliers can be seen in Figure 3-2 which shows the multipliers for the three hydrogeologic regions at a distance of 0 meters. In this case, only the unsaturated soil (SESOIL) and mixing zone adjustments are used.

It is apparent from Figure 3-2 that the modified model, using a deeper zone of contamination and some different SESOIL parameters, leads to multipliers which are similar at shallow soil depths but can vary by factors of 2-5 at greater soil depths. The linear nature of the model means that soil levels derived from the base parameter set would have to be reduced by factors of 2-5 at deeper soil depths if the user was interested in accommodating deeper contamination. Because the saturated zone parameters did not change between the base and this modified set, the factor of 2-5 would not change if 100 and 300 meter distances were examined.

TABLE 3-1 UNSATURATED ZONE TRANSPORT (SESOIL)

Parameter		Value	
		Volatilization/ Surface Soil Pathway	Groundwater Pathway
Contaminated Zone Thickness		2.5 meter	2.5 meter
Contaminated Zone Burial Depth		2.0 meter	2.0 meter
Depth to Saturated Zone		14.5 meter	4.5-23.5 meter
Contaminated Zone Area		1.2×10^6 cm^2	
Soil Bulk Density		1.60 gm/cm^3	
Intrinsic Permeability	Sand	10^{-7} cm^2	
	Silt	10^{-9} cm^2	
	Clay	10^{-10} cm^2	
Disconnectedness Index	Sand	3.7	
	Silt	5.5	
	Clay	7.5	
Organic Carbon Content		0.1%	
Porosity		0.40	
Precipitation/Temperature		Lexington, KY (RISKPRO Data Base)	
SESOIL VOLF (Volatilization)		1.0	0.2

Table 3-2. BTEX SOIL SURFACE CONCENTRATION MULTIPLIERS [1]

Extent of Contamination (refer to Figure 1)	B/T/E/X f_{SS} (mg/kg/mg/kg)		
	Sand	Silt	Clay
Entire 4.5 meter UST Pit Contaminated	1.0/ 1.0/ 1.0/ 1.0	1.0/ 1.0/ 1.0/ 1.0	1.0/ 1.0/ 1.0/ 1.0
2.5 m contaminated below 2.0 m initially clean soil	0.023/ 0.027/ 0.026/ 0.026	0.017/ 0.023/ 0.016/ 0.023	0.012/ 0.012/ 0.003/ 0.008

[1] Upper 30 cm

Table 3-3. BTEX SOIL SURFACE VOLATILIZATION MULTIPLIERS

Extent of Contamination (refer to Figure 1)	B/T/E/X f_{SS} (mg/day/mg/kg)[1]		
	Sand	Silt	Clay
2.5 m contaminated below 2.0 m initially clean soil	4046/ 2136/ 561/ 1512	602/ 527/ 94/ 345	100/ 65/ 5/ 28

(1) Site area of $1.2x10^6 cm^2$

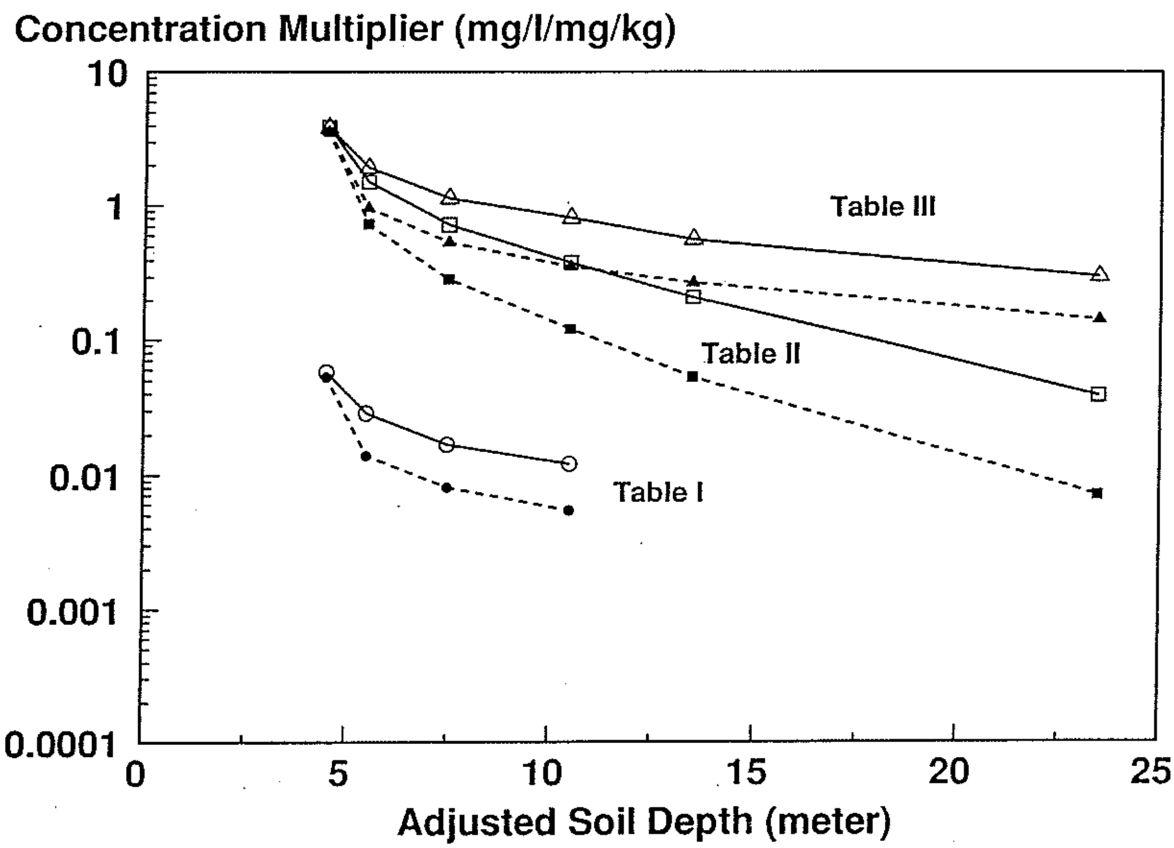

FIGURE 3-2. Groundwater concentration multipliers for the modified system (solid lines) compared to those for the original system (dashed lines). Multipliers shown for sand at 0 meter below the contaminated zone (4.5 meter from surface).

CHAPTER 4. SUMMARY

A generic contaminant migration pathway was used to develop concentration adjustment factors relating soil contamination levels to concentrations in migrating media. These concentration adjustments are based on relatively simple models and parameter values from the literature. The methodology is a screening-level tool and is not designed to be used in the site-specific analysis where additional information on the source of contamination and the local conditions is available.

The results demonstrate that contaminant concentrations can be very sensitive to the processes which occur during the migration of contaminants. Because the rates of these processes may be site specific it is difficult to assign values to many of the parameters required to describe them. The parameter estimates used at the different steps in the analysis are based on the results of a literature investigation and an understanding of the hydrogeology of Kentucky. It is apparent from this study that the multipliers are quite sensitive to parameter values selected, particularly for degradation. The sensitivity of the multipliers reinforces the need to validate these results with monitoring at existing sites. Further research on the anticipated values and conditions will be valuable in refining estimates of contaminant biodegradation for generic standards determination.

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APPENDIX A

Component and Total Multipliers for Base Parameter Value Set

APPENDIX B

Component and Total Mulitipliers for Modified Parameter Value Set

APPENDIX A

Component and Total Groundwater Multipliers for Base Parameter Value Set

MULTIPLIER TABLE EXPLANATION

The multiplier tables present the individual multipliers for the four segments of the groundwater pathway and the total multiplier (the product of the four individual multipliers). The individual column headings and other information from the tables are explained below.

Soil D: Soil depth in meters from the surface. As explained in the text, for the base set of parameters this depth was not exactly the depth used in the simulation (the contaminated zone was below the 4.5 meter pit, not at the base of the 4.5 meter pit), and subsequent simulations demonstrated that values used are slightly higher than values which use a 1 meter zone at the base of the pit (hence conservative with respect to predicting water concentration).

v-gw: velocity of flow in the saturated zone.

v-cont: contaminant velocity in the saturated zone obtained by dividing the flow velocity by the contaminant's retardation factor (assuming 0.1% organic carbon, dry bulk density of 1.6 g/cm^3 and a water filled porosity of 0.4).

THE FOUR COMPONENT MULTIPLIERS

SOIL: The concentration of contaminant in the soil percolate arising from a 1 mg/kg concentration of contamination in the soil at the soil depth indicated. This concentration was determined from a SESOIL simulation and has the units of mg/l.

MIXING: The multiplier arising from dilution in the mixing zone. The depth of the mixing zone is also indicated on the Table.

1-D: The multiplier arising from transport in the longitudinal direction. This is a center line concentration during a steady-state simulation (source concentration constant) and incorporates a degradation term (shown on each Table) and the contaminant velocity.

2-D: The multiplier arising from mixing in the direction transverse to flow. This was only used in Tables 2 and 3. In Table 1, it was assumed that there was no transverse mixing.

THE TOTAL MULTIPLIER

TOTAL: This column is the product of the four component multipliers. It represents the groundwater concentration in mg/l for the distance and conditions shown and 1 mg/kg of contamination in the soil. At relatively low soil concentration (see text), the groundwater concentration corresponding to other soil concentrations can be obtained by linear scaling.

Table 1 - Sand

					distance	0	meter	
					t-1/2	7	days	
					mix depth	100	centimeters	
						1-D	2-D	TOTAL
	Soil D (m)	v-gw	v-cont	SOIL	MIXING	100		
B	4.5	10	7.519	5.35	0.010	1.000	1	5.31E-02
	5.5	10	7.519	1.44	0.010	1.000	1	1.43E-02
	7.5	10	7.519	0.81	0.010	1.000	1	8.04E-03
	10.5	10	7.519	0.54	0.010	1.000	1	5.36E-03
T	4.5	10	4.808	2.61	0.010	1.000	1	2.59E-02
	5.5	10	4.808	0.769	0.010	1.000	1	7.63E-03
	7.5	10	4.808	0.379	0.010	1.000	1	3.76E-03
	10.5	10	4.808	0.229	0.010	1.000	1	2.27E-03
E	4.5	10	3.030	1.51	0.010	1.000	1	1.50E-02
	5.5	10	3.030	0.489	0.010	1.000	1	4.85E-03
	7.5	10	3.030	0.317	0.010	1.000	1	3.15E-03
	10.5	10	3.030	0.224	0.010	1.000	1	2.22E-03
X	4.5	10	4.529	2.48	0.010	1.000	1	2.46E-02
	5.5	10	4.529	0.673	0.010	1.000	1	6.68E-03
	7.5	10	4.529	0.425	0.010	1.000	1	4.22E-03
	10.5	10	4.529	0.288	0.010	1.000	1	2.86E-03

Table 1 - Sand

	distance	100	meter
	t-1/2	7	days
	mix depth	100	centimeters

	Soil D (m)	v-gw	v-cont	SOIL	MIXING	1-D 100	2-D	TOTAL
B	4.5	10	7.519	5.35	0.010	0.472	1	2.50E-02
	5.5	10	7.519	1.44	0.010	0.472	1	6.74E-03
	7.5	10	7.519	0.81	0.010	0.472	1	3.79E-03
	10.5	10	7.519	0.54	0.010	0.472	1	2.53E-03
T	4.5	10	4.808	2.61	0.010	0.361	1	9.35E-03
	5.5	10	4.808	0.769	0.010	0.361	1	2.75E-03
	7.5	10	4.808	0.379	0.010	0.361	1	1.36E-03
	10.5	10	4.808	0.229	0.010	0.361	1	8.20E-04
E	4.5	10	3.030	1.51	0.010	0.253	1	3.79E-03
	5.5	10	3.030	0.489	0.010	0.253	1	1.23E-03
	7.5	10	3.030	0.317	0.010	0.253	1	7.95E-04
	10.5	10	3.030	0.224	0.010	0.253	1	5.62E-04
X	4.5	10	4.529	2.48	0.010	0.346	1	8.52E-03
	5.5	10	4.529	0.673	0.010	0.346	1	2.31E-03
	7.5	10	4.529	0.425	0.010	0.346	1	1.46E-03
	10.5	10	4.529	0.288	0.010	0.346	1	9.90E-04

Table 1 - Sand

distance 300 meter
t-1/2 7 days
mix depth 100 centimeters

	Soil D (m)	v-gw	v-cont	SOIL	MIXING	1-D 100	2-D	TOTAL
B	4.5	10	7.519	5.35	0.010	0.105	1	5.57E-03
	5.5	10	7.519	1.44	0.010	0.105	1	1.50E-03
	7.5	10	7.519	0.81	0.010	0.105	1	8.43E-04
	10.5	10	7.519	0.54	0.010	0.105	1	5.62E-04
T	4.5	10	4.808	2.61	0.010	0.047	1	1.22E-03
	5.5	10	4.808	0.769	0.010	0.047	1	3.58E-04
	7.5	10	4.808	0.379	0.010	0.047	1	1.77E-04
	10.5	10	4.808	0.229	0.010	0.047	1	1.07E-04
E	4.5	10	3.030	1.51	0.010	0.016	1	2.42E-04
	5.5	10	3.030	0.489	0.010	0.016	1	7.84E-05
	7.5	10	3.030	0.317	0.010	0.016	1	5.08E-05
	10.5	10	3.030	0.224	0.010	0.016	1	3.59E-05
X	4.5	10	4.529	2.48	0.010	0.041	1	1.02E-03
	5.5	10	4.529	0.673	0.010	0.041	1	2.77E-04
	7.5	10	4.529	0.425	0.010	0.041	1	1.75E-04
	10.5	10	4.529	0.288	0.010	0.041	1	1.19E-04

Table 1 - Silt

distance 0 meter
t-1/2 7 days
mix depth 100 centimeters

	Soil D (m)	v-gw	v-cont	SOIL	MIXING	1-D 100	2-D	TOTAL
B	4.5	10	7.519	5.35	0.010	1.000	1	5.31E-02
	5.5	10	7.519	1.55	0.010	1.000	1	1.54E-02
	7.5	10	7.519	1	0.010	1.000	1	9.93E-03
	10.5	10	7.519	0.5	0.010	1.000	1	4.96E-03
T	4.5	10	4.808	2.61	0.010	1.000	1	2.59E-02
	5.5	10	4.808	1.152	0.010	1.000	1	1.14E-02
	7.5	10	4.808	0.48	0.010	1.000	1	4.76E-03
	10.5	10	4.808	0.27	0.010	1.000	1	2.68E-03
E	4.5	10	3.030	1.51	0.010	1.000	1	1.50E-02
	5.5	10	3.030	0.647	0.010	1.000	1	6.42E-03
	7.5	10	3.030	0.366	0.010	1.000	1	3.63E-03
	10.5	10	3.030	0.209	0.010	1.000	1	2.07E-03
X	4.5	10	4.529	2.48	0.010	1.000	1	2.46E-02
	5.5	10	4.529	0.857	0.010	1.000	1	8.51E-03
	7.5	10	4.529	0.445	0.010	1.000	1	4.42E-03
	10.5	10	4.529	0.297	0.010	1.000	1	2.95E-03

