

US EPA ARCHIVE DOCUMENT

# DATA COLLECTION FOR THE HAZARDOUS WASTE IDENTIFICATION RULE

## SECTION 16.0 MISCELLANEOUS DATA

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## **DISCLAIMER**

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## List of Acronyms

3MRA	multimedia, multiple-exposure pathway, multiple-receptor risk assessment
AOI	2-km radius area of interest around HWIR WMU
API	American Petroleum Institute
CDF	Cumulative probability distribution function
ELP	HWIR 3MRA Exit Level Processor
EPA	U.S. Environmental Protection Agency
GIRAS	Geographic Information Retrieval and Analysis System
GIS	geographic information system
HGDB	Hydrogeologic Database
HQ	Hazard quotient
HWIR	Hazardous Waste Identification Rule
ISCST3	Industrial Source Complex Short Term, Version 3, air model
LAU	land application unit
LWS	local watershed
MOE	margin of exposure
NOAA	National Oceanic and Atmospheric Administration
QA/QC	quality assurance/quality control
SAMSON	Solar and Meteorological Surface Observation Network
SCIM	Sampled Chronological Input Model
STORET	Storage and Retrieval System
USGS	U.S. Geological Survey
WMU	waste management unit

## 16.0 Miscellaneous Variables

The U.S. Environmental Protection Agency's (EPA's) Hazardous Waste Identification Rule (HWIR) multimedia, multiple-exposure pathway, multiple-receptor risk assessment model (3MRA model) requires over 700 nonchemical-specific inputs to characterize the 201 sites on which the 3MRA is based. Sections 2 through 15 describe the collection of these data, along with chemical-specific health benchmarks and biouptake factors for 46 chemicals. These sections were organized according to data type; however, this organization left several parameter types that did not fit well under any section heading but did not justify a section of their own. These miscellaneous variables are shown in Table 16-1.

**Table 16-1. Miscellaneous Data Processed for the HWIR 3MRA Model**

Data Type	Module	Collection Approach (number of variables)	Comments (Section)
Air	Air	National (12), site-based (5)	Non-meteorological variables (Section 16.1)
Hydrogeologic	Vadose, aquifer	National (11), regional (4), site-based (2)	Mostly based on data collected for prior regulatory efforts (Section 16.2)
Breast milk	Human exposure	National (all)	Required for breast milk model; values from EPA guidelines (Section 16.3)
Shower	Human exposure	National (all)	Required for shower model; literature and professional judgment (Section 16.4)
Waste properties	Sources	National (all)	Limited available data; distributions based on professional judgment (Section 16.5)
Control	Human risk, ecological risk; various	National (all)	Risk bins, exposed population, termination criteria; set by technical policy criteria (Section 16.6)

### 16.1 Air Model Inputs

In addition to the meteorological and associated meteorological station data described in Section 4.0, the HWIR 3MRA air module requires other specific data inputs shown in Table 16-2. These variables include both site-based and nationally specified data. They are included in the 3MRA input database and, except for MetSta, are all in the air data group. Additional detail on these variables and how they are used in the air module can be found in U.S. EPA (1998a), U.S. EPA (1999), and U.S. EPA (1999).

**Table 16-2. Air Model Input Data**

Description	Code	Units	Value
<b>Site-Based Variables</b>			
Surface meteorological station number	SurfData, MetSta		Values sent for each of 419 settings (see Appendix 16A for a full listing of values by setting)
Upper air meteorological station number	AirData		
First year of meteorological data	StartYr		
Anemometer height	AnemHght	m	
Rural or urban land use (2 km radius around site)	RuralStr		
<b>National Variables</b>			
Dry depletion option	DryDpStr		DRYDPLT
Wet depletion option	WetDpStr		WETDPLT
Flag for internal calculation of PMF (TRUE or FALSE)	MASSFRAXOption		TRUE (particulate distributions specified)
Number of particle size categories	ArrayLen	unitless	4
Diameter of particles by category	PARTDIAM	µm	23.3042, 12.6645, 6.92457, 1.5749
Mass fraction by particle size category (LAU) <sup>1</sup>	MASSFRAX	fraction	0.4, 0.1, 0.3, 0.2
Mass fraction by particle size category (landfill) <sup>1</sup>	MASSFRAX	fraction	0.4, 0.1, 0.3, 0.2
Mass fraction by particle size category (wastepile) <sup>1</sup>	MASSFRAX	fraction	0.4, 0.1, 0.3, 0.2
Particle scavenging coefficient for frozen precipitation <sup>2</sup>	PARTSICE	h/s-mm	0.000665, 0.000665, 0.000458, 0.000071
Particle scavenging coefficient for liquid precipitation <sup>2</sup>	PARTSLIQ	h/s-mm	0.000665, 0.000665, 0.000458, 0.000071
Gas scavenging coefficient for frozen precipitation	IceScav	h/s-mm	0.00017
Gas scavenging coefficient for liquid precipitation	LiqScav	h/s-mm	0.00017
SCIM option	ScimStr		SCIM
Number of hours to skip in SCIM processing	SCIMBYHR	unitless	1, 193, 1, 8

<sup>1</sup> Dimensioned on WMU type (3) and number of particle size categories (ArrayLen = 4).

<sup>2</sup> Dimensioned on number of particle size categories (ArrayLen = 4).

### 16.1.1 Meteorological Station Variables

Meteorological station variables are sent in the site-based tables by site based on the station assigned to the site. Station numbers include *AirData* for radiosonde data *upper air stations* and *SurfDat* (or *MetSta*) for SAMSON *surface stations*. These text variables are the National Weather Service's WBAN number for each station and are assigned using a geographic information system (GIS), as described in Section 4.0 of this document.

Meteorological station location and *anemometer height* (*AnemHght*) data were retrieved for each station from the Local Climatology Data Summaries for 1982 (NOAA, 1983). Where the anemometer height was unavailable from this source, the mode of all available anemometer heights (6.1 m) was used as a default value. The *starting year of meteorological data* (*StartYr*) was taken from the hourly meteorological file used for modeling. This varied based on data availability for the meteorological station.

### 16.1.2 Urban/Rural Designation

*RuralStr* specifies whether a modeled facility is in a rural or urban location and is based on Geographic Information Retrieval and Analysis System (GIRAS) land use/land cover data (U.S. EPA, 1994b). GIRAS digital geographic information system (GIS) coverages, available



from EPA by one-degree quadrangles (1:250,000 scale), are based on Anderson land use codes (Anderson et al., 1976). A GIS was used to process the GIRAS data and create database tables containing land use codes and their areas within the 2-km radius area of interest (AOI) at each site. A data processing program then used a lookup table that relates the Anderson code to an urban or rural designation to calculate the percentage of each within the AOI.

Table 16-3 shows the Anderson codes assumed to be urban; all other codes were assumed to be rural. Urban was specified if an AOI was composed of 50 percent or more urban land use types; otherwise, rural was selected.

**Table 16-3. Urban Anderson Land Use Codes**

Code	Description
11	Residential
12	Commercial and services
13	Industrial
14	Transportation-communication-utilities
15	Industrial and commercial complexes
16	Mixed urban or built-up land
17	Other urban or built-up land

### 16.1.3 Particulate Data

The Industrial Source Complex Short-Term (ISCST3) air module used in the 3MRA model includes the option (*MASSFRAXOption*) of using run-specific particulate distributions generated from the 3MRA source modules (i.e., landfill, wastepile, and land application unit [LAU]) or having these distributions externally specified by waste management unit (WMU) type. Because run-time considerations required the air output files (LFO files) to be generated externally, the latter option was used for HWIR99, and *MASSFRAXOption* was set to TRUE, with particulate distributions being externally specified.

The *number of particle size categories (ArrayLen)* was specified as 4, in accordance with U.S. EPA (1985) (AP-42). The *particle diameters represented by these ranges (PARTDIAM)* also were fixed according to AP-42. The distribution of particles among these four categories is, ideally, generated by the model (i.e., is WMU- and site-specific). However, because the air model was run offline to generate fixed air output files for the system, the particle size distributions were assumed to be the same across WMUs. The *fraction of each particle size category by WMU (MASSFRAX)* was fixed across WMU type using typical values reported in U.S. EPA (1985).

### 16.1.4 Sampled Chronological Input Model (SCIM) Inputs

To reduce computational times, the enhanced ISCST3 air module used in HWIR models only a fraction of the hourly meteorological data at regular intervals rather than the complete period of record for each meteorological station. This method, the Sampled Chronological Input Model (SCIM), significantly reduces model run time while producing long-term averages comparable to those obtained using the full data set (U.S. EPA, 1998a). *ScimStr* is a text variable that sets the option and is specified in HWIR as "SCIM" to exercise SCIM within ISCST3. *SCIMBYHR* is an integer 4-place vector (1, 193, 1, 8) that specifies the different SCIM levels applied for dry deposition (1 hour of data selected for every 193 hours) and wet deposition (1 hour of data selected for every 8 hours). These sampling intervals were based on a study (U.S.

EPA, 1998a) that determined the optimum sampling intervals by selecting values that reduced run time without unduly compromising accuracy.

### 16.1.5 Other National Variables

**16.1.5.1 DryDpStr and WetDpStr.** These text variables specify whether the dry and wet depletion options are invoked within ISCST3. For HWIR, both *dry* and *wet depletion* were set “on” by specifying these variables as *DRYDPLT* and *WETDPLT*, respectively, in the *National\_Variable\_Distribution\_Data* table. Within the model, the dry depletion option is exercised depending on WMU type because the HWIR version of the ISCST3 can only estimate dry depletion of particles, not dry depletion of vapor. Therefore, dry depletion is calculated for particulate sources (landfills, land application units, and wastepiles), but is not needed or considered for vapor-only sources (tanks or surface impoundments). Wet depletion is calculated at all sources for vapor and/or particles, as appropriate.

**16.1.5.2 Scavenging Coefficients.** The *frozen and liquid particle scavenging rate coefficients* (*PARTSICE* and *PARTSLIQ*) were taken from Figure 1-11 in Volume II of the ISCST3 User's Guide. Appropriate values were assigned for each of the four particle size ranges, and frozen and liquid precipitation were assumed to scavenge particles at the same rate.

*Gas scavenging rate coefficients for frozen and liquid precipitation* (*IceScav* and *LiqScav*) were both assigned a value of  $1.7E-4$  h/s-mm. This value also was taken from Figure 1-11 in Volume II of the ISCST3 User's Guide (U.S. EPA, 1995b) under the assumption that gases scavenge similarly to small particles. The value for the smallest particle size on the graph (0.1 micron) was chosen for the scavenging rate.

### 16.1.6 Quality Assurance/Quality Control

Quality control (QC) activities for air model input data followed the same protocols as for other data. The manually entered values (e.g., the national data inputs) were checked 100 percent against the original sources. For automatically generated values (i.e., GIS-derived meteorological station assignments), a percentage of the final values were checked manually to ensure that the GIS and database programs were processing data accurately and consistently. Quality assurance (QA) was conducted to ensure that these QC activities were performed correctly and consistently and adequately documented.