Table 1 - Silt

					distance	100	meter	
					t-1/2	7	days	
					mix depth	100	centimeters	
						1-D	2-D	TOTAL
	Soil D (m)	v-gw	v-cont	SOIL	MIXING	100		
B	4.5	10	7.519	5.35	0.010	0.472	1	2.50E-02
	5.5	10	7.519	1.55	0.010	0.472	1	7.25E-03
	7.5	10	7.519	1	0.010	0.472	1	4.68E-03
	10.5	10	7.519	0.5	0.010	0.472	1	2.34E-03
T	4.5	10	4.808	2.61	0.010	0.361	1	9.35E-03
	5.5	10	4.808	1.152	0.010	0.361	1	4.12E-03
	7.5	10	4.808	0.48	0.010	0.361	1	1.72E-03
	10.5	10	4.808	0.27	0.010	0.361	1	9.67E-04
E	4.5	10	3.030	1.51	0.010	0.253	1	3.79E-03
	5.5	10	3.030	0.647	0.010	0.253	1	1.62E-03
	7.5	10	3.030	0.366	0.010	0.253	1	9.18E-04
	10.5	10	3.030	0.209	0.010	0.253	1	5.24E-04
X	4.5	10	4.529	2.48	0.010	0.346	1	8.52E-03
	5.5	10	4.529	0.857	0.010	0.346	1	2.94E-03
	7.5	10	4.529	0.445	0.010	0.346	1	1.53E-03
	10.5	10	4.529	0.297	0.010	0.346	1	1.02E-03

Table 1 - Silt

distance 300 meter
t-1/2 7 days
mix depth 100 centimeters

	Soil D (m)	v-gw	v-cont	SOIL	MIXING	1-D 100	2-D	TOTAL
B	4.5	10	7.519	5.35	0.010	0.105	1	5.57E-03
	5.5	10	7.519	1.55	0.010	0.105	1	1.61E-03
	7.5	10	7.519	1	0.010	0.105	1	1.04E-03
	10.5	10	7.519	0.5	0.010	0.105	1	5.20E-04
T	4.5	10	4.808	2.61	0.010	0.047	1	1.22E-03
	5.5	10	4.808	1.152	0.010	0.047	1	5.37E-04
	7.5	10	4.808	0.48	0.010	0.047	1	2.24E-04
	10.5	10	4.808	0.27	0.010	0.047	1	1.26E-04
E	4.5	10	3.030	1.51	0.010	0.016	1	2.42E-04
	5.5	10	3.030	0.647	0.010	0.016	1	1.04E-04
	7.5	10	3.030	0.366	0.010	0.016	1	5.87E-05
	10.5	10	3.030	0.209	0.010	0.016	1	3.35E-05
X	4.5	10	4.529	2.48	0.010	0.041	1	1.02E-03
	5.5	10	4.529	0.857	0.010	0.041	1	3.53E-04
	7.5	10	4.529	0.445	0.010	0.041	1	1.83E-04
	10.5	10	4.529	0.297	0.010	0.041	1	1.22E-04

Table 1 - Clay

distance 0 meter
t-1/2 7 days
mix depth 100 centimeters

	Soil D (m)	v-gw	v-cont	SOIL	MIXING	1-D 100	2-D	TOTAL
B	4.5	10	7.519	5.35	0.010	1.000	1	5.31E-02
	5.5	10	7.519	1.88	0.010	1.000	1	1.87E-02
	7.5	10	7.519	1.19	0.010	1.000	1	1.18E-02
	10.5	10	7.519	0.35	0.010	1.000	1	3.47E-03
T	4.5	10	4.808	2.61	0.010	1.000	1	2.59E-02
	5.5	10	4.808	1.191	0.010	1.000	1	1.18E-02
	7.5	10	4.808	0.638	0.010	1.000	1	6.33E-03
	10.5	10	4.808	0.213	0.010	1.000	1	2.11E-03
E	4.5	10	3.030	1.51	0.010	1.000	1	1.50E-02
	5.5	10	3.030	0.838	0.010	1.000	1	8.32E-03
	7.5	10	3.030	0.496	0.010	1.000	1	4.92E-03
	10.5	10	3.030	0.107	0.010	1.000	1	1.06E-03
X	4.5	10	4.529	2.48	0.010	1.000	1	2.46E-02
	5.5	10	4.529	1.246	0.010	1.000	1	1.24E-02
	7.5	10	4.529	0.709	0.010	1.000	1	7.04E-03
	10.5	10	4.529	0.211	0.010	1.000	1	2.09E-03

Table 1 - Clay

distance 100 meter
t-1/2 7 days
mix depth 100 centimeters

	Soil D (m)	v-gw	v-cont	SOIL	MIXING	1-D 100	2-D	TOTAL
B	4.5	10	7.519	5.35	0.010	0.472	1	2.50E-02
	5.5	10	7.519	1.88	0.010	0.472	1	8.80E-03
	7.5	10	7.519	1.19	0.010	0.472	1	5.57E-03
	10.5	10	7.519	0.35	0.010	0.472	1	1.64E-03
T	4.5	10	4.808	2.61	0.010	0.361	1	9.35E-03
	5.5	10	4.808	1.191	0.010	0.361	1	4.26E-03
	7.5	10	4.808	0.638	0.010	0.361	1	2.28E-03
	10.5	10	4.808	0.213	0.010	0.361	1	7.63E-04
E	4.5	10	3.030	1.51	0.010	0.253	1	3.79E-03
	5.5	10	3.030	0.838	0.010	0.253	1	2.10E-03
	7.5	10	3.030	0.496	0.010	0.253	1	1.24E-03
	10.5	10	3.030	0.107	0.010	0.253	1	2.68E-04
X	4.5	10	4.529	2.48	0.010	0.346	1	8.52E-03
	5.5	10	4.529	1.246	0.010	0.346	1	4.28E-03
	7.5	10	4.529	0.709	0.010	0.346	1	2.44E-03
	10.5	10	4.529	0.211	0.010	0.346	1	7.25E-04

Table 1 - Clay

distance 300 meter
t-1/2 7 days
mix depth 100 centimeters

	Soil D (m)	v-gw	v-cont	SOIL	MIXING	1-D 100	2-D	TOTAL
B	4.5	10	7.519	5.35	0.010	0.105	1	5.57E-03
	5.5	10	7.519	1.88	0.010	0.105	1	1.96E-03
	7.5	10	7.519	1.19	0.010	0.105	1	1.24E-03
	10.5	10	7.519	0.35	0.010	0.105	1	3.64E-04
T	4.5	10	4.808	2.61	0.010	0.047	1	1.22E-03
	5.5	10	4.808	1.191	0.010	0.047	1	5.55E-04
	7.5	10	4.808	0.638	0.010	0.047	1	2.97E-04
	10.5	10	4.808	0.213	0.010	0.047	1	9.92E-05
E	4.5	10	3.030	1.51	0.010	0.016	1	2.42E-04
	5.5	10	3.030	0.838	0.010	0.016	1	1.34E-04
	7.5	10	3.030	0.496	0.010	0.016	1	7.95E-05
	10.5	10	3.030	0.107	0.010	0.016	1	1.71E-05
X	4.5	10	4.529	2.48	0.010	0.041	1	1.02E-03
	5.5	10	4.529	1.246	0.010	0.041	1	5.13E-04
	7.5	10	4.529	0.709	0.010	0.041	1	2.92E-04
	10.5	10	4.529	0.211	0.010	0.041	1	8.69E-05

Table 2- Silt

distance 0 meter
t-1/2 100 days
mix depth 50 centimeters

	Soil D (m)	v-gw	v-cont	SOIL	MIXING	1-D 100	2-D	TOTAL
B	4.5	0.1	0.075	5.35	0.667	1.000	1	3.57E+00
	5.5	0.1	0.075	0.31	0.667	1.000	1	2.07E-01
	7.5	0.1	0.075	0.037	0.667	1.000	1	2.47E-02
	10.5	0.1	0.075	0.012	0.667	1.000	1	8.01E-03
	13.5	0.1	0.075	0.0015	0.667	1.000	1	1.00E-03
	23.5	0.1	0.075	0.000005	0.667	1.000	1	3.34E-06
T	4.5	0.1	0.048	2.61	0.667	1.000	1	1.74E+00
	5.5	0.1	0.048	0.662	0.667	1.000	1	4.42E-01
	7.5	0.1	0.048	0.035	0.667	1.000	1	2.34E-02
	10.5	0.1	0.048	0.0047	0.667	1.000	1	3.14E-03
	13.5	0.1	0.048	0.00073	0.667	1.000	1	4.87E-04
	23.5	0.1	0.048	0.000002	0.667	1.000	1	1.33E-06
E	4.5	0.1	0.030	1.51	0.667	1.000	1	1.01E+00
	5.5	0.1	0.030	0.176	0.667	1.000	1	1.17E-01
	7.5	0.1	0.030	0.026	0.667	1.000	1	1.73E-02
	10.5	0.1	0.030	0.0039	0.667	1.000	1	2.60E-03
	13.5	0.1	0.030	0.00069	0.667	1.000	1	4.60E-04
	23.5	0.1	0.030	0.000001	0.667	1.000	1	6.67E-07
X	4.5	0.1	0.045	2.48	0.667	1.000	1	1.65E+00
	5.5	0.1	0.045	0.221	0.667	1.000	1	1.47E-01
	7.5	0.1	0.045	0.026	0.667	1.000	1	1.73E-02
	10.5	0.1	0.045	0.0062	0.667	1.000	1	4.14E-03
	13.5	0.1	0.045	0.0005	0.667	1.000	1	3.34E-04
	23.5	0.1	0.045	0.000002	0.667	1.000	1	1.33E-06

Table 2- Silt

distance 100 meter
t-1/2 100 days
mix depth 50 centimeters

	Soil D (m)	v-gw	v-cont	SOIL	MIXING	1-D 100	2-D	TOTAL
B	4.5	0.1	0.075	5.35	0.667	0.076	0.334	9.06E-02
	5.5	0.1	0.075	0.31	0.667	0.076	0.334	5.25E-03
	7.5	0.1	0.075	0.037	0.667	0.076	0.334	6.27E-04
	10.5	0.1	0.075	0.012	0.667	0.076	0.334	2.03E-04
	13.5	0.1	0.075	0.0015	0.667	0.076	0.334	2.54E-05
	23.5	0.1	0.075	0.000005	0.667	0.076	0.334	8.47E-08
T	4.5	0.1	0.048	2.61	0.667	0.036	0.334	2.08E-02
	5.5	0.1	0.048	0.662	0.667	0.036	0.334	5.28E-03
	7.5	0.1	0.048	0.035	0.667	0.036	0.334	2.79E-04
	10.5	0.1	0.048	0.0047	0.667	0.036	0.334	3.75E-05
	13.5	0.1	0.048	0.00073	0.667	0.036	0.334	5.83E-06
	23.5	0.1	0.048	0.000002	0.667	0.036	0.334	1.60E-08
E	4.5	0.1	0.030	1.51	0.667	0.013	0.334	4.53E-03
	5.5	0.1	0.030	0.176	0.667	0.013	0.334	5.28E-04
	7.5	0.1	0.030	0.026	0.667	0.013	0.334	7.80E-05
	10.5	0.1	0.030	0.0039	0.667	0.013	0.334	1.17E-05
	13.5	0.1	0.030	0.00069	0.667	0.013	0.334	2.07E-06
	23.5	0.1	0.030	0.000001	0.667	0.013	0.334	3.00E-09
X	4.5	0.1	0.045	2.48	0.667	0.032	0.334	1.77E-02
	5.5	0.1	0.045	0.221	0.667	0.032	0.334	1.57E-03
	7.5	0.1	0.045	0.026	0.667	0.032	0.334	1.85E-04
	10.5	0.1	0.045	0.0062	0.667	0.032	0.334	4.41E-05
	13.5	0.1	0.045	0.0005	0.667	0.032	0.334	3.56E-06
	23.5	0.1	0.045	0.000002	0.667	0.032	0.334	1.42E-08

Table 2- Silt

distance 300 meter
t-1/2 100 days
mix depth 50 centimeters

	Soil D (m)	v-gw	v-cont	SOIL	MIXING	1-D 100	2-D	TOTAL
B	4.5	0.1	0.075	5.35	0.667	4.39E-04	0.197	3.09E-04
	5.5	0.1	0.075	0.31	0.667	4.39E-04	0.197	1.79E-05
	7.5	0.1	0.075	0.037	0.667	4.39E-04	0.197	2.14E-06
	10.5	0.1	0.075	0.012	0.667	4.39E-04	0.197	6.93E-07
	13.5	0.1	0.075	0.0015	0.667	4.39E-04	0.197	8.66E-08
	23.5	0.1	0.075	0.000005	0.667	4.39E-04	0.197	2.89E-10
T	4.5	0.1	0.048	2.61	0.667	4.59E-05	0.197	1.58E-05
	5.5	0.1	0.048	0.662	0.667	4.59E-05	0.197	4.00E-06
	7.5	0.1	0.048	0.035	0.667	4.59E-05	0.197	2.11E-07
	10.5	0.1	0.048	0.0047	0.667	4.59E-05	0.197	2.84E-08
	13.5	0.1	0.048	0.00073	0.667	4.59E-05	0.197	4.41E-09
	23.5	0.1	0.048	0.000002	0.667	4.59E-05	0.197	1.21E-11
E	4.5	0.1	0.030	1.51	0.667	2.44E-06	0.197	4.84E-07
	5.5	0.1	0.030	0.176	0.667	2.44E-06	0.197	5.64E-08
	7.5	0.1	0.030	0.026	0.667	2.44E-06	0.197	8.33E-09
	10.5	0.1	0.030	0.0039	0.667	2.44E-06	0.197	1.25E-09
	13.5	0.1	0.030	0.00069	0.667	2.44E-06	0.197	2.21E-10
	23.5	0.1	0.030	0.000001	0.667	2.44E-06	0.197	3.20E-13
X	4.5	0.1	0.045	2.48	0.667	3.26E-05	0.197	1.06E-05
	5.5	0.1	0.045	0.221	0.667	3.26E-05	0.197	9.48E-07
	7.5	0.1	0.045	0.026	0.667	3.26E-05	0.197	1.11E-07
	10.5	0.1	0.045	0.0062	0.667	3.26E-05	0.197	2.66E-08
	13.5	0.1	0.045	0.0005	0.667	3.26E-05	0.197	2.14E-09
	23.5	0.1	0.045	0.000002	0.667	3.26E-05	0.197	8.58E-12

Table 2- Clay

distance 0 meter
t-1/2 100 days
mix depth 50 centimeters

	Soil D (m)	v-gw	v-cont	SOIL	MIXING	1-D 100	2-D	TOTAL
B	4.5	0.1	0.075	5.35	0.667	1.000	1	3.57E+00
	5.5	0.1	0.075	0.06	0.667	1.000	1	4.00E-02
	7.5	0.1	0.075	0.0005	0.667	1.000	1	3.34E-04
	10.5	0.1	0.075	0.0000004	0.667	1.000	1	2.67E-07
	13.5	0.1	0.075	1E-10	0.667	1.000	1	6.67E-11
	23.5	0.1	0.075	1E-10	0.667	1.000	1	6.67E-11
T	4.5	0.1	0.048	2.61	0.667	1.000	1	1.74E+00
	5.5	0.1	0.048	0.029	0.667	1.000	1	1.93E-02
	7.5	0.1	0.048	0.0002	0.667	1.000	1	1.33E-04
	10.5	0.1	0.048	0.0000003	0.667	1.000	1	2.00E-07
	13.5	0.1	0.048	1E-10	0.667	1.000	1	6.67E-11
	23.5	0.1	0.048	1E-10	0.667	1.000	1	6.67E-11
E	4.5	0.1	0.030	1.51	0.667	1.000	1	1.01E+00
	5.5	0.1	0.030	0.018	0.667	1.000	1	1.20E-02
	7.5	0.1	0.030	0.00014	0.667	1.000	1	9.34E-05
	10.5	0.1	0.030	0.0000001	0.667	1.000	1	6.67E-08
	13.5	0.1	0.030	1E-09	0.667	1.000	1	6.67E-10
	23.5	0.1	0.030	1E-10	0.667	1.000	1	6.67E-11
X	4.5	0.1	0.045	2.48	0.667	1.000	1	1.65E+00
	5.5	0.1	0.045	0.0356	0.667	1.000	1	2.38E-02
	7.5	0.1	0.045	0.0003	0.667	1.000	1	2.00E-04
	10.5	0.1	0.045	0.0000003	0.667	1.000	1	2.00E-07
	13.5	0.1	0.045	1E-10	0.667	1.000	1	6.67E-11
	23.5	0.1	0.045	1E-10	0.667	1.000	1	6.67E-11