## 16.2 Hydrogeologic Data

Hydrogeologic data are required for the HWIR 3MRA model aquifer and vadose zone modules. For many variables, site-specific hydrogeologic data were not available for the 1999 HWIR 3MRA data collection effort. Site-specific hydrogeologic investigations at the 201 Industrial D sites were well beyond project resources, and although useful information was found in permit applications collected for a few sites during the data collection pilot, concerns about the consistent availability of permit information on subsurface conditions, as well as the projected costs for collecting and evaluating it, precluded site-specific hydrogeologic data collection.

Instead, EPA relied upon a regional site-based data collection approach and data very similar to that used in the risk assessment that supported the 1995 HWIR proposal.

In general, public and peer-review comments did not find significant faults in the regional site-based approach used in 1995, and EPA believes it still represents a proven, state-of-the-art methodology for estimating site-based hydrogeologic conditions for a nationwide analysis. Commenters did point out some inconsistencies between the ground water data and data collected for the other pathways in 1995, and EPA has updated and improved the 1995 methodology to address these concerns. First, site-specific soils data provide a consistent set of soil properties to all 3MRA modules requiring such data, including the vadose zone module. Section 7.0 of this report describes the soil property data collection methodology. Second, receptor wells (private drinking water wells) are placed around each site using U.S. census data (see Section 9.0) for all exposure pathways. Third, ground water flow direction is defined site-specifically based on topography and surface drainage patterns (see Section 5.0).

Table 16-4 summarizes the regional and site-based hydrogeologic data collected for the HWIR 3MRA, including collection approach (site-based or regional) and data sources. Table 16-5 shows data sources and values for nationally collected parameters. These variables are discussed by collection approach below.

### 16.2.1 Site-Based Hydrogeologic Data

Site-based data include the variables necessary to describe the aquifer and vadose zone layout at a site. These variables are collected using GIS technology, as described in detail in Sections 5.0 and 9.0 of this document. In general, the aquifer and vadose zone properties are assumed to be uniform across a site, and a single aquifer and a single vadose zone are modeled for each realization of the 3MRA model. However, the *direction of ground water flow (AquDir)* is assumed to be the same as the direction of overland surface water flow from the WMU, as defined by the local watershed<sup>1</sup> for the WMU in question. For a site with two local watersheds (i.e., where the WMU crosses a drainage divide), two ground water flow directions, represented as two aquifers and two vadose zones in the site layout, are sent to the model. In this case, a single aquifer is still modeled, with the ground water flow direction being picked randomly from the two alternatives for each Monte Carlo realization at the site.

The watershed subbasin assigned to the aquifer (indicated by *AquWSSubIndex*) is the subbasin containing the WMU and is used by the aquifer model to obtain aquifer recharge rates from the watershed model. The waterbody reach impacted by the aquifer (indicated by *WBNRchAquIndex*) is assigned as the same reach that is impacted by the local watershed, and, in the data, the entire reach is assumed to be potentially impacted by the aquifer (*WBNRchAquFrac* = 1; during model implementation the plume may or may not intersect the entire reach, depending on flow and transport conditions and the width of the WMU).

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<sup>1</sup> A local watershed (LWS) is defined as the drainage area that contains a WMU. The LWS extends from the upslope drainage divide downslope across the WMU to the first defined stream channel, lake, pond, or wetland. It includes the WMU and any areas upslope to the divide and downslope to the receiving waterbody.

**Table 16-4. HWIR Site-Based and Regional Hydrogeologic Data Sources, Collection Approach, and Data Locations**

Variable	Code	Units	Data Location	Data Source
<b><i>Aquifer and Vadose Zone Spatial Layout (site-specific)</i></b>				
Ground water flow direction in degrees from N	AquDir	degrees	3MRA model site-based data table: Site_Variable_Distribution_Data	Assumed to equal local watershed flow direction(s) (see Section 5.0)
Number of vadose zones	NumVad			Set equal to the number of local watersheds (LWSs) (see Section 5.0)
Number of aquifers	NumAqu			AquVadIndex=AquLWSIndex = VadLWSIndex = SrcLWSIndex (see Section 5.0)
Index of vadose zone per aquifer	AquVadIndex			
Local watershed index per vadose zone	VadLWSIndex			
Local watershed index per aquifer	AquLWSIndex			
Local watershed subarea index per aquifer	AquLWSSubAreaIndex			LWS subarea containing source (see Section 5.0)
Index of watershed per aquifer	AquWSSubIndex			Index of watershed subbasin containing source (see Section 5.0)
Number of aquifers that impact a reach	WBNRchNumAqu			= 1 for reaches impacted by the local watershed
Index of aquifer that impacts a reach	WBNRchAquIndex			Aquifer index impacting reach (= index of LWS impacting reach)
Fraction of a reach impacted by the aquifer	WBNRchAquFrac			Always = 1 for reaches impacted by aquifer
Reach locations - E-W in site coordinate system	WBNRchLocX	degrees		Coordinates for centroids of grid cells occupied by reach (see Section 5.0)
Reach locations - N-S in site coordinate system	WBNRchLocY	degrees		
Number of wells in an aquifer	NumAquWell			Drinking water well placed at each US Census block centroid within a block group with wells and at each farm centroid (see Section 9.0)
Well location - N-S in site coordinate system	AquWellLocY	m		
Well location - E-W in site coordinate system	AquWellLocX	m		
<b><i>Site-Specific Hydrogeologic Data</i></b>				
Average aquifer temperature	AquTemp	degrees C	3MRA model site-based data table: Site_Variable_Distribution_Data (see Appendix 16A for data)	From Collins (1925) (U.S. EPA, 1997b)
Average vadose zone temperature	VadTemp	degrees C		Assumed to equal AquTemp
Hydrogeologic environment (GWClass1-GWClass13)	GWClass			Assigned by site location (U.S. EPA, 1997b)
<b><i>Regional Hydrogeologic Data</i></b>				
Hydraulic conductivity in direction of gradient	AquSatK	m/yr	3MRA model regional data table: Regional_Variable_Distribution_Data (see Appendix 16B for data)	From API Hydrogeologic Database by hydrogeologic environment (GWClass) (U.S. EPA, 1997b)
Regional ground water gradient	AquGrad			
Saturated zone thickness	AquThick	m		
Vadose zone thickness	VadThick	m		
Number of sites per GWClass	GWClassIndex	unitless		

**Table 16-5. HWIR National Hydrogeologic Data Sources and Values**

National Hydrogeologic Data	Code	Units	Distribution Type	Standard Deviation	Mean	Min	Max	Data Source	
Particle diameter (d)	DIAM	mm	User-defined (empirical; see Table 16-7)				From Shea (1974) (U.S. EPA, 1997b)		
Longitudinal dispersivity	AL	m	User-defined (empirical; see Table 16-8)				U.S. EPA (1997b)		
Longitudinal to transverse dispersivity ratio	ALATratio	m	Constant		8			U.S. EPA (1997b)	
Longitudinal to vertical dispersivity ratio	ALAVratio	m	Constant		160			U.S. EPA (1997b)	
Anisotropy ratio	ANIST		Uniform			0	100	U.S. EPA (1997b)	
Fraction of aquifer covered by well screen	AquWellFracZ	fraction	Uniform			0.01	0.99	EPA technical policy; sent for each well	
Average aquifer pH	AquPh	pH units	User-defined (empirical; see Table 16-9)				From STORET data (U.S. EPA, 1997b)		
Fraction organic carbon (aquifer)	FOC	fraction	TrnJohnsonSB	0.90756	-4.99	0	0.064	Derived from U.S. EPA (1997b)	
Fraction iron-hydroxide adsorbent	AquFEOX	fraction	Uniform			6.4E-05	0.00607	U.S. EPA (1997b)	
Leachate organic matter	AquLOM	mg/L	Uniform			105	1156	U.S. EPA (1997b)	
Random number to choose anaerobic Biodegradation regime: 0=methanogenic; 1= sulfate reducing	AquAnaBioRandUnif		IntUniform			0	1	EPA technical policy	

Coordinates of the impacted reach (*WBNRchLocX*, *WBNRchLocY*) are used by the aquifer model to model contaminant flux into the reach. Details of the methodology used to collect and process these waterbody- and watershed-related variables are provided in Section 5.0. How the 3MRA model uses these data is described in the the HWIR aquifer module documentation (U.S. EPA, 1999d).

Receptor points for the ground water exposure pathway are private drinking water wells. Using a GIS, wells are placed spatially around the WMU at the centroids of U.S. Census blocks, within the 2-km-radius AOI, that are within U.S. Census block groups that have households with private drinking water wells.<sup>2</sup> In addition, a drinking water well is placed at the centroid of every farm. The detailed methodology for collecting and processing the site-based variables that specify receptor well locations can be found in Section 9.0, Human Receptor Data.

Site-specific long-term average *aquifer temperature* (*AquTemp*) was determined for each site using an isotherm map from Collins (1925) (U.S. EPA, 1997b). *Vadose zone temperature* (*VadTemp*) was assumed to be equal to *AquTemp*. Finally, each site was assigned to one of 12 *regional hydrogeologic environments* (*GWClass*; see Table 16-6 and Section 16.2.2) by plotting its location on state-by-state U.S. Geological Survey (USGS) water resource maps (U.S. EPA, 1997b). Sites that could not be assigned to 1 of the 12 environments were assigned to a 13<sup>th</sup> unclassified environment.

*AquTemp*, *VadTemp*, and *GWClass* assignments for the 419 HWIR site/WMU settings are provided in Appendix 16A along with the number of receptor wells (*NumAquWell*) at each setting. Note that there are no wells or subsurface temperature data for aerated tank sites because the ground water pathway is not modeled for these sites.

### 16.2.2 Regional Hydrogeologic Data

Four key hydrogeological parameters were collected regionally based on a site's hydrogeologic environment: *hydraulic conductivity* (*AquSatK*), *hydraulic gradient* (*AquGrad*), *saturated thickness* (*AquThick*), and depth to the water table or *vadose zone thickness* (*VadThick*). These parameters were characterized using discrete distributions derived from the American Petroleum Institute's (API's) Hydrogeologic Database (HGDB; Newell et al., 1989).

The HGDB contains data on these variables for approximately 400 sites nationwide. The HGDB places these sites in 12 Heath ground water regions and 4 to 13 DRASTIC hydrogeologic settings per region (Newell et al., 1989). For HWIR, these settings were combined across regions into the generalized hydrogeologic environments (*GWClass*) shown in Table 16-6 (U.S. EPA, 1997b). This resulted in a 394-site database with data from 16 to 62 sites per *GWClass*. *GWClass* 13 contains the median values for each variable across the 394 sites and was assigned to sites that cannot be classified into the *GWClass* 1 through 12. Appendix 16B contains the *AquSatK*, *AquGrad*, *AquThick*, and *VadThick* data by hydrogeologic environment for all 394 sites and for *GWClass* 13.

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<sup>2</sup> Census data on drinking water source are only available at the block group level.