Table 2- Clay

distance 100 meter
t-1/2 100 days
mix depth 50 centimeters

	Soil D (m)	v-gw	v-cont	SOIL	MIXING	1-D 100	2-D	TOTAL
B	4.5	0.1	0.075	5.35	0.667	0.076	0.334	9.06E-02
	5.5	0.1	0.075	0.06	0.667	0.076	0.334	1.02E-03
	7.5	0.1	0.075	0.0005	0.667	0.076	0.334	8.47E-06
	10.5	0.1	0.075	0.0000004	0.667	0.076	0.334	6.78E-09
	13.5	0.1	0.075	1E-10	0.667	0.076	0.334	1.69E-12
	23.5	0.1	0.075	1E-10	0.667	0.076	0.334	1.69E-12
T	4.5	0.1	0.048	2.61	0.667	0.036	0.334	2.08E-02
	5.5	0.1	0.048	0.029	0.667	0.036	0.334	2.31E-04
	7.5	0.1	0.048	0.0002	0.667	0.036	0.334	1.60E-06
	10.5	0.1	0.048	0.0000003	0.667	0.036	0.334	2.39E-09
	13.5	0.1	0.048	1E-10	0.667	0.036	0.334	7.98E-13
	23.5	0.1	0.048	1E-10	0.667	0.036	0.334	7.98E-13
E	4.5	0.1	0.030	1.51	0.667	0.013	0.334	4.53E-03
	5.5	0.1	0.030	0.018	0.667	0.013	0.334	5.40E-05
	7.5	0.1	0.030	0.00014	0.667	0.013	0.334	4.20E-07
	10.5	0.1	0.030	0.0000001	0.667	0.013	0.334	3.00E-10
	13.5	0.1	0.030	1E-09	0.667	0.013	0.334	3.00E-12
	23.5	0.1	0.030	1E-09	0.667	0.013	0.334	3.00E-12
X	4.5	0.1	0.045	2.48	0.667	0.032	0.334	1.77E-02
	5.5	0.1	0.045	0.0356	0.667	0.032	0.334	2.53E-04
	7.5	0.1	0.045	0.0003	0.667	0.032	0.334	2.14E-06
	10.5	0.1	0.045	0.0000003	0.667	0.032	0.334	2.14E-09
	13.5	0.1	0.045	1E-10	0.667	0.032	0.334	7.12E-13
	23.5	0.1	0.045	1E-10	0.667	0.032	0.334	7.12E-13

Table 2- Clay

	distance	300	meter
	t-1/2	100	days
	mix depth	50	centimeters

	Soil D (m)	v-gw	v-cont	SOIL	MIXING	1-D 100	2-D	TOTAL
B	4.5	0.1	0.075	5.35	0.667	4.39E-04	0.197	3.09E-04
	5.5	0.1	0.075	0.06	0.667	4.39E-04	0.197	3.46E-06
	7.5	0.1	0.075	0.0005	0.667	4.39E-04	0.197	2.89E-08
	10.5	0.1	0.075	0.0000004	0.667	4.39E-04	0.197	2.31E-11
	13.5	0.1	0.075	1E-10	0.667	4.39E-04	0.197	5.77E-15
	23.5	0.1	0.075	1E-10	0.667	4.39E-04	0.197	5.77E-15
T	4.5	0.1	0.048	2.61	0.667	4.59E-05	0.197	1.58E-05
	5.5	0.1	0.048	0.029	0.667	4.59E-05	0.197	1.75E-07
	7.5	0.1	0.048	0.0002	0.667	4.59E-05	0.197	1.21E-09
	10.5	0.1	0.048	0.0000003	0.667	4.59E-05	0.197	1.81E-12
	13.5	0.1	0.048	1E-10	0.667	4.59E-05	0.197	6.04E-16
	23.5	0.1	0.048	1E-10	0.667	4.59E-05	0.197	6.04E-16
E	4.5	0.1	0.030	1.51	0.667	2.44E-06	0.197	4.84E-07
	5.5	0.1	0.030	0.018	0.667	2.44E-06	0.197	5.77E-09
	7.5	0.1	0.030	0.00014	0.667	2.44E-06	0.197	4.48E-11
	10.5	0.1	0.030	0.0000001	0.667	2.44E-06	0.197	3.20E-14
	13.5	0.1	0.030	1E-09	0.667	2.44E-06	0.197	3.20E-16
	23.5	0.1	0.030	1E-09	0.667	2.44E-06	0.197	3.20E-16
X	4.5	0.1	0.045	2.48	0.667	3.26E-05	0.197	1.06E-05
	5.5	0.1	0.045	0.0356	0.667	3.26E-05	0.197	1.53E-07
	7.5	0.1	0.045	0.0003	0.667	3.26E-05	0.197	1.29E-09
	10.5	0.1	0.045	0.0000003	0.667	3.26E-05	0.197	1.29E-12
	13.5	0.1	0.045	1E-10	0.667	3.26E-05	0.197	4.29E-16
	23.5	0.1	0.045	1E-10	0.667	3.26E-05	0.197	4.29E-16

Table 3 - Sand

distance 0 meter
t-1/2 700 days
mix depth 50 centimeters

	Soil D (m)	v-gw	v-cont	SOIL	MIXING	1-D 100	2-D	TOTAL
B	4.5	0.1	0.075	5.35	0.667	1.000	1	3.5696
	5.5	0.1	0.075	1.44	0.667	1.000	1	0.9608
	7.5	0.1	0.075	0.81	0.667	1.000	1	0.5404
	10.5	0.1	0.075	0.54	0.667	1.000	1	0.3603
	13.5	0.1	0.075	0.4	0.667	1.000	1	0.2669
	23.5	0.1	0.075	0.214	0.667	1.000	1	0.1428
T	4.5	0.1	0.048	2.61	0.667	1.000	1	1.7414
	5.5	0.1	0.048	0.769	0.667	1.000	1	0.5131
	7.5	0.1	0.048	0.379	0.667	1.000	1	0.2529
	10.5	0.1	0.048	0.229	0.667	1.000	1	0.1528
	13.5	0.1	0.048	0.172	0.667	1.000	1	0.1148
	23.5	0.1	0.048	0.095	0.667	1.000	1	0.0634
E	4.5	0.1	0.030	1.51	0.667	1.000	1	1.0075
	5.5	0.1	0.030	0.489	0.667	1.000	1	0.3263
	7.5	0.1	0.030	0.317	0.667	1.000	1	0.2115
	10.5	0.1	0.030	0.224	0.667	1.000	1	0.1495
	13.5	0.1	0.030	0.171	0.667	1.000	1	0.1141
	23.5	0.1	0.030	0.087	0.667	1.000	1	0.0580
X	4.5	0.1	0.045	2.48	0.667	1.000	1	1.6547
	5.5	0.1	0.045	0.673	0.667	1.000	1	0.4490
	7.5	0.1	0.045	0.425	0.667	1.000	1	0.2836
	10.5	0.1	0.045	0.288	0.667	1.000	1	0.1922
	13.5	0.1	0.045	0.223	0.667	1.000	1	0.1488
	23.5	0.1	0.045	0.112	0.667	1.000	1	0.0747

Table 3 - Sand

distance 100 meter
t-1/2 700 days
mix depth 50 centimeters

	Soil D (m)	v-gw	v-cont	SOIL	MIXING	1-D 100	2-D	TOTAL
B	4.5	0.1	0.075	5.35	0.667	0.472	0.334	0.5622
	5.5	0.1	0.075	1.44	0.667	0.472	0.334	0.1513
	7.5	0.1	0.075	0.81	0.667	0.472	0.334	0.0851
	10.5	0.1	0.075	0.54	0.667	0.472	0.334	0.0567
	13.5	0.1	0.075	0.4	0.667	0.472	0.334	0.0420
	23.5	0.1	0.075	0.214	0.667	0.472	0.334	0.0225
T	4.5	0.1	0.048	2.61	0.667	0.361	0.334	0.2098
	5.5	0.1	0.048	0.769	0.667	0.361	0.334	0.0618
	7.5	0.1	0.048	0.379	0.667	0.361	0.334	0.0305
	10.5	0.1	0.048	0.229	0.667	0.361	0.334	0.0184
	13.5	0.1	0.048	0.172	0.667	0.361	0.334	0.0138
	23.5	0.1	0.048	0.095	0.667	0.361	0.334	0.0076
E	4.5	0.1	0.030	1.51	0.667	0.253	0.334	0.0851
	5.5	0.1	0.030	0.489	0.667	0.253	0.334	0.0275
	7.5	0.1	0.030	0.317	0.667	0.253	0.334	0.0179
	10.5	0.1	0.030	0.224	0.667	0.253	0.334	0.0126
	13.5	0.1	0.030	0.171	0.667	0.253	0.334	0.0096
	23.5	0.1	0.030	0.087	0.667	0.253	0.334	0.0049
X	4.5	0.1	0.045	2.48	0.667	0.346	0.334	0.1913
	5.5	0.1	0.045	0.673	0.667	0.346	0.334	0.0519
	7.5	0.1	0.045	0.425	0.667	0.346	0.334	0.0328
	10.5	0.1	0.045	0.288	0.667	0.346	0.334	0.0222
	13.5	0.1	0.045	0.223	0.667	0.346	0.334	0.0172
	23.5	0.1	0.045	0.112	0.667	0.346	0.334	0.0086

Table 3- Sand

	Soil D (m)	v-gw	v-cont	SOIL	MIXING	1-D 100	2-D	TOTAL
					distance	300	meter	
					t-1/2	700	days	
					mix depth	50	centimeters	
B	4.5	0.1	0.075	5.35	0.667	0.105	0.197	7.37E-02
	5.5	0.1	0.075	1.44	0.667	0.105	0.197	1.98E-02
	7.5	0.1	0.075	0.81	0.667	0.105	0.197	1.12E-02
	10.5	0.1	0.075	0.54	0.667	0.105	0.197	7.44E-03
	13.5	0.1	0.075	0.4	0.667	0.105	0.197	5.51E-03
	23.5	0.1	0.075	0.214	0.667	0.105	0.197	2.95E-03
T	4.5	0.1	0.048	2.61	0.667	0.047	0.197	1.61E-02
	5.5	0.1	0.048	0.769	0.667	0.047	0.197	4.74E-03
	7.5	0.1	0.048	0.379	0.667	0.047	0.197	2.34E-03
	10.5	0.1	0.048	0.229	0.667	0.047	0.197	1.41E-03
	13.5	0.1	0.048	0.172	0.667	0.047	0.197	1.06E-03
	23.5	0.1	0.048	0.095	0.667	0.047	0.197	5.86E-04
E	4.5	0.1	0.030	1.51	0.667	0.016	0.197	3.20E-03
	5.5	0.1	0.030	0.489	0.667	0.016	0.197	1.04E-03
	7.5	0.1	0.030	0.317	0.667	0.016	0.197	6.73E-04
	10.5	0.1	0.030	0.224	0.667	0.016	0.197	4.75E-04
	13.5	0.1	0.030	0.171	0.667	0.016	0.197	3.63E-04
	23.5	0.1	0.030	0.087	0.667	0.016	0.197	1.85E-04
X	4.5	0.1	0.045	2.48	0.667	0.041	0.197	1.35E-02
	5.5	0.1	0.045	0.673	0.667	0.041	0.197	3.67E-03
	7.5	0.1	0.045	0.425	0.667	0.041	0.197	2.32E-03
	10.5	0.1	0.045	0.288	0.667	0.041	0.197	1.57E-03
	13.5	0.1	0.045	0.223	0.667	0.041	0.197	1.22E-03
	23.5	0.1	0.045	0.112	0.667	0.041	0.197	6.11E-04

Table 3 - Silt

	Soil D (m)	v-gw	v-cont	SOIL	MIXING	1-D 100	2-D	TOTAL
					distance	0	meter	
					t-1/2	700	days	
					mix depth	50	centimeters	
B	4.5	0.1	0.075	5.35	0.667	1.000	1	3.5696
	5.5	0.1	0.075	1.55	0.667	1.000	1	1.0342
	7.5	0.1	0.075	1	0.667	1.000	1	0.6672
	10.5	0.1	0.075	0.5	0.667	1.000	1	0.3336
	13.5	0.1	0.075	0.361	0.667	1.000	1	0.2409
	23.5	0.1	0.075	0.112	0.667	1.000	1	0.0747
T	4.5	0.1	0.048	2.61	0.667	1.000	1	1.7414
	5.5	0.1	0.048	1.152	0.667	1.000	1	0.7686
	7.5	0.1	0.048	0.48	0.667	1.000	1	0.3203
	10.5	0.1	0.048	0.27	0.667	1.000	1	0.1801
	13.5	0.1	0.048	0.176	0.667	1.000	1	0.1174
	23.5	0.1	0.048	0.0525	0.667	1.000	1	0.0350
E	4.5	0.1	0.030	1.51	0.667	1.000	1	1.0075
	5.5	0.1	0.030	0.647	0.667	1.000	1	0.4317
	7.5	0.1	0.030	0.366	0.667	1.000	1	0.2442
	10.5	0.1	0.030	0.209	0.667	1.000	1	0.1394
	13.5	0.1	0.030	0.138	0.667	1.000	1	0.0921
	23.5	0.1	0.030	0.039	0.667	1.000	1	0.0260
X	4.5	0.1	0.045	2.48	0.667	1.000	1	1.6547
	5.5	0.1	0.045	0.857	0.667	1.000	1	0.5718
	7.5	0.1	0.045	0.445	0.667	1.000	1	0.2969
	10.5	0.1	0.045	0.297	0.667	1.000	1	0.1982
	13.5	0.1	0.045	0.194	0.667	1.000	1	0.1294
	23.5	0.1	0.045	0.058	0.667	1.000	1	0.0387

Table 3 - Silt

					distance	100	meter	
					t-1/2	700	days	
					mix depth	50	centimeters	
						1-D	2-D	TOTAL
	Soil D (m)	v-gw	v-cont	SOIL	MIXING	100		
B	4.5	0.1	0.075	5.35	0.667	0.472	0.334	0.5622
	5.5	0.1	0.075	1.55	0.667	0.472	0.334	0.1629
	7.5	0.1	0.075	1	0.667	0.472	0.334	0.1051
	10.5	0.1	0.075	0.5	0.667	0.472	0.334	0.0525
	13.5	0.1	0.075	0.361	0.667	0.472	0.334	0.0379
	23.5	0.1	0.075	0.112	0.667	0.472	0.334	0.0118
T	4.5	0.1	0.048	2.61	0.667	0.361	0.334	0.2098
	5.5	0.1	0.048	1.152	0.667	0.361	0.334	0.0926
	7.5	0.1	0.048	0.48	0.667	0.361	0.334	0.0386
	10.5	0.1	0.048	0.27	0.667	0.361	0.334	0.0217
	13.5	0.1	0.048	0.176	0.667	0.361	0.334	0.0141
	23.5	0.1	0.048	0.0525	0.667	0.361	0.334	0.0042
E	4.5	0.1	0.030	1.51	0.667	0.253	0.334	0.0851
	5.5	0.1	0.030	0.647	0.667	0.253	0.334	0.0364
	7.5	0.1	0.030	0.366	0.667	0.253	0.334	0.0206
	10.5	0.1	0.030	0.209	0.667	0.253	0.334	0.0118
	13.5	0.1	0.030	0.138	0.667	0.253	0.334	0.0078
	23.5	0.1	0.030	0.039	0.667	0.253	0.334	0.0022
X	4.5	0.1	0.045	2.48	0.667	0.346	0.334	0.1913
	5.5	0.1	0.045	0.857	0.667	0.346	0.334	0.0661
	7.5	0.1	0.045	0.445	0.667	0.346	0.334	0.0343
	10.5	0.1	0.045	0.297	0.667	0.346	0.334	0.0229
	13.5	0.1	0.045	0.194	0.667	0.346	0.334	0.0150
	23.5	0.1	0.045	0.058	0.667	0.346	0.334	0.0045

Table 3 - Silt

distance 300 meter
t-1/2 700 days
mix depth 50 centimeters

	Soil D (m)	v-gw	v-cont	SOIL	MIXING	1-D 100	2-D	TOTAL
B	4.5	0.1	0.075	5.35	0.667	0.105	0.197	7.37E-02
	5.5	0.1	0.075	1.55	0.667	0.105	0.197	2.14E-02
	7.5	0.1	0.075	1	0.667	0.105	0.197	1.38E-02
	10.5	0.1	0.075	0.5	0.667	0.105	0.197	6.89E-03
	13.5	0.1	0.075	0.361	0.667	0.105	0.197	4.98E-03
	23.5	0.1	0.075	0.112	0.667	0.105	0.197	1.54E-03
T	4.5	0.1	0.048	2.61	0.667	0.047	0.197	1.61E-02
	5.5	0.1	0.048	1.152	0.667	0.047	0.197	7.11E-03
	7.5	0.1	0.048	0.48	0.667	0.047	0.197	2.96E-03
	10.5	0.1	0.048	0.27	0.667	0.047	0.197	1.67E-03
	13.5	0.1	0.048	0.176	0.667	0.047	0.197	1.09E-03
	23.5	0.1	0.048	0.0525	0.667	0.047	0.197	3.24E-04
E	4.5	0.1	0.030	1.51	0.667	0.016	0.197	3.20E-03
	5.5	0.1	0.030	0.647	0.667	0.016	0.197	1.37E-03
	7.5	0.1	0.030	0.366	0.667	0.016	0.197	7.77E-04
	10.5	0.1	0.030	0.209	0.667	0.016	0.197	4.44E-04
	13.5	0.1	0.030	0.138	0.667	0.016	0.197	2.93E-04
	23.5	0.1	0.030	0.039	0.667	0.016	0.197	8.28E-05
X	4.5	0.1	0.045	2.48	0.667	0.041	0.197	1.35E-02
	5.5	0.1	0.045	0.857	0.667	0.041	0.197	4.67E-03
	7.5	0.1	0.045	0.445	0.667	0.041	0.197	2.43E-03
	10.5	0.1	0.045	0.297	0.667	0.041	0.197	1.62E-03
	13.5	0.1	0.045	0.194	0.667	0.041	0.197	1.06E-03
	23.5	0.1	0.045	0.058	0.667	0.041	0.197	3.16E-04

Table 3 - Clay

					distance	0	meter	
					t-1/2	700	days	
					mix depth	50	centimeters	
						1-D	2-D	TOTAL
	Soil D (m)	v-gw	v-cont	SOIL	MIXING	100		
B	4.5	0.1	0.075	5.35	0.667	1.000	1	3.5696
	5.5	0.1	0.075	1.88	0.667	1.000	1	1.2544
	7.5	0.1	0.075	1.19	0.667	1.000	1	0.7940
	10.5	0.1	0.075	0.35	0.667	1.000	1	0.2335
	13.5	0.1	0.075	0.115	0.667	1.000	1	0.0767
	23.5	0.1	0.075	0.02	0.667	1.000	1	0.0133
T	4.5	0.1	0.048	2.61	0.667	1.000	1	1.7414
	5.5	0.1	0.048	1.191	0.667	1.000	1	0.7947
	7.5	0.1	0.048	0.638	0.667	1.000	1	0.4257
	10.5	0.1	0.048	0.213	0.667	1.000	1	0.1421
	13.5	0.1	0.048	0.071	0.667	1.000	1	0.0474
	23.5	0.1	0.048	0.02	0.667	1.000	1	0.0133
E	4.5	0.1	0.030	1.51	0.667	1.000	1	1.0075
	5.5	0.1	0.030	0.838	0.667	1.000	1	0.5591
	7.5	0.1	0.030	0.496	0.667	1.000	1	0.3309
	10.5	0.1	0.030	0.107	0.667	1.000	1	0.0714
	13.5	0.1	0.030	0.048	0.667	1.000	1	0.0320
	23.5	0.1	0.030	0.01	0.667	1.000	1	0.0067
X	4.5	0.1	0.045	2.48	0.667	1.000	1	1.6547
	5.5	0.1	0.045	1.246	0.667	1.000	1	0.8314
	7.5	0.1	0.045	0.709	0.667	1.000	1	0.4731
	10.5	0.1	0.045	0.211	0.667	1.000	1	0.1408
	13.5	0.1	0.045	0.072	0.667	1.000	1	0.0480
	23.5	0.1	0.045	0.02	0.667	1.000	1	0.0133

Table 3 - Clay

distance 100 meter
t-1/2 700 days
mix depth 50 centimeters

	Soil D (m)	v-gw	v-cont	SOIL	MIXING	1-D 100	2-D	TOTAL
B	4.5	0.1	0.075	5.35	0.667	0.472	0.334	0.5622
	5.5	0.1	0.075	1.88	0.667	0.472	0.334	0.1976
	7.5	0.1	0.075	1.19	0.667	0.472	0.334	0.1251
	10.5	0.1	0.075	0.35	0.667	0.472	0.334	0.0368
	13.5	0.1	0.075	0.115	0.667	0.472	0.334	0.0121
	23.5	0.1	0.075	0.02	0.667	0.472	0.334	0.0021
T	4.5	0.1	0.048	2.61	0.667	0.361	0.334	0.2098
	5.5	0.1	0.048	1.191	0.667	0.361	0.334	0.0957
	7.5	0.1	0.048	0.638	0.667	0.361	0.334	0.0513
	10.5	0.1	0.048	0.213	0.667	0.361	0.334	0.0171
	13.5	0.1	0.048	0.071	0.667	0.361	0.334	0.0057
	23.5	0.1	0.048	0.02	0.667	0.361	0.334	0.0016
E	4.5	0.1	0.030	1.51	0.667	0.253	0.334	0.0851
	5.5	0.1	0.030	0.838	0.667	0.253	0.334	0.0472
	7.5	0.1	0.030	0.496	0.667	0.253	0.334	0.0279
	10.5	0.1	0.030	0.107	0.667	0.253	0.334	0.0060
	13.5	0.1	0.030	0.048	0.667	0.253	0.334	0.0027
	23.5	0.1	0.030	0.01	0.667	0.253	0.334	0.0006
X	4.5	0.1	0.045	2.48	0.667	0.346	0.334	0.1913
	5.5	0.1	0.045	1.246	0.667	0.346	0.334	0.0961
	7.5	0.1	0.045	0.709	0.667	0.346	0.334	0.0547
	10.5	0.1	0.045	0.211	0.667	0.346	0.334	0.0163
	13.5	0.1	0.045	0.072	0.667	0.346	0.334	0.0056
	23.5	0.1	0.045	0.02	0.667	0.346	0.334	0.0015

Table 3 - Clay

					distance	300	meter	
					t-1/2	700	days	
					mix depth	50	centimeters	
						1-D	2-D	TOTAL
	Soil D (m)	v-gw	v-cont	SOIL	MIXING	100		
B	4.5	0.1	0.075	5.35	0.667	0.105	0.197	7.37E-02
	5.5	0.1	0.075	1.88	0.667	0.105	0.197	2.59E-02
	7.5	0.1	0.075	1.19	0.667	0.105	0.197	1.64E-02
	10.5	0.1	0.075	0.35	0.667	0.105	0.197	4.82E-03
	13.5	0.1	0.075	0.115	0.667	0.105	0.197	1.59E-03
	23.5	0.1	0.075	0.02	0.667	0.105	0.197	2.76E-04
T	4.5	0.1	0.048	2.61	0.667	0.047	0.197	1.61E-02
	5.5	0.1	0.048	1.191	0.667	0.047	0.197	7.35E-03
	7.5	0.1	0.048	0.638	0.667	0.047	0.197	3.94E-03
	10.5	0.1	0.048	0.213	0.667	0.047	0.197	1.31E-03
	13.5	0.1	0.048	0.071	0.667	0.047	0.197	4.38E-04
	23.5	0.1	0.048	0.02	0.667	0.047	0.197	1.23E-04
E	4.5	0.1	0.030	1.51	0.667	0.016	0.197	3.20E-03
	5.5	0.1	0.030	0.838	0.667	0.016	0.197	1.78E-03
	7.5	0.1	0.030	0.496	0.667	0.016	0.197	1.05E-03
	10.5	0.1	0.030	0.107	0.667	0.016	0.197	2.27E-04
	13.5	0.1	0.030	0.048	0.667	0.016	0.197	1.02E-04
	23.5	0.1	0.030	0.01	0.667	0.016	0.197	2.12E-05
X	4.5	0.1	0.045	2.48	0.667	0.041	0.197	1.35E-02
	5.5	0.1	0.045	1.246	0.667	0.041	0.197	6.80E-03
	7.5	0.1	0.045	0.709	0.667	0.041	0.197	3.87E-03
	10.5	0.1	0.045	0.211	0.667	0.041	0.197	1.15E-03
	13.5	0.1	0.045	0.072	0.667	0.041	0.197	3.93E-04
	23.5	0.1	0.045	0.02	0.667	0.041	0.197	1.09E-04

APPENDIX B

Component and Total Groundwater Multipliers for Modified Parameter Value Set

Table 1 - Sand

distance 0 meter
t-1/2 7 days
mix depth 100 centimeters

	Soil D (m)	v-gw	v-cont	SOIL	MIXING	1-D 100	2-D	TOTAL
B	4.5	10	7.519	5.8	0.010	1.000	1	5.76E-02
	5.5	10	7.519	2.25	0.010	1.000	1	2.23E-02
	6.5	10	7.519	1.7	0.010	1.000	1	1.69E-02
	7.5	10	7.519	1.08	0.010	1.000	1	1.07E-02
	10.5	10	7.519	0.58	0.010	1.000	1	5.76E-03
T	4.5	10	4.808	2.7	0.010	1.000	1	2.68E-02
	5.5	10	4.808	0.97	0.010	1.000	1	9.63E-03
	6.5	10	4.808	0.65	0.010	1.000	1	6.45E-03
	7.5	10	4.808	0.46	0.010	1.000	1	4.57E-03
	10.5	10	4.808	0.22	0.010	1.000	1	2.18E-03
E	4.5	10	3.030	1.56	0.010	1.000	1	1.55E-02
	5.5	10	3.030	0.74	0.010	1.000	1	7.34E-03
	6.5	10	3.030	0.56	0.010	1.000	1	5.56E-03
	7.5	10	3.030	0.43	0.010	1.000	1	4.27E-03
	10.5	10	3.030	0.23	0.010	1.000	1	2.28E-03
X	4.5	10	4.529	2.6	0.010	1.000	1	2.58E-02
	5.5	10	4.529	1.04	0.010	1.000	1	1.03E-02
	6.5	10	4.529	0.75	0.010	1.000	1	7.44E-03
	7.5	10	4.529	0.58	0.010	1.000	1	5.76E-03
	10.5	10	4.529	0.28	0.010	1.000	1	2.78E-03

Table 1 - Sand

distance 100 meter
t-1/2 7 days
mix depth 100 centimeters

	Soil D (m)	v-gw	v-cont	SOIL	MIXING	1-D 100	2-D	TOTAL
B	4.5	10	7.519	5.8	0.010	0.472	0.334	9.07E-03
	5.5	10	7.519	2.25	0.010	0.472	0.334	3.52E-03
	6.5	10	7.519	1.7	0.010	0.472	0.334	2.66E-03
	7.5	10	7.519	1.08	0.010	0.472	0.334	1.69E-03
	10.5	10	7.519	0.58	0.010	0.472	0.334	9.07E-04
T	4.5	10	4.808	2.7	0.010	0.361	0.334	3.23E-03
	5.5	10	4.808	0.97	0.010	0.361	0.334	1.16E-03
	6.5	10	4.808	0.65	0.010	0.361	0.334	7.77E-04
	7.5	10	4.808	0.46	0.010	0.361	0.334	5.50E-04
	10.5	10	4.808	0.22	0.010	0.361	0.334	2.63E-04
E	4.5	10	3.030	1.56	0.010	0.253	0.334	1.31E-03
	5.5	10	3.030	0.74	0.010	0.253	0.334	6.20E-04
	6.5	10	3.030	0.56	0.010	0.253	0.334	4.69E-04
	7.5	10	3.030	0.43	0.010	0.253	0.334	3.60E-04
	10.5	10	3.030	0.23	0.010	0.253	0.334	1.93E-04
X	4.5	10	4.529	2.6	0.010	0.346	0.334	2.98E-03
	5.5	10	4.529	1.04	0.010	0.346	0.334	1.19E-03
	6.5	10	4.529	0.75	0.010	0.346	0.334	8.61E-04
	7.5	10	4.529	0.58	0.010	0.346	0.334	6.66E-04
	10.5	10	4.529	0.28	0.010	0.346	0.334	3.21E-04

Table 1 - Sand

					distance	300	meter	
					t-1/2	7	days	
					mix depth	100	centimeters	
						1-D	2-D	TOTAL
	Soil D (m)	v-gw	v-cont	SOIL	MIXING	100		
B	4.5	10	7.519	5.8	0.010	0.105	0.197	1.19E-03
	5.5	10	7.519	2.25	0.010	0.105	0.197	4.61E-04
	6.5	10	7.519	1.7	0.010	0.105	0.197	3.49E-04
	7.5	10	7.519	1.08	0.010	0.105	0.197	2.21E-04
	10.5	10	7.519	0.58	0.010	0.105	0.197	1.19E-04
T	4.5	10	4.808	2.7	0.010	0.047	0.197	2.48E-04
	5.5	10	4.808	0.97	0.010	0.047	0.197	8.90E-05
	6.5	10	4.808	0.65	0.010	0.047	0.197	5.97E-05
	7.5	10	4.808	0.46	0.010	0.047	0.197	4.22E-05
	10.5	10	4.808	0.22	0.010	0.047	0.197	2.02E-05
E	4.5	10	3.030	1.56	0.010	0.016	0.197	4.92E-05
	5.5	10	3.030	0.74	0.010	0.016	0.197	2.34E-05
	6.5	10	3.030	0.56	0.010	0.016	0.197	1.77E-05
	7.5	10	3.030	0.43	0.010	0.016	0.197	1.36E-05
	10.5	10	3.030	0.23	0.010	0.016	0.197	7.26E-06
X	4.5	10	4.529	2.6	0.010	0.041	0.197	2.11E-04
	5.5	10	4.529	1.04	0.010	0.041	0.197	8.44E-05
	6.5	10	4.529	0.75	0.010	0.041	0.197	6.08E-05
	7.5	10	4.529	0.58	0.010	0.041	0.197	4.71E-05
	10.5	10	4.529	0.28	0.010	0.041	0.197	2.27E-05