**Table 16-6. HWIR 3MRA Hydrogeologic Environments**

<b>Code</b>	<b>Hydrogeologic Environment</b>	<b>HGDB Sites (GWClassIndex)</b>
GWClass01	Metamorphic & igneous	23
GWClass02	Bedded sedimentary rock	44
GWClass03	Till over sedimentary rock	16
GWClass04	Sand and gravel	33
GWClass05	Alluvial basins valleys & fans	62
GWClass06	River valleys and flood plains with overbank deposits	36
GWClass07	River valleys and flood plains without overbank deposits	33
GWClass08	Outwash	43
GWClass09	Till and till over outwash	29
GWClass10	Unconsolidated and semiconsolidated shallow aquifers	27
GWClass11	Coastal beaches	26
GWClass12	Solution limestone	22
GWClass13	Undefined (median values across 394 sites)	1

HGDB = Hydrogeologic Database (Newell et al., 1989).

Source: U.S. EPA (1997b).

The HWIR 3MRA model utilizes these data as follows. Based on a site's GWClass assignment, the 3MRA model randomly picks one set of the four variables for each Monte Carlo realization. By selecting the variables together, the dependencies between the hydrogeologic parameters (which represent measurements taken at the same location) are preserved in the analysis. For example, assume a site is assigned to GWClass1. There are 23 sets of hydrogeologic variables, i.e., combinations of AquSatK, AquGrad, AquThick, and VadThick measured at 23 locations, that fall within that hydrogeologic environment. For a particular model run for this site, the 3MRA system randomly picks one of these 23 variable sets.

Note that in Appendix 16B, some of the variable sets are missing parameters (indicated by a -999). If one of these sets is selected, the 3MRA system randomly generates a value based on the statistical correlations among the parameters for that hydrogeologic environment. This automatically preserves regional differences in aquifer characteristics while accounting for dependencies between hydrogeologic variables. The parameters necessary for this process (mean, minimum, maximum, and a correlation matrix) are present at the end of each set of GWClass variables in the data (see Appendix 16B). U.S. EPA (1997b) describes the replacement routine.

### 16.2.3 National Hydrogeologic Data

The remaining hydrogeologic variables are characterized by national distributions. As shown in Table 16-5, values for these 11 variables were mainly obtained from previous EPA

efforts as documented in U.S. EPA (1997b). Additional details on how each of these variables function within the aquifer model may be found in the aquifer module documentation (U.S. EPA, 1996a,b; 1999d).

*Mean particle diameter (DIAM)* is used by the aquifer module to calculate a variety of related parameters including total and effective porosity and bulk density. An empirical distribution for DIAM (Table 16-7) was developed from particle diameter data compiled by Shea (1974). These data are passed to the 3MRA model in the User\_Defined\_Distribution\_Data database table.

*Longitudinal, transverse, and vertical aquifer dispersivities* are used, along with seepage velocities, to calculate dispersion

**Table 16-8. Empirical Distribution for Aquifer Longitudinal Dispersivity (AL)**

AL (m)	Cumulative Probability
0.1	0.0
1	0.1
10	0.7
100	1.0

Source: U.S. EPA (1997b).

*AquWellFracZ* is the fraction of the saturated thickness of the aquifer covered by the well screen. Because information on this parameter was limited, EPA assumed a uniform distribution from 0.01 to 0.99 for modeling purposes.

The distribution of *average aquifer pH (AquPh)* was obtained from an analysis of nearly 25,000 field measurements obtained from EPA's Storage and Retrieval System (STORET) database (see Section 6.0 for additional information on STORET). These data are represented by an empirical distribution with a range of 3.2 to 9.7 and a median value of 6.8 (Table 16-9). Because extreme values in

**Table 16-7. Empirical (User-Defined) Distribution for Aquifer Particle Diameter (DIAM)**

DIAM (mm)	Cumulative Probability
3.90E-04	0.000
7.80E-04	0.038
1.60E-03	0.104
3.10E-03	0.171
6.30E-03	0.262
1.25E-02	0.371
2.50E-02	0.560
5.00E-02	0.792
1.00E-01	0.904
2.00E-01	0.944
4.00E-01	0.976

Source: U.S. EPA (1997b).

coefficients within the aquifer module. The

probabilistic formulation used for *longitudinal dispersivity (AL)* is shown in Table 16-8, which is passed to the system in the User\_Defined\_Distribution\_Data database table.

Transverse and vertical dispersivities are calculated from AL using the ratios of 8 (for *ALATratio*) and 160 (for *ALAVratio*). Additional detail on the aquifer module's treatment of dispersivity and dispersion coefficients may be found in U.S. EPA (1996a,b; 1999d).

**Table 16-9. Empirical Probability Distribution for Aquifer pH**

Value	Cumulative Probability
3.2	0
3.6	0.01
4.5	0.05
5.2	0.1
6.07	0.25
6.8	0.5
7.4	0.75
7.9	0.9
8.2	0.95
8.95	0.99
9.7	1

Source: U.S. EPA (1997b).



STORET are unreliable, the upper and lower bounds were determined through a literature search for reported pH values for uncontaminated ground water (U.S. EPA, 1997b). The values specifying this distribution in Table 16-9 were passed to the 3MRA system in the User\_Defined\_Distribution\_Data data table.

*Fraction organic carbon (FOC)* for the aquifer was assumed to have a low range, and the distribution shape (JohnsonSB) was based on the distribution of dissolved organic carbon measurements in EPA's STORET database (U.S. EPA, 1997b). The ranges for *fraction of amorphous iron oxides (AquFEOX)* and the *concentration of dissolved organic matter in leachate (AquLOM)* were based on analytical data for aquifer and leachate samples collected by EPA in Florida, New Jersey, Oregon, Texas, Utah, and Wisconsin (U.S. EPA, 1999e). A uniform distribution was assumed for AquFEOX and AquLOM because data were not adequate to define distribution type.

*AquAnaBioRandUnif* is a variable used to choose whether the subsurface anaerobic biodegradation regime will be methanogenic or sulfate-reducing. Because information on the national prevalence of these regimes is very limited, EPA has specified the variable as an integer with a uniform distribution of 0 to 1 to ensure equal probability of selecting either regime.

#### 16.2.4 Quality Assurance/Quality Control

Quality control (QC) activities for hydrogeologic data followed the same protocols as for other data. All manually entered values (e.g., the national data inputs) were checked 100 percent against the original sources. For automatically generated values (i.e., GIS-derived spatial layout variables, variables processed in the database), a percentage of the final values were checked manually to ensure that the GIS and database programs were processing data accurately and consistently (QC activities for watershed- and receptor-well-related variables are described in greater detail in Sections 5.0 and 9.0, respectively). Finally, the regional hydrogeologic data and the site-based aquifer temperature and GWClass assignments were transferred in electronic format from the previous EPA models using these variables. These data were spot checked after transfer to ensure that they were processed into 3MRA model format without error.

Quality assurance (QA) was conducted to ensure that the QC activities above were performed correctly and consistently and adequately documented.

#### 16.2.5 Issues and Uncertainties

Because no site-based ground water flow direction (*AquDir*) data were available, ground water was assumed to flow in the same direction as surface water in the local watershed. In addition, the local watershed-to-reach connectivity was used to represent the aquifer-to-reach connectivity at the site. This adds uncertainty to the analysis because ground water flow does not always follow topography or discharge to the nearest waterbody. Evaluation of this uncertainty would require collection of site-specific data; however, it is not expected to have added a consistent bias to the analysis.

## 16.3 Breast Milk Ingestion Variables

The breast milk ingestion pathway is modeled in the HWIR 3MRA human exposure module using a steady-state-first order kinetics model obtained from *Methodology for Assessing Health Risks Associated with Multiple Pathways of Exposure to Combustor Emissions* (U.S. EPA, in press). This model bases infant exposure to both lipophilic and nonlipophilic constituents on projected constituent concentrations in maternal breast milk. For lipophilic compounds, the model assumes that constituents accumulate in the fatty component of breast milk and that these concentrations are equal to concentrations in maternal body fat. For nonlipophilic compounds, the model assumes that accumulation occurs in the aqueous phase of breast milk which, in turn, is assumed to be proportional to the concentration in the aqueous phase of blood plasma. Semilipophilic constituents are apportioned between both maternal fat and aqueous blood plasma phases in order to project the overall concentration in maternal breast milk. *Human Exposure Module: Background and Implementation for the HWIR 3MRA Model* (U.S. EPA, 1999f) provides additional detail on the breast milk model in the context of the 3MRA human exposure module.

Table 16-10 contains the variables required to calculate breast milk exposure with the HWIR human exposure module, divided into chemical-specific and non-chemical-specific inputs. All variables are collected nationally from either U.S. EPA (in press) or from *Estimating Exposure to Dioxin-Like Compounds. Volume II: Properties, Sources, Occurrence and Background Exposures* (U.S. EPA, 1994a).

### 16.3.1 Non-Chemical-Specific Variables

Non-chemical-specific are included in the National\_Variable\_Distribution table in the 3MRA model input database. The *fraction of mother's weight that is fat (ffm)* allows the constituent concentration in maternal fat to be estimated—this value is in turn related to the constituent concentration in milkfat. The HWIR analysis adopted the assumption from U.S. EPA (1994a) that 30 percent of a mother's bodyweight is fat. Constant values for other non-chemical-specific variables, including *fraction of mother's weight that is plasma (fpm)*, *fraction of whole blood that is plasma (fbp)*, and *fraction of fat in maternal breast milk (fmbm)*, were taken from U.S. EPA (in press).

### 16.3.2 Chemical-Specific Variables

Chemical-specific variables are passed to the HWIR 3MRA chemical properties processor in comma-separated text (.csv) files. At present HWIR evaluates the breast milk ingestion pathway only for dioxin, which is lipophilic, and the component of the breast milk model designed to model concentrations for nonlipophilic constituents (i.e., the component that projects constituent concentrations in the aqueous phase of breast milk) is not used. As a result, the chemical-specific flag to indicate that the breast milk model is used (*ChemBreastMilkExp*) is set to 1 for 2,3,7,8-TCDD (dioxin) and set to 0 for all other chemicals.