Table 2 - Sand

					distance	0	meter	
					t-1/2	100	days	
					mix depth	50	centimeters	
						1-D	2-D	TOTAL
	Soil D (m)	v-gw	v-cont	SOIL	MIXING	100		
B	4.5	0.1	0.075	5.8	0.667	1.000	1	3.8699
	5.5	0.1	0.075	2.25	0.667	1.000	1	1.5012
	6.5	0.1	0.075	1.7	0.667	1.000	1	1.1343
	7.5	0.1	0.075	1.08	0.667	1.000	1	0.7206
	10.5	0.1	0.075	0.58	0.667	1.000	1	0.3870
	13.5	0.1	0.075	0.31	0.667	1.000	1	0.2068
	23.5	0.1	0.075	0.058	0.667	1.000	1	0.0387
T	4.5	0.1	0.048	2.7	0.667	1.000	1	1.8015
	5.5	0.1	0.048	0.97	0.667	1.000	1	0.6472
	6.5	0.1	0.048	0.65	0.667	1.000	1	0.4337
	7.5	0.1	0.048	0.46	0.667	1.000	1	0.3069
	10.5	0.1	0.048	0.22	0.667	1.000	1	0.1468
	13.5	0.1	0.048	0.117	0.667	1.000	1	0.0781
	23.5	0.1	0.048	0.024	0.667	1.000	1	0.0160
E	4.5	0.1	0.030	1.56	0.667	1.000	1	1.0409
	5.5	0.1	0.030	0.74	0.667	1.000	1	0.4937
	6.5	0.1	0.030	0.56	0.667	1.000	1	0.3736
	7.5	0.1	0.030	0.43	0.667	1.000	1	0.2869
	10.5	0.1	0.030	0.23	0.667	1.000	1	0.1535
	13.5	0.1	0.030	0.13	0.667	1.000	1	0.0867
	23.5	0.1	0.030	0.027	0.667	1.000	1	0.0180
X	4.5	0.1	0.045	2.6	0.667	1.000	1	1.7348
	5.5	0.1	0.045	1.04	0.667	1.000	1	0.6939
	6.5	0.1	0.045	0.75	0.667	1.000	1	0.5004
	7.5	0.1	0.045	0.58	0.667	1.000	1	0.3870
	10.5	0.1	0.045	0.28	0.667	1.000	1	0.1868
	13.5	0.1	0.045	0.159	0.667	1.000	1	0.1061
	23.5	0.1	0.045	0.032	0.667	1.000	1	0.0214

Table 2 - Sand

	Soil D (m)	v-gw	v-cont	SOIL	distance t-1/2 mix depth MIXING	100 100 50 1-D 100	meter days centimeters 2-D	TOTAL
B	4.5	0.1	0.075	5.8	0.667	0.076	0.334	9.83E-02
	5.5	0.1	0.075	2.25	0.667	0.076	0.334	3.81E-02
	6.5	0.1	0.075	1.7	0.667	0.076	0.334	2.88E-02
	7.5	0.1	0.075	1.08	0.667	0.076	0.334	1.83E-02
	10.5	0.1	0.075	0.58	0.667	0.076	0.334	9.83E-03
	13.5	0.1	0.075	0.31	0.667	0.076	0.334	5.25E-03
	23.5	0.1	0.075	0.058	0.667	0.076	0.334	9.83E-04
T	4.5	0.1	0.048	2.7	0.667	0.036	0.334	2.15E-02
	5.5	0.1	0.048	0.97	0.667	0.036	0.334	7.74E-03
	6.5	0.1	0.048	0.65	0.667	0.036	0.334	5.19E-03
	7.5	0.1	0.048	0.46	0.667	0.036	0.334	3.67E-03
	10.5	0.1	0.048	0.22	0.667	0.036	0.334	1.76E-03
	13.5	0.1	0.048	0.117	0.667	0.036	0.334	9.34E-04
	23.5	0.1	0.048	0.024	0.667	0.036	0.334	1.92E-04
E	4.5	0.1	0.030	1.56	0.667	0.013	0.334	4.68E-03
	5.5	0.1	0.030	0.74	0.667	0.013	0.334	2.22E-03
	6.5	0.1	0.030	0.56	0.667	0.013	0.334	1.68E-03
	7.5	0.1	0.030	0.43	0.667	0.013	0.334	1.29E-03
	10.5	0.1	0.030	0.23	0.667	0.013	0.334	6.90E-04
	13.5	0.1	0.030	0.13	0.667	0.013	0.334	3.90E-04
	23.5	0.1	0.030	0.027	0.667	0.013	0.334	8.10E-05
X	4.5	0.1	0.045	2.6	0.667	0.032	0.334	1.85E-02
	5.5	0.1	0.045	1.04	0.667	0.032	0.334	7.41E-03
	6.5	0.1	0.045	0.75	0.667	0.032	0.334	5.34E-03
	7.5	0.1	0.045	0.58	0.667	0.032	0.334	4.13E-03
	10.5	0.1	0.045	0.28	0.667	0.032	0.334	1.99E-03
	13.5	0.1	0.045	0.159	0.667	0.032	0.334	1.13E-03
	23.5	0.1	0.045	0.032	0.667	0.032	0.334	2.28E-04

Table 2 - Sand

distance 300 meter
t-1/2 100 days
mix depth 50 centimeters

	Soil D (m)	v-gw	v-cont	SOIL	MIXING	1-D 100	2-D	TOTAL
B	4.5	0.1	0.075	5.8	0.667	4.39E-04	0.197	3.35E-04
	5.5	0.1	0.075	2.25	0.667	4.39E-04	0.197	1.30E-04
	6.5	0.1	0.075	1.7	0.667	4.39E-04	0.197	9.81E-05
	7.5	0.1	0.075	1.08	0.667	4.39E-04	0.197	6.24E-05
	10.5	0.1	0.075	0.58	0.667	4.39E-04	0.197	3.35E-05
	13.5	0.1	0.075	0.31	0.667	4.39E-04	0.197	1.79E-05
	23.5	0.1	0.075	0.058	0.667	4.39E-04	0.197	3.35E-06
T	4.5	0.1	0.048	2.7	0.667	4.59E-05	0.197	1.63E-05
	5.5	0.1	0.048	0.97	0.667	4.59E-05	0.197	5.86E-06
	6.5	0.1	0.048	0.65	0.667	4.59E-05	0.197	3.92E-06
	7.5	0.1	0.048	0.46	0.667	4.59E-05	0.197	2.78E-06
	10.5	0.1	0.048	0.22	0.667	4.59E-05	0.197	1.33E-06
	13.5	0.1	0.048	0.117	0.667	4.59E-05	0.197	7.06E-07
	23.5	0.1	0.048	0.024	0.667	4.59E-05	0.197	1.45E-07
E	4.5	0.1	0.030	1.56	0.667	2.44E-06	0.197	5.00E-07
	5.5	0.1	0.030	0.74	0.667	2.44E-06	0.197	2.37E-07
	6.5	0.1	0.030	0.56	0.667	2.44E-06	0.197	1.79E-07
	7.5	0.1	0.030	0.43	0.667	2.44E-06	0.197	1.38E-07
	10.5	0.1	0.030	0.23	0.667	2.44E-06	0.197	7.37E-08
	13.5	0.1	0.030	0.13	0.667	2.44E-06	0.197	4.16E-08
	23.5	0.1	0.030	0.027	0.667	2.44E-06	0.197	8.65E-09
X	4.5	0.1	0.045	2.6	0.667	3.26E-05	0.197	1.11E-05
	5.5	0.1	0.045	1.04	0.667	3.26E-05	0.197	4.46E-06
	6.5	0.1	0.045	0.75	0.667	3.26E-05	0.197	3.22E-06
	7.5	0.1	0.045	0.58	0.667	3.26E-05	0.197	2.49E-06
	10.5	0.1	0.045	0.28	0.667	3.26E-05	0.197	1.20E-06
	13.5	0.1	0.045	0.159	0.667	3.26E-05	0.197	6.82E-07
	23.5	0.1	0.045	0.032	0.667	3.26E-05	0.197	1.37E-07

Table 3 - Sand

distance 0 meter
t-1/2 700 days
mix depth 50 centimeters

	Soil D (m)	v-gw	v-cont	SOIL	MIXING	1-D 100	2-D	TOTAL
B	4.5	0.1	0.075	5.8	0.667	1.000	1	3.8699
	5.5	0.1	0.075	2.9	0.667	1.000	1	1.9349
	6.5	0.1	0.075	2.3	0.667	1.000	1	1.5346
	7.5	0.1	0.075	1.7	0.667	1.000	1	1.1343
	10.5	0.1	0.075	1.22	0.667	1.000	1	0.8140
	13.5	0.1	0.075	0.85	0.667	1.000	1	0.5671
	23.5	0.1	0.075	0.45	0.667	1.000	1	0.3002
T	4.5	0.1	0.048	2.7	0.667	1.000	1	1.8015
	5.5	0.1	0.048	1.22	0.667	1.000	1	0.8140
	6.5	0.1	0.048	0.9	0.667	1.000	1	0.6005
	7.5	0.1	0.048	0.73	0.667	1.000	1	0.4871
	10.5	0.1	0.048	0.47	0.667	1.000	1	0.3136
	13.5	0.1	0.048	0.34	0.667	1.000	1	0.2269
	23.5	0.1	0.048	0.18	0.667	1.000	1	0.1201
E	4.5	0.1	0.030	1.56	0.667	1.000	1	1.0409
	5.5	0.1	0.030	0.94	0.667	1.000	1	0.6272
	6.5	0.1	0.030	0.78	0.667	1.000	1	0.5204
	7.5	0.1	0.030	0.67	0.667	1.000	1	0.4470
	10.5	0.1	0.030	0.48	0.667	1.000	1	0.3203
	13.5	0.1	0.030	0.38	0.667	1.000	1	0.2535
	23.5	0.1	0.030	0.21	0.667	1.000	1	0.1401
X	4.5	0.1	0.045	2.6	0.667	1.000	1	1.7348
	5.5	0.1	0.045	1.37	0.667	1.000	1	0.9141
	6.5	0.1	0.045	1.06	0.667	1.000	1	0.7073
	7.5	0.1	0.045	0.9	0.667	1.000	1	0.6005
	10.5	0.1	0.045	0.6	0.667	1.000	1	0.4003
	13.5	0.1	0.045	0.45	0.667	1.000	1	0.3002
	23.5	0.1	0.045	0.24	0.667	1.000	1	0.1601

Table 3 - Sand

distance 100 meter
t-1/2 700 days
mix depth 50 centimeters

	Soil D (m)	v-gw	v-cont	SOIL	MIXING	1-D 100	2-D	TOTAL
B	4.5	0.1	0.075	5.8	0.667	0.472	0.334	0.6095
	5.5	0.1	0.075	2.9	0.667	0.472	0.334	0.3048
	6.5	0.1	0.075	2.3	0.667	0.472	0.334	0.2417
	7.5	0.1	0.075	1.7	0.667	0.472	0.334	0.1787
	10.5	0.1	0.075	1.22	0.667	0.472	0.334	0.1282
	13.5	0.1	0.075	0.85	0.667	0.472	0.334	0.0893
	23.5	0.1	0.075	0.45	0.667	0.472	0.334	0.0473
T	4.5	0.1	0.048	2.7	0.667	0.361	0.334	0.2171
	5.5	0.1	0.048	1.22	0.667	0.361	0.334	0.0981
	6.5	0.1	0.048	0.9	0.667	0.361	0.334	0.0724
	7.5	0.1	0.048	0.73	0.667	0.361	0.334	0.0587
	10.5	0.1	0.048	0.47	0.667	0.361	0.334	0.0378
	13.5	0.1	0.048	0.34	0.667	0.361	0.334	0.0273
	23.5	0.1	0.048	0.18	0.667	0.361	0.334	0.0145
E	4.5	0.1	0.030	1.56	0.667	0.253	0.334	0.0879
	5.5	0.1	0.030	0.94	0.667	0.253	0.334	0.0529
	6.5	0.1	0.030	0.78	0.667	0.253	0.334	0.0439
	7.5	0.1	0.030	0.67	0.667	0.253	0.334	0.0377
	10.5	0.1	0.030	0.48	0.667	0.253	0.334	0.0270
	13.5	0.1	0.030	0.38	0.667	0.253	0.334	0.0214
	23.5	0.1	0.030	0.21	0.667	0.253	0.334	0.0118
X	4.5	0.1	0.045	2.6	0.667	0.346	0.334	0.2006
	5.5	0.1	0.045	1.37	0.667	0.346	0.334	0.1057
	6.5	0.1	0.045	1.06	0.667	0.346	0.334	0.0818
	7.5	0.1	0.045	0.9	0.667	0.346	0.334	0.0694
	10.5	0.1	0.045	0.6	0.667	0.346	0.334	0.0463
	13.5	0.1	0.045	0.45	0.667	0.346	0.334	0.0347
	23.5	0.1	0.045	0.24	0.667	0.346	0.334	0.0185

Table 3 - Sand

					distance	300	meter	
					t-1/2	700	days	
					mix depth	50	centimeters	
						1-D	2-D	TOTAL
	Soil D (m)	v-gw	v-cont	SOIL	MIXING	100		
B	4.5	0.1	0.075	5.8	0.667	0.105	0.197	7.99E-02
	5.5	0.1	0.075	2.9	0.667	0.105	0.197	4.00E-02
	6.5	0.1	0.075	2.3	0.667	0.105	0.197	3.17E-02
	7.5	0.1	0.075	1.7	0.667	0.105	0.197	2.34E-02
	10.5	0.1	0.075	1.22	0.667	0.105	0.197	1.68E-02
	13.5	0.1	0.075	0.85	0.667	0.105	0.197	1.17E-02
	23.5	0.1	0.075	0.45	0.667	0.105	0.197	6.20E-03
T	4.5	0.1	0.048	2.7	0.667	0.047	0.197	1.67E-02
	5.5	0.1	0.048	1.22	0.667	0.047	0.197	7.53E-03
	6.5	0.1	0.048	0.9	0.667	0.047	0.197	5.55E-03
	7.5	0.1	0.048	0.73	0.667	0.047	0.197	4.50E-03
	10.5	0.1	0.048	0.47	0.667	0.047	0.197	2.90E-03
	13.5	0.1	0.048	0.34	0.667	0.047	0.197	2.10E-03
	23.5	0.1	0.048	0.18	0.667	0.047	0.197	1.11E-03
E	4.5	0.1	0.030	1.56	0.667	0.016	0.197	3.31E-03
	5.5	0.1	0.030	0.94	0.667	0.016	0.197	1.99E-03
	6.5	0.1	0.030	0.78	0.667	0.016	0.197	1.66E-03
	7.5	0.1	0.030	0.67	0.667	0.016	0.197	1.42E-03
	10.5	0.1	0.030	0.48	0.667	0.016	0.197	1.02E-03
	13.5	0.1	0.030	0.38	0.667	0.016	0.197	8.06E-04
	23.5	0.1	0.030	0.21	0.667	0.016	0.197	4.46E-04
X	4.5	0.1	0.045	2.6	0.667	0.041	0.197	1.42E-02
	5.5	0.1	0.045	1.37	0.667	0.041	0.197	7.47E-03
	6.5	0.1	0.045	1.06	0.667	0.041	0.197	5.78E-03
	7.5	0.1	0.045	0.9	0.667	0.041	0.197	4.91E-03
	10.5	0.1	0.045	0.6	0.667	0.041	0.197	3.27E-03
	13.5	0.1	0.045	0.45	0.667	0.041	0.197	2.45E-03
	23.5	0.1	0.045	0.24	0.667	0.041	0.197	1.31E-03

Table 1 - Silt

distance 0 meter
t-1/2 7 days
mix depth 100 centimeters

	Soil D (m)	v-gw	v-cont	SOIL	MIXING	1-D 100	2-D	TOTAL
B	4.5	10	7.519	4.1	0.010	1.000	1	0.0407
	5.5	10	7.519	2.4	0.010	1.000	1	0.0238
	6.5	10	7.519	2.1	0.010	1.000	1	0.0208
	7.5	10	7.519	1.42	0.010	1.000	1	0.0141
	10.5	10	7.519	1.1	0.010	1.000	1	0.0109
T	4.5	10	4.808	2.3	0.010	1.000	1	0.0228
	5.5	10	4.808	1.32	0.010	1.000	1	0.0131
	6.5	10	4.808	1.13	0.010	1.000	1	0.0112
	7.5	10	4.808	0.87	0.010	1.000	1	0.0086
	10.5	10	4.808	0.56	0.010	1.000	1	0.0056
E	4.5	10	3.030	1.37	0.010	1.000	1	0.0136
	5.5	10	3.030	0.91	0.010	1.000	1	0.0090
	6.5	10	3.030	0.82	0.010	1.000	1	0.0081
	7.5	10	3.030	0.63	0.010	1.000	1	0.0063
	10.5	10	3.030	0.255	0.010	1.000	1	0.0025
X	4.5	10	4.529	2.2	0.010	1.000	1	0.0218
	5.5	10	4.529	1.34	0.010	1.000	1	0.0133
	6.5	10	4.529	1.22	0.010	1.000	1	0.0121
	7.5	10	4.529	0.95	0.010	1.000	1	0.0094
	10.5	10	4.529	0.56	0.010	1.000	1	0.0056

Table 1 - Silt

distance 100 meter
t-1/2 7 days
mix depth 100 centimeters

	Soil D (m)	v-gw	v-cont	SOIL	MIXING	1-D 100	2-D	TOTAL
B	4.5	10	7.519	4.1	0.010	0.472	0.334	6.41E-03
	5.5	10	7.519	2.4	0.010	0.472	0.334	3.75E-03
	6.5	10	7.519	2.1	0.010	0.472	0.334	3.28E-03
	7.5	10	7.519	1.42	0.010	0.472	0.334	2.22E-03
	10.5	10	7.519	1.1	0.010	0.472	0.334	1.72E-03
T	4.5	10	4.808	2.3	0.010	0.361	0.334	2.75E-03
	5.5	10	4.808	1.32	0.010	0.361	0.334	1.58E-03
	6.5	10	4.808	1.13	0.010	0.361	0.334	1.35E-03
	7.5	10	4.808	0.87	0.010	0.361	0.334	1.04E-03
	10.5	10	4.808	0.56	0.010	0.361	0.334	6.70E-04
E	4.5	10	3.030	1.37	0.010	0.253	0.334	1.15E-03
	5.5	10	3.030	0.91	0.010	0.253	0.334	7.62E-04
	6.5	10	3.030	0.82	0.010	0.253	0.334	6.87E-04
	7.5	10	3.030	0.63	0.010	0.253	0.334	5.28E-04
	10.5	10	3.030	0.255	0.010	0.253	0.334	2.14E-04
X	4.5	10	4.529	2.2	0.010	0.346	0.334	2.52E-03
	5.5	10	4.529	1.34	0.010	0.346	0.334	1.54E-03
	6.5	10	4.529	1.22	0.010	0.346	0.334	1.40E-03
	7.5	10	4.529	0.95	0.010	0.346	0.334	1.09E-03
	10.5	10	4.529	0.56	0.010	0.346	0.334	6.43E-04

Table 1 - Silt

	Soil D (m)	v-gw	v-cont	SOIL	MIXING	1-D	2-D	TOTAL
					distance	300	meter	
					t-1/2	7	days	
					mix depth	100	centimeters	
						100		
B	4.5	10	7.519	4.1	0.010	0.105	0.197	8.41E-04
	5.5	10	7.519	2.4	0.010	0.105	0.197	4.92E-04
	6.5	10	7.519	2.1	0.010	0.105	0.197	4.31E-04
	7.5	10	7.519	1.42	0.010	0.105	0.197	2.91E-04
	10.5	10	7.519	1.1	0.010	0.105	0.197	2.26E-04
T	4.5	10	4.808	2.3	0.010	0.047	0.197	2.11E-04
	5.5	10	4.808	1.32	0.010	0.047	0.197	1.21E-04
	6.5	10	4.808	1.13	0.010	0.047	0.197	1.04E-04
	7.5	10	4.808	0.87	0.010	0.047	0.197	7.99E-05
	10.5	10	4.808	0.56	0.010	0.047	0.197	5.14E-05
E	4.5	10	3.030	1.37	0.010	0.016	0.197	4.33E-05
	5.5	10	3.030	0.91	0.010	0.016	0.197	2.87E-05
	6.5	10	3.030	0.82	0.010	0.016	0.197	2.59E-05
	7.5	10	3.030	0.63	0.010	0.016	0.197	1.99E-05
	10.5	10	3.030	0.255	0.010	0.016	0.197	8.05E-06
X	4.5	10	4.529	2.2	0.010	0.041	0.197	1.78E-04
	5.5	10	4.529	1.34	0.010	0.041	0.197	1.09E-04
	6.5	10	4.529	1.22	0.010	0.041	0.197	9.90E-05
	7.5	10	4.529	0.95	0.010	0.041	0.197	7.71E-05
	10.5	10	4.529	0.56	0.010	0.041	0.197	4.54E-05

Table 2 - Silt

distance 0 meter
t-1/2 100 days
mix depth 50 centimeters

	Soil D (m)	v-gw	v-cont	SOIL	MIXING	1-D 100	2-D	TOTAL
B	4.5	0.1	0.075	3.8	0.667	1.000	1	2.5354
	5.5	0.1	0.075	0.27	0.667	1.000	1	1.80E-01
	6.5	0.1	0.075	0.115	0.667	1.000	1	7.67E-02
	7.5	0.1	0.075	0.039	0.667	1.000	1	2.60E-02
	10.5	0.1	0.075	0.0079	0.667	1.000	1	5.27E-03
	13.5	0.1	0.075	0.0013	0.667	1.000	1	8.67E-04
	23.5	0.1	0.075	1.38E-06	0.667	1.000	1	9.21E-07
T	4.5	0.1	0.048	2.2	0.667	1.000	1	1.4679
	5.5	0.1	0.048	0.15	0.667	1.000	1	1.00E-01
	6.5	0.1	0.048	0.068	0.667	1.000	1	4.54E-02
	7.5	0.1	0.048	0.031	0.667	1.000	1	2.07E-02
	10.5	0.1	0.048	0.0055	0.667	1.000	1	3.67E-03
	13.5	0.1	0.048	0.00068	0.667	1.000	1	4.54E-04
	23.5	0.1	0.048	7.5E-07	0.667	1.000	1	5.00E-07
E	4.5	0.1	0.030	1.35	0.667	1.000	1	0.9007
	5.5	0.1	0.030	0.103	0.667	1.000	1	6.87E-02
	6.5	0.1	0.030	0.049	0.667	1.000	1	3.27E-02
	7.5	0.1	0.030	0.0245	0.667	1.000	1	1.63E-02
	10.5	0.1	0.030	0.0035	0.667	1.000	1	2.34E-03
	13.5	0.1	0.030	0.0005	0.667	1.000	1	3.34E-04
	23.5	0.1	0.030	5.5E-07	0.667	1.000	1	3.67E-07
X	4.5	0.1	0.045	2.1	0.667	1.000	1	1.4012
	5.5	0.1	0.045	0.162	0.667	1.000	1	1.08E-01
	6.5	0.1	0.045	0.077	0.667	1.000	1	5.14E-02
	7.5	0.1	0.045	0.038	0.667	1.000	1	2.54E-02
	10.5	0.1	0.045	0.00475	0.667	1.000	1	3.17E-03
	13.5	0.1	0.045	0.00074	0.667	1.000	1	4.94E-04
	23.5	0.1	0.045	7.8E-07	0.667	1.000	1	5.20E-07

Table 2 - Silt

distance 100 meter
t-1/2 100 days
mix depth 50 centimeters

	Soil D (m)	v-gw	v-cont	SOIL	MIXING	1-D 100	2-D	TOTAL
B	4.5	0.1	0.075	3.8	0.667	0.076	0.344	6.63E-02
	5.5	0.1	0.075	0.27	0.667	0.076	0.334	4.57E-03
	6.5	0.1	0.075	0.115	0.667	0.076	0.334	1.95E-03
	7.5	0.1	0.075	0.039	0.667	0.076	0.334	6.61E-04
	10.5	0.1	0.075	0.0079	0.667	0.076	0.334	1.34E-04
	13.5	0.1	0.075	0.0013	0.667	0.076	0.334	2.20E-05
	23.5	0.1	0.075	1.38E-06	0.667	0.076	0.334	2.34E-08
T	4.5	0.1	0.048	2.2	0.667	0.036	0.334	1.76E-02
	5.5	0.1	0.048	0.15	0.667	0.036	0.334	1.20E-03
	6.5	0.1	0.048	0.068	0.667	0.036	0.334	5.43E-04
	7.5	0.1	0.048	0.031	0.667	0.036	0.334	2.47E-04
	10.5	0.1	0.048	0.0055	0.667	0.036	0.334	4.39E-05
	13.5	0.1	0.048	0.00068	0.667	0.036	0.334	5.43E-06
	23.5	0.1	0.048	7.5E-07	0.667	0.036	0.334	5.99E-09
E	4.5	0.1	0.030	1.35	0.667	0.013	0.334	4.05E-03
	5.5	0.1	0.030	0.103	0.667	0.013	0.334	3.09E-04
	6.5	0.1	0.030	0.049	0.667	0.013	0.334	1.47E-04
	7.5	0.1	0.030	0.0245	0.667	0.013	0.334	7.35E-05
	10.5	0.1	0.030	0.0035	0.667	0.013	0.334	1.05E-05
	13.5	0.1	0.030	0.0005	0.667	0.013	0.334	1.50E-06
	23.5	0.1	0.030	5.5E-07	0.667	0.013	0.334	1.65E-09
X	4.5	0.1	0.045	2.1	0.667	0.032	0.334	1.50E-02
	5.5	0.1	0.045	0.162	0.667	0.032	0.334	1.15E-03
	6.5	0.1	0.045	0.077	0.667	0.032	0.334	5.48E-04
	7.5	0.1	0.045	0.038	0.667	0.032	0.334	2.71E-04
	10.5	0.1	0.045	0.00475	0.667	0.032	0.334	3.38E-05
	13.5	0.1	0.045	0.00074	0.667	0.032	0.334	5.27E-06
	23.5	0.1	0.045	7.8E-07	0.667	0.032	0.334	5.55E-09

Table 2 - Silt

distance 300 meter
t-1/2 100 days
mix depth 50 centimeters

	Soil D (m)	v-gw	v-cont	SOIL	MIXING	1-D 100	2-D	TOTAL
B	4.5	0.1	0.075	3.8	0.667	4.39E-04	0.197	2.19E-04
	5.5	0.1	0.075	0.27	0.667	4.39E-04	0.197	1.56E-05
	6.5	0.1	0.075	0.115	0.667	4.39E-04	0.197	6.64E-06
	7.5	0.1	0.075	0.039	0.667	4.39E-04	0.197	2.25E-06
	10.5	0.1	0.075	0.0079	0.667	4.39E-04	0.197	4.56E-07
	13.5	0.1	0.075	0.0013	0.667	4.39E-04	0.197	7.51E-08
	23.5	0.1	0.075	1.38E-06	0.667	4.39E-04	0.197	7.97E-11
T	4.5	0.1	0.048	2.2	0.667	4.59E-05	0.197	1.33E-05
	5.5	0.1	0.048	0.15	0.667	4.59E-05	0.197	9.06E-07
	6.5	0.1	0.048	0.068	0.667	4.59E-05	0.197	4.11E-07
	7.5	0.1	0.048	0.031	0.667	4.59E-05	0.197	1.87E-07
	10.5	0.1	0.048	0.0055	0.667	4.59E-05	0.197	3.32E-08
	13.5	0.1	0.048	0.00068	0.667	4.59E-05	0.197	4.11E-09
	23.5	0.1	0.048	7.5E-07	0.667	4.59E-05	0.197	4.53E-12
E	4.5	0.1	0.030	1.35	0.667	2.44E-06	0.197	4.32E-07
	5.5	0.1	0.030	0.103	0.667	2.44E-06	0.197	3.30E-08
	6.5	0.1	0.030	0.049	0.667	2.44E-06	0.197	1.57E-08
	7.5	0.1	0.030	0.0245	0.667	2.44E-06	0.197	7.85E-09
	10.5	0.1	0.030	0.0035	0.667	2.44E-06	0.197	1.12E-09
	13.5	0.1	0.030	0.0005	0.667	2.44E-06	0.197	1.60E-10
	23.5	0.1	0.030	5.5E-07	0.667	2.44E-06	0.197	1.76E-13
X	4.5	0.1	0.045	2.1	0.667	3.26E-05	0.197	9.00E-06
	5.5	0.1	0.045	0.162	0.667	3.26E-05	0.197	6.95E-07
	6.5	0.1	0.045	0.077	0.667	3.26E-05	0.197	3.30E-07
	7.5	0.1	0.045	0.038	0.667	3.26E-05	0.197	1.63E-07
	10.5	0.1	0.045	0.00475	0.667	3.26E-05	0.197	2.04E-08
	13.5	0.1	0.045	0.00074	0.667	3.26E-05	0.197	3.17E-09
	23.5	0.1	0.045	7.8E-07	0.667	3.26E-05	0.197	3.34E-12

Table 3 - Silt

					distance	0	meter	
					t-1/2	700	days	
					mix depth	50	centimeters	
						1-D	2-D	TOTAL
	Soil D (m)	v-gw	v-cont	SOIL	MIXING	100		
B	4.5	0.1	0.075	4.1	0.667	1.000	1	2.7356
	5.5	0.1	0.075	2.4	0.667	1.000	1	1.6013
	6.5	0.1	0.075	2.1	0.667	1.000	1	1.4012
	7.5	0.1	0.075	1.42	0.667	1.000	1	0.9475
	10.5	0.1	0.075	1.1	0.667	1.000	1	0.7339
	13.5	0.1	0.075	0.79	0.667	1.000	1	0.5271
	23.5	0.1	0.075	0.158	0.667	1.000	1	0.1054
T	4.5	0.1	0.048	2.3	0.667	1.000	1	1.5346
	5.5	0.1	0.048	1.32	0.667	1.000	1	0.8807
	6.5	0.1	0.048	1.13	0.667	1.000	1	0.7540
	7.5	0.1	0.048	0.87	0.667	1.000	1	0.5805
	10.5	0.1	0.048	0.56	0.667	1.000	1	0.3736
	13.5	0.1	0.048	0.36	0.667	1.000	1	0.2402
	23.5	0.1	0.048	0.084	0.667	1.000	1	0.0560
E	4.5	0.1	0.030	1.37	0.667	1.000	1	0.9141
	5.5	0.1	0.030	0.91	0.667	1.000	1	0.6072
	6.5	0.1	0.030	0.82	0.667	1.000	1	0.5471
	7.5	0.1	0.030	0.63	0.667	1.000	1	0.4203
	10.5	0.1	0.030	0.255	0.667	1.000	1	0.1701
	13.5	0.1	0.030	0.25	0.667	1.000	1	0.1668
	23.5	0.1	0.030	0.059	0.667	1.000	1	0.0394
X	4.5	0.1	0.045	2.2	0.667	1.000	1	1.4679
	5.5	0.1	0.045	1.34	0.667	1.000	1	0.8941
	6.5	0.1	0.045	1.22	0.667	1.000	1	0.8140
	7.5	0.1	0.045	0.95	0.667	1.000	1	0.6339
	10.5	0.1	0.045	0.56	0.667	1.000	1	0.3736
	13.5	0.1	0.045	0.35	0.667	1.000	1	0.2335
	23.5	0.1	0.045	0.087	0.667	1.000	1	0.0580