**Table 16-10. Breast Milk Exposure Variables**

Description	Code	Units	Value	Data Source
<i>Non-Chemical-Specific Variables</i>				
Fraction of mother's weight that is fat	ffm	Fraction	0.3	U.S. EPA (1994)
Fraction of mother's weight that is plasma	fpm	Fraction	0.046	U.S. EPA (in press)
Fraction of whole blood that is plasma	fbp	Fraction	0.65	U.S. EPA (in press)
Fraction of fat in maternal breast milk	fmbm	Unitless	0.04	U.S. EPA (1997a)
<i>Chemical-Specific Variables (Dioxin Only)</i>				
Logical flag indicating breast milk exposure? (1=yes, 0=no)	ChemBreastMilkExp	Unitless	1	Set to 1 if ChemBM is > 0
Background breast milk consumption rate (nonspecific sources)	ChemBM	mg/kg-d	5E-08	Based on a measured US background level of 16 ppt in the lipid portion of maternal breast milk (U.S. EPA, 1994a)
Fraction of contaminant ingested by the infant that is absorbed	Chemfai	Fraction	0.9	U.S. EPA (1994a)
Fraction of contaminant ingested by mother that is absorbed	ChemFam	Fraction	1	U.S. EPA (in press)
Fraction of contaminant in whole blood compartment	ChemFbl	Fraction	0	U.S. EPA (in press)
Fraction of contaminant stored in maternal fat	ChemFf	Fraction	0.9	U.S. EPA (1994a)
Concentration proportionality constant between plasma and breast milk aqueous phase	Chemkpm	Unitless	1	U.S. EPA (in press)
Concentration proportionality constant between red blood cells and plasma	ChemKrbc	Unitless	1	U.S. EPA (in press)
Biological half-life of chemical in lactating women	Chemt_halfb	d	2555	U.S. EPA (1994a)

**16.3.2.1 Benchmark.** A verified noncancer toxicity factor (i.e., RfD or RfC) has not been developed for dioxin. Consequently, modeled dose estimates are compared to typical background exposure levels to characterize the potential for noncancer effects in the infant resulting from the ingestion of dioxin contained in breast milk. Specifically, the modeled infant ADD dose estimate for the breast milk ingestion pathway is divided by the background infant exposure level for dioxin in breast milk in order to produce a margin of exposure (MOE) estimate. The MOE estimate, which is generated by the model, compares the modeled incremental dose estimate for a specific infant receptor population to typical background exposure levels seen across the United States. In this way, the incremental exposure level generated for a particular infant receptor population at a specific site can be placed in context relatively to typical exposure levels occurring nationwide.

HWIR uses a background breast milk ingestion level (*ChemBM*) for dioxin of 5E-8 mg/kg-day in this calculation, which is based on a background breast milk dioxin concentration level of 16 ppt reported in U.S. EPA (1994a).

**16.3.2.2 Biological Half-Life.** The constituent concentration in maternal milkfat is dependent on the *biological elimination constant for the contaminant in nonlactating women*, which can be related to the *biological half-life of the contaminant in lactating women* (*Chemt\_halfB*), which is chemical-specific and empirically derived. For the HWIR analysis, a

half-life of 2,555 days (7 years) was used for dioxin. U.S. EPA (1994a) reports a half-life ranging from 5 to 7 years for 2,3,7,8-TCDD (dioxin) in lactating women. The HWIR analysis uses the upper bound of the identified range. In general, a higher half-life reflects a longer time to steady state and results in a higher overall dioxin concentration in maternal fat and, consequently, in maternal breast milk. Because the HWIR analysis assumes steady-state conditions in modeling the breast milk pathway, using the maximum 7-year half-life is conservative.

**16.3.2.3 Adsorption and Proportionality Constants.** In estimating breast milk concentrations, HWIR assumes that 100 percent of the constituent ingested by the mother is absorbed ( $ChemFam = 1$ ) and therefore available for distribution to breast milk. Although reasonable for lipophilic compounds such as dioxin (U.S. EPA, in press), this assumption is somewhat conservative, because it is unlikely that all of an ingested constituent, even if lipophilic, would be absorbed. The *proportion of contaminant that is stored in maternal fat* ( $ChemFf$ ) is constituent-specific and is usually empirically derived based on absorption/distribution studies. For the HWIR analysis, it was assumed that 90 percent of the ingested absorbed dioxin was stored in maternal fat (i.e.,  $ChemFf = 0.90$ ) (U.S. EPA, 1994a). Similarly, the *fraction of contaminant ingested by the infant that is absorbed* ( $Chemfai$ ) was set at 0.90 based on information in U.S. EPA (1994a).

As described in U.S. EPA (in press), the breast milk model requires certain inputs to partition coefficients between different blood and milk compartments for nonlipophilic chemicals. As specified in U.S. EPA (in press), for lipophilic chemicals like dioxin, the *fraction of contaminant in whole blood compartment* ( $ChemFbl$ ) is set to 0 and both the *concentration proportionality constant between plasma and breast milk aqueous phase* ( $Chemkpm$ ) and the *concentration proportionality constant between red blood cells and plasma* ( $ChemKrbc$ ) are set to 1.

### 16.3.3 Quality Assurance/Quality Control

Quality control (QC) activities for variables used by the breast milk component of the human exposure module followed the same protocols as for other data: these manually entered values (e.g., the national data inputs) were checked 100 percent against the original sources. Quality assurance (QA) was conducted to ensure that the QC activities were performed correctly and consistently and adequately documented.

### 16.3.4 Issues and Uncertainties

All of the variables used in modeling the breast milk pathway are subject to some parameter uncertainty, and most are also subject to variability from differences in physiology or physical attributes between modeled individuals. However, the HWIR 3MRA does not consider between-individual variability or uncertainty in these variables; i.e., none are specified as distributions and thereby treated stochastically in the HWIR 3MRA. Uncertainty associated with modeling the breast milk pathway within the HWIR analysis could be reduced if a stochastic approach were adopted for modeling this pathway. Specifically, parameter-specific variability and uncertainty distributions could be developed and incorporated into the 3MRA Monte Carlo simulation.

The HWIR 3MRA assumes an exposure duration of 9 years for the mother, which is close to the projected half-life for dioxin, and further assumes that breast feeding occurs at the end of that exposure duration. Under these assumptions, maternal body burdens should approach steady-state concentrations at the point when breast feeding occurs, which should minimize the amount of error introduced into the analysis from the steady-state assumption. Similarly, because the HWIR 3MRA maternal body burdens should approach steady-state concentrations at the end of a 9-year exposure period, the amount of error introduced into the analysis by not accounting for reductions in maternal body burdens resulting from breast-feeding losses is expected to be small as well. As shown in the sensitivity analysis presented in U.S. EPA (in press), considering maternal body burden losses from breast feeding impacts model results primarily during the initial stages of maternal exposure; i.e., body burdens are low when the breast milk loss mechanism is most significant.

## 16.4 Shower Model Variables

The HWIR 3MRA human exposure module includes a shower algorithm adapted from McKone (1987). This model requires several inputs specific to the dimensions and characteristics of the shower and bathroom, as well as ventilation rates between the shower and bathroom and bathroom and house. These variables are shown in Table 16-11, along with the values used in the HWIR 3MRA and the data sources. Additional information on how these variables are specified and used in the HWIR human exposure module can be found in U.S. EPA (1999c).

**Table 16-11. Shower-Related Variables**

Description	Code	Units	Value	Data Source
Shower temperature (typical)	HumRcpTemp	Degrees Celsius	43	Foster & Chrostowski (1987)
Shower volume	Vshower	m <sup>3</sup>	2	McKone (1987)
Bathroom volume	Vbath	m <sup>3</sup>	10	McKone (1987)
Shower rate	Rshower	L/min	5.5	Best professional judgment
Shower-to-bathroom ventilation rate	VRsb	L/min	100	
Bathroom-to-house ventilation rate	VRbh	L/min	300	
Droplet terminal velocity	Vn	cm/s	400	
Nozzle height	Hn	cm	180	
Droplet diameter	DD	cm	0.1	

Typical, national values were used for all shower-related variables because of the limited variability expected in these parameters. *Shower volume and bathroom volume (Vshower and Vbath)* were obtained from McKone (1987). *Shower temperature (HumRcpTemp)* represents a typical value from Andelman et al. (1986) as reported in Foster and Chrostowski (1987). The remaining variables were specified based on best professional judgment.

Uncertainties in shower variables include the potential variability ignored by specifying these variables as constants, as well as the accuracy of the professional judgment values. EPA will evaluate each of these uncertainties as additional data become available. In addition, EPA

may investigate the overall sensitivity of human exposure estimates to expected variability in shower-related variables.

## 16.5 Waste Properties

Waste property variables are required by all source models. For the HWIR 3MRA, waste properties include liquid waste properties for the surface impoundment and aerated tank models, solid waste properties for the landfill and wastepile models, and both liquid and solid waste properties for the LAU model. The variables required are listed by 3MRA model component in Table 16-12, along with the values used in this analysis. Details on how these variables are utilized in the source modules can be found in U.S. EPA (1999g,h).

**Table 16-12. Waste Property Data**

Description	Code	Units	Distribution Type	Typical	Min	Max
Average waste/source temperature	SrcTemp	Degrees Celsius	Constant	site-specific (= air temp.)		
Average waste/source pH	SrcPh	pH units	Triangular	7	1	14
<b>Landfill Wastes</b>						
Mode of the aggregate size distribution (waste zone surface)	asdm	mm	Triangular	5	0.1	100
Dry bulk density (waste)	BDw	g/cm <sup>3</sup>	Triangular	1.825	1	2.65
Depth (root zone in LF waste zone)	DRZ_W	cm	Constant	500		
Fraction organic carbon (waste)	focW	Mass fraction	Triangular	0.15	0.001	0.9
Fraction hazardous waste in WMU	fwmu	Mass fraction	Uniform		0.001	1
Saturated hydraulic conductivity (waste)	KsatW	cm/h	Triangular	0.5	0.05	10
Volumetric water content (waste on trucks)	mcW	Volume percent	Triangular	40	1	75
Porosity (total, waste)	porW	Volume fraction	Triangular	0.5	0.2	0.8
Soil moisture coefficient b (waste)	SMbW	Unitless	Uniform		4	10
Soil moisture field capacity (LF waste zone)	SMFC_W	Volume %	Triangular	50	0	100
Soil moisture wilting point (LF waste zone)	SMWP_W	Volume %	Triangular	50	0	100
Silt content (waste)	Sw	Mass percent	Uniform		0	100
<b>Wastepile Wastes</b>						
Dry bulk density (waste)	BDw	g/cm <sup>3</sup>	Triangular	1.825	1	2.65
Settling velocity (suspended solids)	ConVs	m/d	Uniform		0.05	1
Depth (WP root zone)	DRZ_W	cm	Constant	500		
Fraction organic carbon (waste)	focW	Mass fraction	Triangular	0.15	0.001	0.9
Fraction hazardous waste in WMU	fwmu	Mass fraction	Uniform		0.001	1
Saturated hydraulic conductivity (waste)	KsatW	cm/h	Triangular	0.5	0.05	10
Volumetric water content (waste on trucks)	mcW	Volume percent	Triangular	40	1	75
Porosity (total, waste)	porW	Volume fraction	Triangular	0.5	0.2	0.8
Soil moisture coefficient b (waste)	SMbW	Unitless	Uniform		4	10
Soil moisture field capacity (WP)	SMFC_W	Volume %	Triangular	50	0	100
Soil moisture wilting point (WP)	SMWP_W	Volume %	Triangular	50	0	100
Silt content (waste)	Sw	Mass percent	Triangular	15	0	80
<b>Land Application Unit Wastes</b>						
Mode of the aggregate size distribution (till zone surface)	asdm	mm	Constant	5		
Dry bulk density (waste solids)	BDw	g/cm <sup>3</sup>	Triangular	1.825	1	2.65

(continued)

Table 16-12. (continued)

Description	Code	Units	Distribution Type	Typical	Min	Max
Settling velocity (suspended solids)	ConVs	m/d	Uniform		0.05	1
Fraction organic carbon (waste solids)	focW	Mass fraction	Triangular	0.35	0.001	0.99
Fraction hazardous waste in WMU	fwmu	Mass fraction	Uniform		0.001	1
Percent solids (waste)	solid	Mass percent	Uniform		0	30
Silt content (waste solids)	Sw	Mass percent	Triangular	50	0	100
<b><i>Aerated Tank Wastes</i></b>						
BOD (influent)	CBOD	g/cm <sup>3</sup>	Triangular	0.01	0	0.1
Particle diameter (mean, waste suspended solids)	dmeanTSS	cm	Triangular	0.001	0.0005	0.0025
Fraction organic carbon (waste solids)	focW	Mass fraction	Triangular	0.35	0.001	0.99
Fraction hazardous waste in WMU	fwmu	Mass fraction	Uniform		0.001	1
Molecular weight (liquid [water])	MWt_H2O	g/mol	Constant	18		
Density (liquid [water])	rho_l	g/cm <sup>3</sup>	Constant	0.998		
Solids density	rho_part	g/cm <sup>3</sup>	Triangular	2.5	1	4
Total suspended solids (influent)	TSS_in	g/cm <sup>3</sup>	Triangular	0.001	0.00001	0.01
<b><i>Surface Impoundment Wastes</i></b>						
BOD (influent)	CBOD	g/cm <sup>3</sup>	Triangular	0.01	0	0.1
Particle diameter (mean, waste suspended solids)	dmeanTSS	cm	Triangular	0.001	0.0005	0.0025
Fraction organic carbon (waste solids)	focW	Mass fraction	Triangular	0.35	0.001	0.99
Fraction hazardous waste in WMU	fwmu	Mass fraction	Uniform		0.001	1
Molecular weight (liquid [water])	MWt_H2O	g/mol	Constant	18		
Density (liquid [water])	rho_l	g/cm <sup>3</sup>	Constant	0.998		
Solids density	rho_part	g/cm <sup>3</sup>	Triangular	2.5	1	4
Total suspended solids (influent)	TSS_in	g/cm <sup>3</sup>	Triangular	0.001	0.00001	0.01

The waste property variables should be reflective of nonhazardous industrial wastes. However, little data were available on the waste characteristics needed by the models. EPA conducted an investigation and review of available waste characterization data (U.S. EPA, 1998b) but results are incomplete and were not adaptable in time for HWIR model runs. Instead, engineering judgment was used to estimate reasonable ranges and typical variables for properties, and a uniform or triangular distribution was assumed to represent uncertainty.

One significant source of uncertainty in these data is that they are not assumed to be correlated; if they are, random selection of variables could lead to unreasonable combinations of values. EPA will continue to look for approaches and additional sources to improve on waste property data, including correlations.

## 16.6 Control Variables

The HWIR 3MRA model includes several input variables that are used to control the risk calculations. These parameters are shown in Table 16-13 and are described by variable below.

**Table 16-13. HWIR Model Control Variables**

Description	Code	Units	Dimension	Value
Peak output fraction for simulation termination	TermFrac	Fraction		0.01
Maximum years for source module simulation	NyrMax	Years		200
Minimum values of bins for human risk -- cancer	BinRange_Min_C	Unitless	NumBinC	0E+00, 1E-08, 5E-07, 1E-06, 5E-06, 1E-05, 1E-04
Minimum values of bins for human risk -- noncancer	BinRange_Min_NC	Unitless	NumBinNC	0, 0.1, 1, 10
Minimum values of bins for eco risk	EcoBinRange_Min	Unitless	NumEcoBin	0, 0.1, 1, 10, 100
Number of bins for human -- carcinogen	NumBinC	Unitless		7
Number of bins for human -- noncarcinogen	NumBinNC	Unitless		4
Number of bins for ecological risk	NumEcoBin	Unitless		5
Regulatory percentile for human risk (policy criterion)	RegPercentile	Unitless		100
Regulatory percentile for eco risk (policy criterion)	EcoRegPercentile	Unitless		100
Option on whether to include all receptors (true) or exposed receptors (false) in CDF calculations	DoExposed	Unitless		FALSE

### 16.6.1 Termination Criteria

Within the landfill, wastepile, and land application unit modules, simulation is stopped when the contaminant mass is significantly depleted. The stopping criteria is defined by *TermFrac*: at the end of the year in which the contaminant mass in the source (or source subcomponent for the landfill, wastepile, or LAU) is less than or equal to *TermFrac* times the total contaminant mass remaining, the simulation is stopped (U.S. EPA, 1999g). *NyrMax*, at which point the simulation is automatically stopped, overrides the *TermFrac* criteria. In HWIR, *TermFrac* is set at 0.01 (i.e., the source model simulation is stopped when the waste contaminant concentration is 1/100 of its maximum). *NyrMax* is set to 200 years due to computer memory constraints and run time considerations.

### 16.6.2 Risk Control Variables

Risk bins are defined as the histogram class intervals constituting the cumulative probability distribution functions (CDFs) computed by the human risk module for cancer risk, hazard quotient (HQ), and margin of exposure (MOE). There are seven bins for cancer risk (*NumBinC* = 7) and four bins for HQ or MOE (*NumBinNC* = 4). The bins are defined as specific risk and HQ/MOE ranges by specifying the minimum value for each bin using the variables *BinRange\_Min\_C* and *BinRange\_Min\_NC*, which are vectors dimensioned on *NumBinC* and *NumBinNC*, respectively. Similarly, the number of bins for ecological risk (five) is defined by *NumEcoBin*, with the bin ranges specified by *EcoBinRange\_Min*. The number of human and ecological risk bins and their ranges were specified by EPA to provide adequate resolution in results for policy decisions.



*RegPercentile* is a user-specified population percentage for which the total cancer risk, hazard quotient, or margin of exposure is computed by the human risk module. *EcoRegPercentile* serves the same function for ecological risk. Because the 3MRA exit level processor (ELP) also includes the option to specify population percentage, and the ELP option is exercised at 90 percent in HWIR, both variables are set to 100.

When computing human risk, the human risk module can either include in the histograms all receptor/cohort individuals whether exposed to a contaminant or not or only those individuals that are exposed. In the latter case, the risk and/or HQ histograms can be interpreted as further conditioned on positive exposure. The option is set by the logical flag *DoExposed*. *DoExposed* was set to “False” for HWIR, meaning all individuals are included in the histograms, whether exposed or not.

Additional information on the specification and function of these control variables can be found in *Background Document for the Human Risk Module for HWIR99 Multimedia, Multipathway and Multireceptor Risk Assessment (3MRA) Model* (U.S. EPA, 1999i) for human risk variables and *Ecological Risk Module: Background and Implementation for the Multimedia, Multipathway and Multireceptor Risk Assessment (3MRA) for HWIR99* (U.S. EPA, 1999j) for ecological risk variables.

## 16.7 References

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**Appendix 16A. Site-Based Meteorological Station and Hydrogeologic Data**

Setting_ID	Meteorological Station				Site RuralStr	Hydrogeologic		
	Upper Air Station	Surface Station	AnemHght	StartYr		GWClass	NumAquWell	AquTemp, VadTemp
WP0114001	94823	94823	6.1	1961	URBAN	GWClass02	47	12.5
WP0130207	14842	14923	7.6	1961	RURAL	GWClass02	78	12.5
AT0131104	14842	94822	6.1	1961	RURAL	GWClass02	0	
SI0131104	14842	94822	6.1	1961	RURAL	GWClass02	96	7.5
AT0131207	14733	14733	10.1	1961	URBAN	GWClass02	0	
SI0131207	14733	14733	10.1	1961	URBAN	GWClass02	3	7.5
AT0131508	03860	13877	6.1	1962	URBAN	GWClass02	0	
LF0131508	03860	13877	6.1	1962	URBAN	GWClass02	9	12.5
SI0131508	03860	13877	6.1	1962	URBAN	GWClass02	6	12.5
WP0131508	03860	13877	6.1	1962	URBAN	GWClass02	5	12.5
AT0136703	23047	23047	7	1963	RURAL	GWClass05	0	
LA0136703	23047	23047	7	1963	RURAL	GWClass05	70	17.5
SI0136703	23047	23047	7	1963	RURAL	GWClass05	58	17.5
WP0220102	13880	13880	6.1	1961	URBAN	GWClass02	0	17.5
WP0221207	13840	93815	6.7	1961	URBAN	GWClass02	113	12.5
LA0223504	94823	14895	6.1	1961	URBAN	GWClass04	123	12.5
LF0223504	94823	14895	6.1	1961	URBAN	GWClass04	113	12.5
WP0223504	94823	14895	6.1	1961	URBAN	GWClass04	125	12.5
WP0224002	14842	14923	7.6	1961	URBAN	GWClass02	30	7.5
LF0231002	13840	93815	6.7	1961	RURAL	GWClass09	104	12.5
LF0231106	93734	13739	6.1	1961	RURAL	GWClass04	29	12.5
LF0231407	13901	03927	6.7	1975	RURAL	GWClass02	28	17.5
AT0231610	14842	94846	6.1	1961	URBAN	GWClass02	0	
SI0231610	14842	94846	6.1	1961	URBAN	GWClass02	26	12.5
WP0231911	14826	14826	6.4	1961	URBAN	GWClass02	35	7.5
AT0231914	14826	94847	6.1	1961	URBAN	GWClass02	0	
SI0231914	14826	94847	6.1	1961	URBAN	GWClass02	26	12.5
WP0232305	14735	14742	6.1	1961	RURAL	GWClass10	21	7.5
AT0232313	03951	13957	6.1	1981	RURAL	GWClass02	0	
LF0232313	03951	13957	6.1	1981	RURAL	GWClass02	63	17.5
SI0232313	03951	13957	6.1	1981	RURAL	GWClass02	55	17.5
WP0232313	03951	13957	6.1	1981	RURAL	GWClass02	55	17.5
AT0232402	93734	13781	6.1	1961	URBAN	GWClass01	0	
LF0232402	93734	13781	6.1	1961	URBAN	GWClass01	181	12.5
SI0232402	93734	13781	6.1	1961	URBAN	GWClass01	167	12.5
AT0232415	14733	14820	6.1	1961	URBAN	GWClass02	0	
SI0232415	14733	14820	6.1	1961	URBAN	GWClass02	0	12.5
WP0232415	14733	14820	6.1	1961	URBAN	GWClass02	0	12.5
LF0232501	94823	14852	6.1	1961	RURAL	GWClass02	108	12.5
WP0232501	94823	14852	6.1	1961	RURAL	GWClass02	107	12.5
AT0232705	13873	13874	6.1	1961	RURAL	GWClass02	0	

(continued)