Table 3 - Silt

distance 100 meter
t-1/2 700 days
mix depth 50 centimeters

	Soil D (m)	v-gw	v-cont	SOIL	MIXING	1-D 100	2-D	TOTAL
B	4.5	0.1	0.075	4.1	0.667	0.472	0.334	0.4309
	5.5	0.1	0.075	2.4	0.667	0.472	0.334	0.2522
	6.5	0.1	0.075	2.1	0.667	0.472	0.334	0.2207
	7.5	0.1	0.075	1.42	0.667	0.472	0.334	0.1492
	10.5	0.1	0.075	1.1	0.667	0.472	0.334	0.1156
	13.5	0.1	0.075	0.79	0.667	0.472	0.334	0.0830
	23.5	0.1	0.075	0.158	0.667	0.472	0.334	0.0166
T	4.5	0.1	0.048	2.3	0.667	0.361	0.334	0.1849
	5.5	0.1	0.048	1.32	0.667	0.361	0.334	0.1061
	6.5	0.1	0.048	1.13	0.667	0.361	0.334	0.0908
	7.5	0.1	0.048	0.87	0.667	0.361	0.334	0.0699
	10.5	0.1	0.048	0.56	0.667	0.361	0.334	0.0450
	13.5	0.1	0.048	0.36	0.667	0.361	0.334	0.0289
	23.5	0.1	0.048	0.084	0.667	0.361	0.334	0.0068
E	4.5	0.1	0.030	1.37	0.667	0.253	0.334	0.0772
	5.5	0.1	0.030	0.91	0.667	0.253	0.334	0.0513
	6.5	0.1	0.030	0.82	0.667	0.253	0.334	0.0462
	7.5	0.1	0.030	0.63	0.667	0.253	0.334	0.0355
	10.5	0.1	0.030	0.255	0.667	0.253	0.334	0.0144
	13.5	0.1	0.030	0.25	0.667	0.253	0.334	0.0141
	23.5	0.1	0.030	0.059	0.667	0.253	0.334	0.0033
X	4.5	0.1	0.045	2.2	0.667	0.346	0.334	0.1697
	5.5	0.1	0.045	1.34	0.667	0.346	0.334	0.1034
	6.5	0.1	0.045	1.22	0.667	0.346	0.334	0.0941
	7.5	0.1	0.045	0.95	0.667	0.346	0.334	0.0733
	10.5	0.1	0.045	0.56	0.667	0.346	0.334	0.0432
	13.5	0.1	0.045	0.35	0.667	0.346	0.334	0.0270
	23.5	0.1	0.045	0.087	0.667	0.346	0.334	0.0067

Table 3 - Silt

distance 300 meter
t-1/2 700 days
mix depth 50 centimeters

	Soil D (m)	v-gw	v-cont	SOIL	MIXING	1-D 100	2-D	TOTAL
B	4.5	0.1	0.075	4.1	0.667	0.105	0.197	5.65E-02
	5.5	0.1	0.075	2.4	0.667	0.105	0.197	3.31E-02
	6.5	0.1	0.075	2.1	0.667	0.105	0.197	2.89E-02
	7.5	0.1	0.075	1.42	0.667	0.105	0.197	1.96E-02
	10.5	0.1	0.075	1.1	0.667	0.105	0.197	1.52E-02
	13.5	0.1	0.075	0.79	0.667	0.105	0.197	1.09E-02
	23.5	0.1	0.075	0.158	0.667	0.105	0.197	2.18E-03
T	4.5	0.1	0.048	2.3	0.667	0.047	0.197	1.42E-02
	5.5	0.1	0.048	1.32	0.667	0.047	0.197	8.14E-03
	6.5	0.1	0.048	1.13	0.667	0.047	0.197	6.97E-03
	7.5	0.1	0.048	0.87	0.667	0.047	0.197	5.37E-03
	10.5	0.1	0.048	0.56	0.667	0.047	0.197	3.46E-03
	13.5	0.1	0.048	0.36	0.667	0.047	0.197	2.22E-03
	23.5	0.1	0.048	0.084	0.667	0.047	0.197	5.18E-04
E	4.5	0.1	0.030	1.37	0.667	0.016	0.197	2.91E-03
	5.5	0.1	0.030	0.91	0.667	0.016	0.197	1.93E-03
	6.5	0.1	0.030	0.82	0.667	0.016	0.197	1.74E-03
	7.5	0.1	0.030	0.63	0.667	0.016	0.197	1.34E-03
	10.5	0.1	0.030	0.255	0.667	0.016	0.197	5.41E-04
	13.5	0.1	0.030	0.25	0.667	0.016	0.197	5.31E-04
	23.5	0.1	0.030	0.059	0.667	0.016	0.197	1.25E-04
X	4.5	0.1	0.045	2.2	0.667	0.041	0.197	1.20E-02
	5.5	0.1	0.045	1.34	0.667	0.041	0.197	7.31E-03
	6.5	0.1	0.045	1.22	0.667	0.041	0.197	6.65E-03
	7.5	0.1	0.045	0.95	0.667	0.041	0.197	5.18E-03
	10.5	0.1	0.045	0.56	0.667	0.041	0.197	3.05E-03
	13.5	0.1	0.045	0.35	0.667	0.041	0.197	1.91E-03
	23.5	0.1	0.045	0.087	0.667	0.041	0.197	4.74E-04

Table 1 - Clay

distance 0 meter
t-1/2 7 days
mix depth 100 centimeters

	Soil D (m)	v-gw	v-cont	SOIL	MIXING	1-D 100	2-D	TOTAL
B	4.5	10	7.519	3.5	0.010	1.000	1	0.0347
	5.5	10	7.519	1.23	0.010	1.000	1	0.0122
	6.5	10	7.519	0.96	0.010	1.000	1	0.0095
	7.5	10	7.519	0.68	0.010	1.000	1	0.0067
	10.5	10	7.519	0.3	0.010	1.000	1	0.0030
T	4.5	10	4.808	2.1	0.010	1.000	1	0.0208
	5.5	10	4.808	0.76	0.010	1.000	1	0.0075
	6.5	10	4.808	0.57	0.010	1.000	1	0.0057
	7.5	10	4.808	0.4	0.010	1.000	1	0.0040
	10.5	10	4.808	0.165	0.010	1.000	1	0.0016
E	4.5	10	3.030	1.3	0.010	1.000	1	0.0129
	5.5	10	3.030	0.56	0.010	1.000	1	0.0056
	6.5	10	3.030	0.42	0.010	1.000	1	0.0042
	7.5	10	3.030	0.29	0.010	1.000	1	0.0029
	10.5	10	3.030	0.114	0.010	1.000	1	0.0011
X	4.5	10	4.529	1.95	0.010	1.000	1	0.0194
	5.5	10	4.529	0.7	0.010	1.000	1	0.0069
	6.5	10	4.529	0.57	0.010	1.000	1	0.0057
	7.5	10	4.529	0.44	0.010	1.000	1	0.0044
	10.5	10	4.529	0.17	0.010	1.000	1	0.0017

Table 1 - Clay

distance 100 meter
t-1/2 7 days
mix depth 100 centimeters

	Soil D (m)	v-gw	v-cont	SOIL	MIXING	1-D 100	2-D	TOTAL
B	4.5	10	7.519	3.5	0.010	0.472	0.334	0.0055
	5.5	10	7.519	1.23	0.010	0.472	0.334	0.0019
	6.5	10	7.519	0.96	0.010	0.472	0.334	0.0015
	7.5	10	7.519	0.68	0.010	0.472	0.334	0.0011
	10.5	10	7.519	0.3	0.010	0.472	0.334	0.0005
T	4.5	10	4.808	2.1	0.010	0.361	0.334	0.0025
	5.5	10	4.808	0.76	0.010	0.361	0.334	0.0009
	6.5	10	4.808	0.57	0.010	0.361	0.334	0.0007
	7.5	10	4.808	0.4	0.010	0.361	0.334	0.0005
	10.5	10	4.808	0.165	0.010	0.361	0.334	0.0002
E	4.5	10	3.030	1.3	0.010	0.253	0.344	0.0011
	5.5	10	3.030	0.56	0.010	0.253	0.344	0.0005
	6.5	10	3.030	0.42	0.010	0.253	0.344	0.0004
	7.5	10	3.030	0.29	0.010	0.253	0.344	0.0003
	10.5	10	3.030	0.114	0.010	0.253	0.344	0.0001
X	4.5	10	4.529	1.95	0.010	0.346	0.344	0.0023
	5.5	10	4.529	0.7	0.010	0.346	0.344	0.0008
	6.5	10	4.529	0.57	0.010	0.346	0.344	0.0007
	7.5	10	4.529	0.44	0.010	0.346	0.344	0.0005
	10.5	10	4.529	0.17	0.010	0.346	0.344	0.0002

Table 1 - Clay

distance 300 meter
t-1/2 7 days
mix depth 100 centimeters

	Soil D (m)	v-gw	v-cont	SOIL	MIXING	1-D 100	2-D	TOTAL
B	4.5	10	7.519	3.5	0.010	0.105	0.197	7.18E-04
	5.5	10	7.519	1.23	0.010	0.105	0.197	2.52E-04
	6.5	10	7.519	0.96	0.010	0.105	0.197	1.97E-04
	7.5	10	7.519	0.68	0.010	0.105	0.197	1.39E-04
	10.5	10	7.519	0.3	0.010	0.105	0.197	6.15E-05
T	4.5	10	4.808	2.1	0.010	0.047	0.197	1.93E-04
	5.5	10	4.808	0.76	0.010	0.047	0.197	6.98E-05
	6.5	10	4.808	0.57	0.010	0.047	0.197	5.23E-05
	7.5	10	4.808	0.4	0.010	0.047	0.197	3.67E-05
	10.5	10	4.808	0.165	0.010	0.047	0.197	1.51E-05
E	4.5	10	3.030	1.3	0.010	0.016	0.197	4.10E-05
	5.5	10	3.030	0.56	0.010	0.016	0.197	1.77E-05
	6.5	10	3.030	0.42	0.010	0.016	0.197	1.33E-05
	7.5	10	3.030	0.29	0.010	0.016	0.197	9.16E-06
	10.5	10	3.030	0.114	0.010	0.016	0.197	3.60E-06
X	4.5	10	4.529	1.95	0.010	0.041	0.197	1.58E-04
	5.5	10	4.529	0.7	0.010	0.041	0.197	5.68E-05
	6.5	10	4.529	0.57	0.010	0.041	0.197	4.62E-05
	7.5	10	4.529	0.44	0.010	0.041	0.197	3.57E-05
	10.5	10	4.529	0.17	0.010	0.041	0.197	1.38E-05

Table 2 - Clay

distance 0 meter
t-1/2 100 days
mix depth 50 centimeters

	Soil D (m)	v-gw	v-cont	SOIL	MIXING	1-D 100	2-D	TOTAL
B	4.5	0.1	0.075	3.30	0.667	1.000	1	2.20E+00
	5.5	0.1	0.075	8.90E-04	0.667	1.000	1	5.94E-04
	6.5	0.1	0.075	1.60E-04	0.667	1.000	1	1.07E-04
	7.5	0.1	0.075	7.80E-05	0.667	1.000	1	5.20E-05
	10.5	0.1	0.075	7.70E-07	0.667	1.000	1	5.14E-07
	13.5	0.1	0.075	1.00E-10	0.667	1.000	1	6.67E-11
	23.5	0.1	0.075	1.00E-10	0.667	1.000	1	6.67E-11
T	4.5	0.1	0.048	2.05	0.667	1.000	1	1.37E+00
	5.5	0.1	0.048	7.80E-04	0.667	1.000	1	5.20E-04
	6.5	0.1	0.048	1.25E-04	0.667	1.000	1	8.34E-05
	7.5	0.1	0.048	3.60E-05	0.667	1.000	1	2.40E-05
	10.5	0.1	0.048	4.80E-07	0.667	1.000	1	3.20E-07
	13.5	0.1	0.048	1.00E-10	0.667	1.000	1	6.67E-11
	23.5	0.1	0.048	1.00E-11	0.667	1.000	1	6.67E-12
E	4.5	0.1	0.030	1.26	0.667	1.000	1	8.41E-01
	5.5	0.1	0.030	4.70E-04	0.667	1.000	1	3.14E-04
	3.5	0.1	0.030	1.00E-04	0.667	1.000	1	6.67E-05
	7.5	0.1	0.030	3.20E-05	0.667	1.000	1	2.14E-05
	10.5	0.1	0.030	3.30E-07	0.667	1.000	1	2.20E-07
	13.5	0.1	0.030	1.00E-10	0.667	1.000	1	6.67E-11
	23.5	0.1	0.030	1.00E-11	0.667	1.000	1	6.67E-12
X	4.5	0.1	0.045	1.85	0.667	1.000	1	1.23E+00
	5.5	0.1	0.045	5.80E-04	0.667	1.000	1	3.87E-04
	6.5	0.1	0.045	1.23E-04	0.667	1.000	1	8.21E-05
	7.5	0.1	0.045	3.70E-05	0.667	1.000	1	2.47E-05
	10.5	0.1	0.045	4.80E-07	0.667	1.000	1	3.20E-07
	13.5	0.1	0.045	1.00E-10	0.667	1.000	1	6.67E-11
	23.5	0.1	0.045	1.00E-11	0.667	1.000	1	6.67E-12

Table 2 - Clay

					distance	100	meter	
					t-1/2	100	days	
					mix depth	50	centimeters	
						1-D	2-D	TOTAL
	Soil D (m)	v-gw	v-cont	SOIL	MIXING	100		
B	4.5	0.1	0.075	3.30	0.667	0.076	0.344	5.76E-02
	5.5	0.1	0.075	8.90E-04	0.667	0.076	0.334	1.51E-05
	6.5	0.1	0.075	1.60E-04	0.667	0.076	0.334	2.71E-06
	7.5	0.1	0.075	7.80E-05	0.667	0.076	0.334	1.32E-06
	10.5	0.1	0.075	7.70E-07	0.667	0.076	0.334	1.30E-08
	13.5	0.1	0.075	1.00E-10	0.667	0.076	0.334	1.69E-12
	23.5	0.1	0.075	1.00E-10	0.667	0.076	0.334	1.69E-12
T	4.5	0.1	0.048	2.05	0.667	0.036	0.334	1.64E-02
	5.5	0.1	0.048	7.80E-04	0.667	0.036	0.334	6.23E-06
	6.5	0.1	0.048	1.25E-04	0.667	0.036	0.334	9.98E-07
	7.5	0.1	0.048	3.60E-05	0.667	0.036	0.334	2.87E-07
	10.5	0.1	0.048	4.80E-07	0.667	0.036	0.334	3.83E-09
	13.5	0.1	0.048	1.00E-10	0.667	0.036	0.334	7.98E-13
	23.5	0.1	0.048	1.00E-11	0.667	0.036	0.334	7.98E-14
E	4.5	0.1	0.030	1.26	0.667	0.013	0.334	3.78E-03
	5.5	0.1	0.030	4.70E-04	0.667	0.013	0.334	1.41E-06
	3.5	0.1	0.030	1.00E-04	0.667	0.013	0.334	3.00E-07
	7.5	0.1	0.030	3.20E-05	0.667	0.013	0.334	9.60E-08
	10.5	0.1	0.030	3.30E-07	0.667	0.013	0.334	9.90E-10
	13.5	0.1	0.030	1.00E-10	0.667	0.013	0.334	3.00E-13
	23.5	0.1	0.030	1.00E-11	0.667	0.013	0.334	3.00E-14
X	4.5	0.1	0.045	1.85	0.667	0.032	0.334	1.32E-02
	5.5	0.1	0.045	5.80E-04	0.667	0.032	0.334	4.13E-06
	6.5	0.1	0.045	1.23E-04	0.667	0.032	0.334	8.76E-07
	7.5	0.1	0.045	3.70E-05	0.667	0.032	0.334	2.63E-07
	10.5	0.1	0.045	4.80E-07	0.667	0.032	0.334	3.42E-09
	13.5	0.1	0.045	1.00E-10	0.667	0.032	0.334	7.12E-13
	23.5	0.1	0.045	1.00E-11	0.667	0.032	0.334	7.12E-14