## Appendix 16A. (continued)

Setting_ID	Meteorological Station				Site RuralStr	Hydrogeologic		
	Upper Air Station	Surface Station	AnemHght	StartYr		GWClass	NumAquWell	AquTemp, VadTemp
SI0232705	13873	13874	6.1	1961	RURAL	GWClass02	149	17.5
AT0233601	13723	13741	9.1	1961	URBAN	GWClass02	0	
SI0233601	13723	13741	9.1	1961	URBAN	GWClass02	57	12.5
LF0233603	13897	03856	7.6	1961	RURAL	GWClass02	57	17.5
LF0234904	93734	14737	6.1	1961	RURAL	GWClass02	134	12.5
LF0235301	13840	93819	6.1	1961	URBAN	GWClass09	147	12.5
AT0312301	13723	13741	9.1	1961	RURAL	GWClass02	0	
LA0312301	13723	13741	9.1	1961	RURAL	GWClass02	94	12.5
SI0312301	13723	13741	9.1	1961	RURAL	GWClass02	89	12.5
LF0314202	14735	14735	6.1	1961	URBAN	GWClass04	62	7.5
AT0321802	24232	24229	6.1	1961	RURAL	GWClass05	0	
SI0321802	24232	24229	6.1	1961	RURAL	GWClass05	0	12.5
WP0321802	24232	24229	6.1	1961	RURAL	GWClass05	0	12.5
AT0331006	13963	13893	6.7	1962	RURAL	GWClass05	0	
SI0331006	13963	13893	6.7	1962	RURAL	GWClass05	3	17.5
AT0331902	13985	13985	6.1	1961	RURAL	GWClass10	0	
SI0331902	13985	13985	6.1	1961	RURAL	GWClass10	28	17.5
WP0331902	13985	13985	6.1	1961	RURAL	GWClass10	28	17.5
AT0332104	23047	23047	7	1963	RURAL	GWClass10	0	
LA0332104	23047	23047	7	1963	RURAL	GWClass10	91	17.5
SI0332104	23047	23047	7	1963	RURAL	GWClass10	66	17.5
WP0332104	23047	23047	7	1963	RURAL	GWClass10	62	17.5
LF0332707	12842	12842	6.7	1961	RURAL	GWClass02	48	22.5
WP0332707	12842	12842	6.7	1961	RURAL	GWClass02	57	22.5
WP0332811	13840	14821	6.1	1961	URBAN	GWClass02	133	12.5
AT0430108	13996	03947	9.8	1973	RURAL	GWClass05	0	
SI0430108	13996	03947	9.8	1973	RURAL	GWClass05	11	12.5
WP0430108	13996	03947	9.8	1973	RURAL	GWClass05	11	12.5
AT0430412	14733	14820	6.1	1961	RURAL	GWClass02	0	
LF0430412	14733	14820	6.1	1961	RURAL	GWClass02	38	12.5
SI0430412	14733	14820	6.1	1961	RURAL	GWClass02	37	12.5
AT0431912	13996	03947	9.8	1973	RURAL	GWClass02	0	
LF0431912	13996	03947	9.8	1973	RURAL	GWClass02	18	12.5
SI0431912	13996	03947	9.8	1973	RURAL	GWClass02	18	12.5
LF0432011	13897	03856	7.6	1961	RURAL	GWClass02	8	17.5
AT0432106	93734	14737	6.1	1961	RURAL	GWClass02	0	
SI0432106	93734	14737	6.1	1961	RURAL	GWClass02	59	12.5
AT0432716	14918	14913	6.4	1961	RURAL	GWClass02	0	
SI0432716	14918	14913	6.4	1961	RURAL	GWClass02	11	2.5
AT0433201	14826	14848	6.4	1961	RURAL	GWClass09	0	
LF0433201	14826	14848	6.4	1961	RURAL	GWClass09	15	12.5
SI0433201	14826	14848	6.4	1961	RURAL	GWClass09	21	12.5

(continued)

## Appendix 16A. (continued)

Setting_ID	Meteorological Station				Site RuralStr	Hydrogeologic		
	Upper Air Station	Surface Station	AnemHght	StartYr		GWClass	NumAquWell	AquTemp, VadTemp
AT0433204	13880	13880	6.1	1961	RURAL	GWClass10	0	
SI0433204	13880	13880	6.1	1961	RURAL	GWClass10	19	17.5
AT0433404	24023	24018	10.1	1961	RURAL	GWClass05	0	
LF0433404	24023	24018	10.1	1961	RURAL	GWClass05	51	7.5
SI0433404	24023	24018	10.1	1961	RURAL	GWClass05	50	7.5
AT0433408	24143	24037	12.2	1961	RURAL	GWClass05	0	
SI0433408	24143	24037	12.2	1961	RURAL	GWClass05	16	7.5
AT0434505	23160	23183	10.1	1961	RURAL	GWClass04	0	
SI0434505	23160	23183	10.1	1961	RURAL	GWClass04	32	22.5
AT0434804	13723	13722	6.1	1961	RURAL	GWClass01	0	
SI0434804	13723	13722	6.1	1961	RURAL	GWClass01	40	17.5
AT0435510	14842	14842	6.1	1961	RURAL	GWClass02	0	
LA0435510	14842	14842	6.1	1961	RURAL	GWClass02	45	12.5
SI0435510	14842	14842	6.1	1961	RURAL	GWClass02	51	12.5
AT0436007	13723	13722	6.1	1961	RURAL	GWClass01	0	
SI0436007	13723	13722	6.1	1961	RURAL	GWClass01	38	17.5
AT0436108	13723	13881	10.1	1961	RURAL	GWClass01	0	
SI0436108	13723	13881	10.1	1961	RURAL	GWClass01	63	17.5
AT0530901	14733	14820	6.1	1961	RURAL	GWClass10	0	
LA0530901	14733	14820	6.1	1961	RURAL	GWClass10	64	12.5
SI0530901	14733	14820	6.1	1961	RURAL	GWClass10	56	12.5
AT0531301	14842	93822	9.4	1961	RURAL	GWClass02	0	
SI0531301	14842	93822	9.4	1961	RURAL	GWClass02	33	12.5
AT0531502	03860	03860	6.1	1962	URBAN	GWClass10	0	
SI0531502	03860	03860	6.1	1962	URBAN	GWClass10	98	12.5
LF0531702	23047	23047	7	1963	RURAL	GWClass10	87	17.5
AT0531902	03937	12960	6.1	1977	URBAN	GWClass04	0	
SI0531902	03937	12960	6.1	1977	URBAN	GWClass04	0	22.5
AT0534504	13873	13874	6.1	1961	URBAN	GWClass01	0	
SI0534504	13873	13874	6.1	1961	URBAN	GWClass01	10	17.5
AT0613402	03879	13994	6.1	1973	URBAN	GWClass02	0	
SI0613402	03879	13994	6.1	1973	URBAN	GWClass02	0	12.5
AT0620401	03937	12960	6.1	1977	URBAN	GWClass04	0	
SI0620401	03937	12960	6.1	1977	URBAN	GWClass04	13	22.5
AT0620604	24127	24127	6.1	1961	RURAL	GWClass05	0	
SI0620604	24127	24127	6.1	1961	RURAL	GWClass05	0	12.5
AT0621603	03937	12960	6.1	1977	RURAL	GWClass04	0	
SI0621603	03937	12960	6.1	1977	RURAL	GWClass04	0	22.5
AT0621902	13996	03928	7.6	1961	RURAL	GWClass05	0	
SI0621902	13996	03928	7.6	1961	RURAL	GWClass05	39	12.5
AT0622902	23160	23160	6.1	1961	RURAL	GWClass05	0	
SI0622902	23160	23160	6.1	1961	RURAL	GWClass05	32	22.5

(continued)

## Appendix 16A. (continued)

Setting_ID	Meteorological Station				Site RuralStr	Hydrogeologic		
	Upper Air Station	Surface Station	AnemHght	StartYr		GWClass	NumAquWell	AquTemp, VadTemp
AT0625002	13880	03822	9.1	1961	RURAL	GWClass02	0	
LF0625002	13880	03822	9.1	1961	RURAL	GWClass02	1	22.5
SI0625002	13880	03822	9.1	1961	RURAL	GWClass02	1	22.5
LA0625501	03937	12960	6.1	1977	RURAL	GWClass04	19	22.5
LA0631701	03937	12960	6.1	1977	RURAL	GWClass04	0	22.5
AT0631903	03937	03937	6.7	1962	URBAN	GWClass04	0	
LF0631903	03937	03937	6.7	1962	URBAN	GWClass04	16	22.5
SI0631903	03937	03937	6.7	1962	URBAN	GWClass04	23	22.5
AT0632003	03951	13957	6.1	1981	RURAL	GWClass02	0	
LF0632003	03951	13957	6.1	1981	RURAL	GWClass02	14	17.5
SI0632003	03951	13957	6.1	1981	RURAL	GWClass02	15	17.5
AT0632606	23047	23047	7	1963	RURAL	GWClass10	0	
LF0632606	23047	23047	7	1963	RURAL	GWClass10	13	17.5
SI0632606	23047	23047	7	1963	RURAL	GWClass10	14	17.5
AT0632608	24232	24229	6.1	1961	RURAL	GWClass05	0	
LF0632608	24232	24229	6.1	1961	RURAL	GWClass05	1	12.5
SI0632608	24232	24229	6.1	1961	RURAL	GWClass05	1	12.5
AT0634001	13873	13874	6.1	1961	RURAL	GWClass02	0	
SI0634001	13873	13874	6.1	1961	RURAL	GWClass02	47	17.5
AT0635301	03160	23169	6.1	1980	URBAN	GWClass02	0	
SI0635301	03160	23169	6.1	1980	URBAN	GWClass02	6	17.5
AT0713618	24225	24225	6.1	1961	URBAN	GWClass02	0	
SI0713618	24225	24225	6.1	1961	URBAN	GWClass02	67	12.5
AT0713705	23160	23183	10.1	1961	RURAL	GWClass05	0	
LF0713705	23160	23183	10.1	1961	RURAL	GWClass05	25	22.5
SI0713705	23160	23183	10.1	1961	RURAL	GWClass05	25	22.5
WP0715007	93734	13739	6.1	1961	URBAN	GWClass01	177	12.5
WP0715216	23230	23174	9.1	1961	URBAN	GWClass11	0	22.5
AT0716701	03879	93817	6.1	1973	RURAL	GWClass09	0	
SI0716701	03879	93817	6.1	1973	RURAL	GWClass09	11	12.5
WP0720506	14764	14764	6.1	1961	RURAL	GWClass04	36	7.5
AT0720803	12842	12842	6.7	1961	RURAL	GWClass11	0	
LA0720803	12842	12842	6.7	1961	RURAL	GWClass11	139	22.5
LF0720803	12842	12842	6.7	1961	RURAL	GWClass11	148	22.5
SI0720803	12842	12842	6.7	1961	RURAL	GWClass11	132	22.5
WP0721305	14826	94847	6.1	1961	URBAN	GWClass02	33	12.5
WP0722107	12842	12842	6.7	1961	RURAL	GWClass11	56	22.5
AT0722503	23062	94018	6.1	1961	URBAN	GWClass02	0	
SI0722503	23062	94018	6.1	1961	URBAN	GWClass02	37	12.5
AT0722505	12839	12839	7	1961	URBAN	GWClass02	0	
SI0722505	12839	12839	7	1961	URBAN	GWClass02	122	27.5
LF0722705	14735	04725	6.7	1961	URBAN	GWClass04	48	7.5

(continued)



## Appendix 16A. (continued)

Setting_ID	Meteorological Station				Site RuralStr	Hydrogeologic		
	Upper Air Station	Surface Station	AnemHght	StartYr		GWClass	NumAquWell	AquTemp, VadTemp
AT0723607	12912	13958	6.1	1973	RURAL	GWClass02	0	
SI0723607	12912	13958	6.1	1973	RURAL	GWClass02	44	22.5
AT0724206	13723	13723	6.1	1961	RURAL	GWClass01	0	
SI0724206	13723	13723	6.1	1961	RURAL	GWClass01	43	17.5
WP0724206	13723	13723	6.1	1961	RURAL	GWClass01	42	17.5
WP0724301	13963	13893	6.7	1962	RURAL	GWClass04	69	17.5
WP0724804	93734	14737	6.1	1961	RURAL	GWClass02	158	12.5
WP0724909	24143	24037	12.2	1961	RURAL	GWClass10	21	7.5
AT0730407	94823	94823	6.1	1961	RURAL	GWClass02	0	
LF0730407	94823	94823	6.1	1961	RURAL	GWClass02	22	12.5
SI0730407	94823	94823	6.1	1961	RURAL	GWClass02	21	12.5
AT0730502	03879	93817	6.1	1973	URBAN	GWClass02	0	
SI0730502	03879	93817	6.1	1973	URBAN	GWClass02	68	12.5
WP0730502	03879	93817	6.1	1973	URBAN	GWClass02	68	12.5
AT0730914	12912	13958	6.1	1973	RURAL	GWClass02	0	
LF0730914	12912	13958	6.1	1973	RURAL	GWClass02	40	22.5
SI0730914	12912	13958	6.1	1973	RURAL	GWClass02	39	22.5
WP0730914	12912	13958	6.1	1973	RURAL	GWClass02	42	22.5
AT0731111	14735	04725	6.7	1961	URBAN	GWClass04	0	
SI0731111	14735	04725	6.7	1961	URBAN	GWClass04	82	7.5
AT0731405	93734	13781	6.1	1961	RURAL	GWClass02	0	
SI0731405	93734	13781	6.1	1961	RURAL	GWClass02	28	12.5
WP0731411	23230	93193	6.1	1961	RURAL	GWClass04	33	17.5
AT0731412	14764	14739	6.7	1961	RURAL	GWClass01	0	
SI0731412	14764	14739	6.7	1961	RURAL	GWClass01	104	7.5
WP0731412	14764	14739	6.7	1961	RURAL	GWClass01	76	7.5
AT0731501	94789	14734	6.1	1961	URBAN	GWClass10	0	
SI0731501	94789	14734	6.1	1961	URBAN	GWClass10	68	12.5
AT0731507	13723	13722	6.1	1961	RURAL	GWClass10	0	
SI0731507	13723	13722	6.1	1961	RURAL	GWClass10	22	17.5
WP0731507	13723	13722	6.1	1961	RURAL	GWClass10	16	17.5
AT0731514	14842	94846	6.1	1961	RURAL	GWClass02	0	
LF0731514	14842	94846	6.1	1961	RURAL	GWClass02	25	12.5
SI0731514	14842	94846	6.1	1961	RURAL	GWClass02	16	12.5
LF0731703	93734	13739	6.1	1961	RURAL	GWClass02	217	12.5
LF0732110	14735	14777	10.1	1961	URBAN	GWClass10	122	12.5
WP0732405	23230	23232	6.1	1961	URBAN	GWClass04	109	17.5
WP0732510	14842	94846	6.1	1961	RURAL	GWClass02	120	12.5
AT0733203	23230	23232	6.1	1961	RURAL	GWClass04	0	
SI0733203	23230	23232	6.1	1961	RURAL	GWClass04	24	17.5
AT0733210	94823	14895	6.1	1961	RURAL	GWClass02	0	
LF0733210	94823	14895	6.1	1961	RURAL	GWClass02	62	12.5

(continued)

## Appendix 16A. (continued)

Setting_ID	Meteorological Station				Site RuralStr	Hydrogeologic		
	Upper Air Station	Surface Station	AnemHght	StartYr		GWClass	NumAquWell	AquTemp, VadTemp
SI0733210	94823	14895	6.1	1961	RURAL	GWClass02	59	12.5
AT0733302	03860	93820	7	1962	URBAN	GWClass02	0	
SI0733302	03860	93820	7	1962	URBAN	GWClass02	45	12.5
WP0733302	03860	93820	7	1962	URBAN	GWClass02	45	12.5
LF0733404	94823	14778	6.1	1961	RURAL	GWClass02	53	12.5
WP0733404	94823	14778	6.1	1961	RURAL	GWClass02	51	12.5
AT0733501	13723	03812	6.1	1973	RURAL	GWClass01	0	
SI0733501	13723	03812	6.1	1973	RURAL	GWClass01	109	17.5
AT0733606	93734	13739	6.1	1961	RURAL	GWClass01	0	
SI0733606	93734	13739	6.1	1961	RURAL	GWClass01	49	12.5
WP0733606	93734	13739	6.1	1961	RURAL	GWClass01	63	12.5
WP0734604	93734	13739	6.1	1961	URBAN	GWClass10	135	12.5
AT0735309	13967	13968	7	1961	RURAL	GWClass02	0	
LF0735309	13967	13968	7	1961	RURAL	GWClass02	106	17.5
SI0735309	13967	13968	7	1961	RURAL	GWClass02	100	17.5
AT0826707	13723	13723	6.1	1961	RURAL	GWClass01	0	
SI0826707	13723	13723	6.1	1961	RURAL	GWClass01	77	17.5
LF0830601	13897	03856	7.6	1961	RURAL	GWClass01	21	17.5
AT0830903	14735	14742	6.1	1961	RURAL	GWClass04	0	
LF0830903	14735	14742	6.1	1961	RURAL	GWClass04	20	7.5
SI0830903	14735	14742	6.1	1961	RURAL	GWClass04	16	7.5
WP0831102	14764	14764	6.1	1961	URBAN	GWClass01	84	7.5
AT0831406	03940	13865	6.1	1974	RURAL	GWClass04	0	
LF0831406	03940	13865	6.1	1974	RURAL	GWClass04	8	17.5
SI0831406	03940	13865	6.1	1974	RURAL	GWClass04	9	17.5
AT0831904	13873	03813	7	1961	RURAL	GWClass02	0	
LA0831904	13873	03813	7	1961	RURAL	GWClass02	91	22.5
LF0831904	13873	03813	7	1961	RURAL	GWClass02	64	22.5
SI0831904	13873	03813	7	1961	RURAL	GWClass02	71	22.5
LF0832304	14898	14898	6.1	1961	URBAN	GWClass04	74	7.5
WP0832304	14898	14898	6.1	1961	URBAN	GWClass04	43	7.5
AT0832510	14735	14777	10.1	1961	RURAL	GWClass10	0	
SI0832510	14735	14777	10.1	1961	RURAL	GWClass10	43	12.5
WP0832510	14735	14777	10.1	1961	RURAL	GWClass10	45	12.5
AT0832903	03937	13970	6.1	1962	RURAL	GWClass04	0	
SI0832903	03937	13970	6.1	1962	RURAL	GWClass04	10	22.5
WP0832903	03937	13970	6.1	1962	RURAL	GWClass04	8	22.5
AT0832904	13873	13873	6.1	1961	RURAL	GWClass01	0	
SI0832904	13873	13873	6.1	1961	RURAL	GWClass01	49	17.5
AT0832909	13840	93815	6.7	1961	URBAN	GWClass04	0	
SI0832909	13840	93815	6.7	1961	URBAN	GWClass04	38	12.5
LF0833001	13723	03812	6.1	1973	RURAL	GWClass01	152	17.5

(continued)

## Appendix 16A. (continued)

Setting_ID	Meteorological Station				Site RuralStr	Hydrogeologic		
	Upper Air Station	Surface Station	AnemHght	StartYr		GWClass	NumAquWell	AquTemp, VadTemp
AT0833007	14898	14898	6.1	1961	RURAL	GWClass04	0	
LF0833007	14898	14898	6.1	1961	RURAL	GWClass04	76	7.5
SI0833007	14898	14898	6.1	1961	RURAL	GWClass04	52	7.5
AT0834009	93734	13739	6.1	1961	RURAL	GWClass01	0	
SI0834009	93734	13739	6.1	1961	RURAL	GWClass01	73	12.5
WP0923004	14826	94860	6.1	1973	RURAL	GWClass09	73	7.5
AT0930205	13723	13723	6.1	1961	RURAL	GWClass01	0	
SI0930205	13723	13723	6.1	1961	RURAL	GWClass01	91	17.5
WP0930205	13723	13723	6.1	1961	RURAL	GWClass01	89	17.5
AT0930301	24157	24243	10.1	1961	RURAL	GWClass10	0	
LF0930301	24157	24243	10.1	1961	RURAL	GWClass10	10	12.5
SI0930301	24157	24243	10.1	1961	RURAL	GWClass10	11	12.5
WP0930301	24157	24243	10.1	1961	RURAL	GWClass10	10	12.5
AT0930702	12912	13958	6.1	1973	RURAL	GWClass02	0	
LF0930702	12912	13958	6.1	1973	RURAL	GWClass02	8	22.5
SI0930702	12912	13958	6.1	1973	RURAL	GWClass02	9	22.5
AT0932103	13873	13883	6.1	1961	RURAL	GWClass04	0	
LF0932103	13873	13883	6.1	1961	RURAL	GWClass04	47	17.5
SI0932103	13873	13883	6.1	1961	RURAL	GWClass04	47	17.5
WP0932103	13873	13883	6.1	1961	RURAL	GWClass04	46	17.5
AT0932507	93734	14737	6.1	1961	URBAN	GWClass02	0	
SI0932507	93734	14737	6.1	1961	URBAN	GWClass02	137	12.5
WP0932507	93734	14737	6.1	1961	URBAN	GWClass02	136	12.5
AT0932509	24157	24157	6.1	1961	RURAL	GWClass09	0	
LF0932509	24157	24157	6.1	1961	RURAL	GWClass09	48	12.5
SI0932509	24157	24157	6.1	1961	RURAL	GWClass09	50	12.5
WP0932509	24157	24157	6.1	1961	RURAL	GWClass09	43	12.5
AT0932903	03937	12960	6.1	1977	RURAL	GWClass04	0	
LF0932903	03937	12960	6.1	1977	RURAL	GWClass04	16	22.5
SI0932903	03937	12960	6.1	1977	RURAL	GWClass04	18	22.5
AT0933704	03860	13877	6.1	1962	RURAL	GWClass02	0	
SI0933704	03860	13877	6.1	1962	RURAL	GWClass02	58	12.5
LA1010805	24157	24155	6.1	1961	URBAN	GWClass10	240	12.5
AT1012203	94789	94728	6.1	1961	RURAL	GWClass10	0	
LF1012203	94789	94728	6.1	1961	RURAL	GWClass10	71	12.5
SI1012203	94789	94728	6.1	1961	RURAL	GWClass10	71	12.5
WP1012203	94789	94728	6.1	1961	RURAL	GWClass10	71	12.5
AT1013209	23230	93193	6.1	1961	RURAL	GWClass04	0	
SI1013209	23230	93193	6.1	1961	RURAL	GWClass04	50	17.5
LF1014805	12832	93805	7.6	1978	RURAL	GWClass02	51	22.5
LF1015510	23047	23042	7.6	1963	RURAL	GWClass05	13	17.5
AT1023705	14733	14768	6.1	1961	RURAL	GWClass04	0	