Table 2 - Clay

					distance	300	meter	
					t-1/2	100	days	
					mix depth	50	centimeters	
						1-D	2-D	TOTAL
	Soil D (m)	v-gw	v-cont	SOIL	MIXING	100		
B	4.5	0.1	0.075	3.30	0.667	4.39E-04	0.197	1.91E-04
	5.5	0.1	0.075	8.90E-04	0.667	4.39E-04	0.197	5.14E-08
	6.5	0.1	0.075	1.60E-04	0.667	4.39E-04	0.197	9.24E-09
	7.5	0.1	0.075	7.80E-05	0.667	4.39E-04	0.197	4.50E-09
	10.5	0.1	0.075	7.70E-07	0.667	4.39E-04	0.197	4.45E-11
	13.5	0.1	0.075	1.00E-10	0.667	4.39E-04	0.197	5.77E-15
	23.5	0.1	0.075	1.00E-10	0.667	4.39E-04	0.197	5.77E-15
T	4.5	0.1	0.048	2.05	0.667	4.59E-05	0.197	1.24E-05
	5.5	0.1	0.048	7.80E-04	0.667	4.59E-05	0.197	4.71E-09
	6.5	0.1	0.048	1.25E-04	0.667	4.59E-05	0.197	7.55E-10
	7.5	0.1	0.048	3.60E-05	0.667	4.59E-05	0.197	2.17E-10
	10.5	0.1	0.048	4.80E-07	0.667	4.59E-05	0.197	2.90E-12
	13.5	0.1	0.048	1.00E-10	0.667	4.59E-05	0.197	6.04E-16
	23.5	0.1	0.048	1.00E-11	0.667	4.59E-05	0.197	6.04E-17
E	4.5	0.1	0.030	1.26	0.667	2.44E-06	0.197	4.04E-07
	5.5	0.1	0.030	4.70E-04	0.667	2.44E-06	0.197	1.51E-10
	3.5	0.1	0.030	1.00E-04	0.667	2.44E-06	0.197	3.20E-11
	7.5	0.1	0.030	3.20E-05	0.667	2.44E-06	0.197	1.03E-11
	10.5	0.1	0.030	3.30E-07	0.667	2.44E-06	0.197	1.06E-13
	13.5	0.1	0.030	1.00E-10	0.667	2.44E-06	0.197	3.20E-17
	23.5	0.1	0.030	1.00E-11	0.667	2.44E-06	0.197	3.20E-18
X	4.5	0.1	0.045	1.85	0.667	3.26E-05	0.197	7.93E-06
	5.5	0.1	0.045	5.80E-04	0.667	3.26E-05	0.197	2.49E-09
	6.5	0.1	0.045	1.23E-04	0.667	3.26E-05	0.197	5.27E-10
	7.5	0.1	0.045	3.70E-05	0.667	3.26E-05	0.197	1.59E-10
	10.5	0.1	0.045	4.80E-07	0.667	3.26E-05	0.197	2.06E-12
	13.5	0.1	0.045	1.00E-10	0.667	3.26E-05	0.197	4.29E-16
	23.5	0.1	0.045	1.00E-11	0.667	3.26E-05	0.197	4.29E-17

Table 3 - Clay

distance 0 meter
t-1/2 700 days
mix depth 50 centimeters

	Soil D (m)	v-gw	v-cont	SOIL	MIXING	1-D 100	2-D	TOTAL
B	4.5	0.1	0.075	3.5	0.667	1.000	1	2.34E+00
	5.5	0.1	0.075	1.23	0.667	1.000	1	8.21E-01
	6.5	0.1	0.075	0.96	0.667	1.000	1	6.41E-01
	7.5	0.1	0.075	0.68	0.667	1.000	1	4.54E-01
	10.5	0.1	0.075	0.3	0.667	1.000	1	2.00E-01
	13.5	0.1	0.075	0.122	0.667	1.000	1	8.14E-02
	23.5	0.1	0.075	0.0063	0.667	1.000	1	4.20E-03
T	4.5	0.1	0.048	2.1	0.667	1.000	1	1.40E+00
	5.5	0.1	0.048	0.76	0.667	1.000	1	5.07E-01
	6.5	0.1	0.048	0.57	0.667	1.000	1	3.80E-01
	7.5	0.1	0.048	0.4	0.667	1.000	1	2.67E-01
	10.5	0.1	0.048	0.165	0.667	1.000	1	1.10E-01
	13.5	0.1	0.048	0.066	0.667	1.000	1	4.40E-02
	23.5	0.1	0.048	0.0035	0.667	1.000	1	2.34E-03
E	4.5	0.1	0.030	1.3	0.667	1.000	1	8.67E-01
	5.5	0.1	0.030	0.56	0.667	1.000	1	3.74E-01
	6.5	0.1	0.030	0.42	0.667	1.000	1	2.80E-01
	7.5	0.1	0.030	0.29	0.667	1.000	1	1.93E-01
	10.5	0.1	0.030	0.114	0.667	1.000	1	7.61E-02
	13.5	0.1	0.030	0.046	0.667	1.000	1	3.07E-02
	23.5	0.1	0.030	0.0023	0.667	1.000	1	1.53E-03
X	4.5	0.1	0.045	1.95	0.667	1.000	1	1.30E+00
	5.5	0.1	0.045	0.7	0.667	1.000	1	4.67E-01
	6.5	0.1	0.045	0.57	0.667	1.000	1	3.80E-01
	7.5	0.1	0.045	0.44	0.667	1.000	1	2.94E-01
	10.5	0.1	0.045	0.17	0.667	1.000	1	1.13E-01
	13.5	0.1	0.045	0.066	0.667	1.000	1	4.40E-02
	23.5	0.1	0.045	0.0035	0.667	1.000	1	2.34E-03

Table 3 - Clay

							1-D	2-D	TOTAL
					distance	100	meter		
					t-1/2	700	days		
					mix depth	50	centimeters		
	Soil D (m)	v-gw	v-cont	SOIL	MIXING	100			
B	4.5	0.1	0.075	3.5	0.667	0.472	0.334	0.3678	
	5.5	0.1	0.075	1.23	0.667	0.472	0.334	0.1293	
	6.5	0.1	0.075	0.96	0.667	0.472	0.334	0.1009	
	7.5	0.1	0.075	0.68	0.667	0.472	0.334	0.0715	
	10.5	0.1	0.075	0.3	0.667	0.472	0.334	0.0315	
	13.5	0.1	0.075	0.122	0.667	0.472	0.334	0.0128	
	23.5	0.1	0.075	0.0063	0.667	0.472	0.334	0.0007	
T	4.5	0.1	0.048	2.1	0.667	0.361	0.334	0.1688	
	5.5	0.1	0.048	0.76	0.667	0.361	0.334	0.0611	
	6.5	0.1	0.048	0.57	0.667	0.361	0.334	0.0458	
	7.5	0.1	0.048	0.4	0.667	0.361	0.334	0.0322	
	10.5	0.1	0.048	0.165	0.667	0.361	0.334	0.0133	
	13.5	0.1	0.048	0.066	0.667	0.361	0.334	0.0053	
	23.5	0.1	0.048	0.0035	0.667	0.361	0.334	0.0003	
E	4.5	0.1	0.030	1.3	0.667	0.253	0.334	0.0732	
	5.5	0.1	0.030	0.56	0.667	0.253	0.334	0.0315	
	6.5	0.1	0.030	0.42	0.667	0.253	0.334	0.0237	
	7.5	0.1	0.030	0.29	0.667	0.253	0.334	0.0163	
	10.5	0.1	0.030	0.114	0.667	0.253	0.334	0.0064	
	13.5	0.1	0.030	0.046	0.667	0.253	0.334	0.0026	
	23.5	0.1	0.030	0.0023	0.667	0.253	0.334	0.0001	
X	4.5	0.1	0.045	1.95	0.667	0.346	0.334	0.1504	
	5.5	0.1	0.045	0.7	0.667	0.346	0.334	0.0540	
	6.5	0.1	0.045	0.57	0.667	0.346	0.334	0.0440	
	7.5	0.1	0.045	0.44	0.667	0.346	0.334	0.0339	
	10.5	0.1	0.045	0.17	0.667	0.346	0.334	0.0131	
	13.5	0.1	0.045	0.066	0.667	0.346	0.334	0.0051	
	23.5	0.1	0.045	0.0035	0.667	0.346	0.334	0.0003	

Table 3 - Clay

distance 300 meter
t-1/2 700 days
mix depth 50 centimeters

	Soil D (m)	v-gw	v-cont	SOIL	MIXING	1-D 100	2-D	TOTAL
B	4.5	0.1	0.075	3.5	0.667	0.105	0.197	4.82E-02
	5.5	0.1	0.075	1.23	0.667	0.105	0.197	1.70E-02
	6.5	0.1	0.075	0.96	0.667	0.105	0.197	1.32E-02
	7.5	0.1	0.075	0.68	0.667	0.105	0.197	9.37E-03
	10.5	0.1	0.075	0.3	0.667	0.105	0.197	4.14E-03
	13.5	0.1	0.075	0.122	0.667	0.105	0.197	1.68E-03
	23.5	0.1	0.075	0.0063	0.667	0.105	0.197	8.68E-05
T	4.5	0.1	0.048	2.1	0.667	0.047	0.197	1.30E-02
	5.5	0.1	0.048	0.76	0.667	0.047	0.197	4.69E-03
	6.5	0.1	0.048	0.57	0.667	0.047	0.197	3.52E-03
	7.5	0.1	0.048	0.4	0.667	0.047	0.197	2.47E-03
	10.5	0.1	0.048	0.165	0.667	0.047	0.197	1.02E-03
	13.5	0.1	0.048	0.066	0.667	0.047	0.197	4.07E-04
	23.5	0.1	0.048	0.0035	0.667	0.047	0.197	2.16E-05
E	4.5	0.1	0.030	1.3	0.667	0.016	0.197	2.76E-03
	5.5	0.1	0.030	0.56	0.667	0.016	0.197	1.19E-03
	6.5	0.1	0.030	0.42	0.667	0.016	0.197	8.91E-04
	7.5	0.1	0.030	0.29	0.667	0.016	0.197	6.15E-04
	10.5	0.1	0.030	0.114	0.667	0.016	0.197	2.42E-04
	13.5	0.1	0.030	0.046	0.667	0.016	0.197	9.76E-05
	23.5	0.1	0.030	0.0023	0.667	0.016	0.197	4.88E-06
X	4.5	0.1	0.045	1.95	0.667	0.041	0.197	1.06E-02
	5.5	0.1	0.045	0.7	0.667	0.041	0.197	3.82E-03
	6.5	0.1	0.045	0.57	0.667	0.041	0.197	3.11E-03
	7.5	0.1	0.045	0.44	0.667	0.041	0.197	2.40E-03
	10.5	0.1	0.045	0.17	0.667	0.041	0.197	9.27E-04
	13.5	0.1	0.045	0.066	0.667	0.041	0.197	3.60E-04
	23.5	0.1	0.045	0.0035	0.667	0.041	0.197	1.91E-05

Table 67. Matrix for Naphthalene/Acenaphthene Soil Concentrations (mg/kg) to Protect Soil and Groundwater Pathways in Well Integrated Karst (Zone 1)

Soil Type	Depth (m) to Groundwater	0-100 meters[1]	100-300 meters[1]	>300 meters[1]
SAND	4.5	5/ 10	10/ 20	50/ 100
	5.5	5/ 10	10/ 20	50/ 100
	7.5	5/ 10	10/ 20	50/ 100
	10.5	5/ 10	10/ 20	50/ 100
SILT	4.5	5/ 10	10/ 20	50/ 100
	5.5	5/ 10	10/ 20	50/ 100
	7.5	5/ 10	10/ 20	50/ 100
	10.5	5/ 10	10/ 20	50/ 100
CLAY	4.5	5/ 10	10/ 20	50/ 100
	5.5	5/ 10	10/ 20	50/ 100
	7.5	5/ 10	10/ 20	50/ 100
	10.5	5/ 10	10/ 20	50/ 100

[1] Distance from UST to receptor(s)

Table 68. Matrix for Naphthalene/Acenaphthene Soil Concentrations (mg/kg) to Protect Soil and Groundwater Pathways in Coarse Grained Shallow Aquifers (Zone 2,3)

Soil Type	Depth (m) to Groundwater	0-100 meters[1]	100-300 meters[1]	>300 meters[1]
	4.5	1/ 4	10/ 20	50/ 100
SAND	5.5	2/ 10	10/ 20	50/ 100
	7.5	4/ 10	10/ 20	50/ 100
	10.5	5/ 10	10/ 20	50/ 100
	4.5	1/ 5	10/ 20	50/ 100
SILT	5.5	5/ 10	10/ 20	50/ 100
	7.5	5/ 10	10/ 20	50/ 100
	10.5	5/ 10	10/ 20	50/ 100
	4.5	1/ 5	10/ 20	50/ 100
CLAY	5.5	5/ 10	10/ 20	50/ 100
	7.5	5/ 10	10/ 20	50/ 100
	10.5	5/ 10	10/ 20	50/ 100

[1]Distance from UST to receptor(s)

Table 69. Matrix for Naphthalene/Acenaphthene Soil Concentrations (mg/kg) to Protect Soil and Groundwater Pathways in Fine Grained Deep Aquifers (Zone 4,5)

Soil Type	Depth (m) to Groundwater	0-100 meters[1]	100-300 meters[1]	>300 meters[1]
	4.5	1/ 5	10/ 20	50/ 100
SAND	5.5	2/ 10	10/ 20	50/ 100
	7.5	3/ 10	10/ 20	50/ 100
	10.5	4/ 10	10/ 20	50/ 100
	4.5	1/ 5	10/ 20	50/ 100
SILT	5.5	2/ 7	10/ 20	50/ 100
	7.5	3/ 10	10/ 20	50/ 100
	10.5	5/ 10	10/ 20	50/ 100
	4.5	1/ 5	10/ 20	50/ 100
CLAY	5.5	2/ 10	10/ 20	50/ 100
	7.5	5/ 10	10/ 20	50/ 100
	10.5	5/ 10	10/ 20	50/ 100

[1]Distance from UST to receptor(s)

Table 70. Corresponding Naphthalene/Acenaphthene Soil and Groundwater Concentrations (mg/kg) for Zero Depth to the Saturated Zone[a]

	Distance from UST Site[b] (m)		
Zone 1	0-100	100-300	>300
Soil[c] (mg/kg)	5/ 10	10/ 20	50/ 100
G.W.[d] (mg/L)	0.04/ 0.02	0.08/ 0.04	0.4/ 0.2
Zones 2, 3			
Soil[c] (mg/kg)	1/ 4	10/ 20	50/ 100
G.W.[d] (mg/L)	0.6/ 0.6	5/ 3	28/ 14[e]
Zones 4, 5			
Soil[c] (mg/kg)	1/ 5	10/ 20	50/ 100
G.W.[d] (mg/L)	0.6/ 0.7	5/ 3	28/ 14[e]

[a] No soil between UST and saturated zone.
[b] Distance from UST to receptor(s).
[c] Values apply to all soil types.
[d] Values were based on concentrations in soil pore water after complete mixing in GW to 0.5m of depth with a flow rate of 0.1 m/day, except in karst (Zone 1) where mixing was 1 m deep and flow rate was 10 m/day. The GW multipliers were calculated with formula no. 7 (McGinley, 1994).
[e] Values exceed water solubility of 3.8 mg/L for acenaphthene.