(continued)

## Appendix 16A. (continued)

Setting_ID	Meteorological Station				Site RuralStr	Hydrogeologic		
	Upper Air Station	Surface Station	AnemHght	StartYr		GWClass	NumAquWell	AquTemp, VadTemp
SI1023705	14733	14768	6.1	1961	RURAL	GWClass04	60	7.5
LA1031503	13996	03928	7.6	1961	RURAL	GWClass05	10	12.5
AT1031507	23230	93193	6.1	1961	RURAL	GWClass04	0	
SI1031507	23230	93193	6.1	1961	RURAL	GWClass04	134	17.5
AT1032715	13897	03856	7.6	1961	RURAL	GWClass02	0	
SI1032715	13897	03856	7.6	1961	RURAL	GWClass02	81	17.5
AT1032802	13723	13722	6.1	1961	RURAL	GWClass01	0	
LA1032802	13723	13722	6.1	1961	RURAL	GWClass01	53	17.5
LF1032802	13723	13722	6.1	1961	RURAL	GWClass01	48	17.5
SI1032802	13723	13722	6.1	1961	RURAL	GWClass01	48	17.5
AT1033107	14826	14840	6.1	1961	URBAN	GWClass09	0	
SI1033107	14826	14840	6.1	1961	URBAN	GWClass09	121	7.5
AT1033114	93755	93730	6.1	1981	RURAL	GWClass04	0	
SI1033114	93755	93730	6.1	1981	RURAL	GWClass04	40	12.5
LA1033202	13967	13968	7	1961	URBAN	GWClass02	1	17.5
AT1033602	14826	94860	6.1	1973	RURAL	GWClass09	0	
LA1033602	14826	94860	6.1	1973	RURAL	GWClass09	122	12.5
SI1033602	14826	94860	6.1	1973	RURAL	GWClass09	52	12.5
LA1034005	13873	13873	6.1	1961	RURAL	GWClass01	54	17.5
WP1034005	13873	13873	6.1	1961	RURAL	GWClass01	46	17.5
AT1034210	14735	04725	6.7	1961	RURAL	GWClass04	0	
LA1034210	14735	04725	6.7	1961	RURAL	GWClass04	65	7.5
SI1034210	14735	04725	6.7	1961	RURAL	GWClass04	52	7.5
AT1034406	03940	03940	10.1	1973	RURAL	GWClass05	0	
SI1034406	03940	03940	10.1	1973	RURAL	GWClass05	22	17.5
AT1034805	03946	13995	6.1	1973	RURAL	GWClass02	0	
SI1034805	03946	13995	6.1	1973	RURAL	GWClass02	22	17.5
AT1035117	13996	03947	9.8	1973	RURAL	GWClass05	0	
SI1035117	13996	03947	9.8	1973	RURAL	GWClass05	21	12.5
AT1035405	24131	24131	6.1	1961	RURAL	GWClass10	0	
SI1035405	24131	24131	6.1	1961	RURAL	GWClass10	89	12.5
AT1035508	24127	24156	6.1	1961	RURAL	GWClass05	0	
LA1035508	24127	24156	6.1	1961	RURAL	GWClass05	101	7.5
SI1035508	24127	24156	6.1	1961	RURAL	GWClass05	90	7.5
AT1120904	14735	14742	6.1	1961	RURAL	GWClass10	0	
SI1120904	14735	14742	6.1	1961	RURAL	GWClass10	20	7.5
AT1122705	03860	13877	6.1	1962	RURAL	GWClass02	0	
SI1122705	03860	13877	6.1	1962	RURAL	GWClass02	37	12.5
AT1131103	03937	12916	6.1	1962	URBAN	GWClass13	0	
SI1131103	03937	12916	6.1	1962	URBAN	GWClass13	64	22.5
LA1131802	23230	23232	6.1	1961	RURAL	GWClass01	4	12.5
LA1133902	13873	03870	7	1963	URBAN	GWClass01	100	17.5

(continued)

## Appendix 16A. (continued)

Setting_ID	Meteorological Station				Site RuralStr	Hydrogeologic		
	Upper Air Station	Surface Station	AnemHght	StartYr		GWClass	NumAquWell	AquTemp, VadTemp
LA1134405	03946	03945	6.1	1975	RURAL	GWClass04	80	12.5
AT1212301	14764	14739	6.7	1961	RURAL	GWClass01	0	
SI1212301	14764	14739	6.7	1961	RURAL	GWClass01	97	12.5
AT1221704	12842	12842	6.7	1961	URBAN	GWClass02	0	
SI1221704	12842	12842	6.7	1961	URBAN	GWClass02	242	22.5
WP1221704	12842	12842	6.7	1961	URBAN	GWClass02	253	22.5
AT1223404	93734	13739	6.1	1961	URBAN	GWClass01	0	
SI1223404	93734	13739	6.1	1961	URBAN	GWClass01	117	12.5
AT1230111	24143	24033	7.6	1961	RURAL	GWClass05	0	
SI1230111	24143	24033	7.6	1961	RURAL	GWClass05	44	7.5
AT1230206	13963	13893	6.7	1962	RURAL	GWClass05	0	
SI1230206	13963	13893	6.7	1962	RURAL	GWClass05	3	17.5
AT1230517	93734	93721	6.1	1961	RURAL	GWClass01	0	
SI1230517	93734	93721	6.1	1961	RURAL	GWClass01	51	12.5
WP1230919	14735	14735	6.1	1961	URBAN	GWClass04	4	7.5
AT1231101	13963	13893	6.7	1962	RURAL	GWClass05	0	
LA1231101	13963	13893	6.7	1962	RURAL	GWClass05	0	17.5
SI1231101	13963	13893	6.7	1962	RURAL	GWClass05	0	17.5
AT1231705	13880	13880	6.1	1961	RURAL	GWClass02	0	
LA1231705	13880	13880	6.1	1961	RURAL	GWClass02	36	17.5
SI1231705	13880	13880	6.1	1961	RURAL	GWClass02	34	17.5
AT1233101	23230	23174	9.1	1961	URBAN	GWClass04	0	
SI1233101	23230	23174	9.1	1961	URBAN	GWClass04	8	17.5
AT1235205	13967	13967	6.1	1961	RURAL	GWClass02	0	
SI1235205	13967	13967	6.1	1961	RURAL	GWClass02	62	17.5
WP1235205	13967	13967	6.1	1961	RURAL	GWClass02	62	17.5
AT1236637	94789	94728	6.1	1961	RURAL	GWClass10	0	
SI1236637	94789	94728	6.1	1961	RURAL	GWClass10	94	12.5
AT1236652	14735	14740	10.1	1961	RURAL	GWClass02	0	
SI1236652	14735	14740	10.1	1961	RURAL	GWClass02	36	12.5
WP1236732	13723	13741	9.1	1961	RURAL	GWClass02	51	12.5
WP1236810	23230	23174	9.1	1961	URBAN	GWClass04	7	17.5
AT1236820	14735	04725	6.7	1961	RURAL	GWClass10	0	
SI1236820	14735	04725	6.7	1961	RURAL	GWClass10	31	7.5
AT1331103	13897	03856	7.6	1961	URBAN	GWClass02	0	
SI1331103	13897	03856	7.6	1961	URBAN	GWClass02	25	17.5
LA1333001	13873	13883	6.1	1961	RURAL	GWClass04	33	17.5
WP1333701	94823	14852	6.1	1961	URBAN	GWClass10	37	12.5
WP1415407	23160	23183	10.1	1961	URBAN	GWClass05	3	17.5
WP1421506	94240	24233	6.1	1974	URBAN	GWClass09	7	12.5
AT1430107	13996	03928	7.6	1961	URBAN	GWClass05	0	
LF1430107	13996	03928	7.6	1961	URBAN	GWClass05	11	12.5

(continued)

## Appendix 16A. (continued)

Setting_ID	Meteorological Station				Site RuralStr	Hydrogeologic		
	Upper Air Station	Surface Station	AnemHght	StartYr		GWClass	NumAquWell	AquTemp, VadTemp
SI1430107	13996	03928	7.6	1961	URBAN	GWClass05	8	12.5
AT1430404	13840	93819	6.1	1961	URBAN	GWClass04	0	
SI1430404	13840	93819	6.1	1961	URBAN	GWClass04	122	12.5
AT1430602	23230	23234	10.1	1961	URBAN	GWClass11	0	
SI1430602	23230	23234	10.1	1961	URBAN	GWClass11	3	7.5
AT1431515	24127	24127	6.1	1961	RURAL	GWClass05	0	
SI1431515	24127	24127	6.1	1961	RURAL	GWClass05	7	12.5
AT1434022	23230	23174	9.1	1961	URBAN	GWClass04	0	
SI1434022	23230	23174	9.1	1961	URBAN	GWClass04	5	17.5
AT1434802	13873	13883	6.1	1961	URBAN	GWClass04	0	
SI1434802	13873	13883	6.1	1961	URBAN	GWClass04	47	17.5
LF1435317	03937	12917	10.1	1962	RURAL	GWClass04	0	22.5
LA1522504	93734	13781	6.1	1961	RURAL	GWClass01	44	12.5
AT1530605	03937	12917	10.1	1962	RURAL	GWClass04	0	
LF1530605	03937	12917	10.1	1962	RURAL	GWClass04	22	22.5
SI1530605	03937	12917	10.1	1962	RURAL	GWClass04	21	22.5
AT1530808	14826	94847	6.1	1961	RURAL	GWClass02	0	
SI1530808	14826	94847	6.1	1961	RURAL	GWClass02	0	12.5
WP1532401	14735	14742	6.1	1961	RURAL	GWClass10	36	7.5
AT1621808	13873	13874	6.1	1961	RURAL	GWClass01	0	
LA1621808	13873	13874	6.1	1961	RURAL	GWClass01	96	17.5
SI1621808	13873	13874	6.1	1961	RURAL	GWClass01	82	17.5
AT1630106	13723	03812	6.1	1973	RURAL	GWClass01	0	
LF1630106	13723	03812	6.1	1973	RURAL	GWClass01	49	17.5
SI1630106	13723	03812	6.1	1973	RURAL	GWClass01	49	17.5
WP1630106	13723	03812	6.1	1973	RURAL	GWClass01	48	17.5
WP1630401	13897	13891	6.7	1961	URBAN	GWClass02	11	17.5
AT1631701	13723	13722	6.1	1961	RURAL	GWClass02	0	
LA1631701	13723	13722	6.1	1961	RURAL	GWClass02	142	17.5
SI1631701	13723	13722	6.1	1961	RURAL	GWClass02	75	17.5
AT1632106	23044	23044	9.8	1961	URBAN	GWClass05	0	
LA1632106	23044	23044	9.8	1961	URBAN	GWClass05	118	17.5
SI1632106	23044	23044	9.8	1961	URBAN	GWClass05	107	17.5
LF1632703	13873	03870	7	1963	RURAL	GWClass01	117	17.5
AT1633404	23160	23183	10.1	1961	RURAL	GWClass05	0	
SI1633404	23160	23183	10.1	1961	RURAL	GWClass05	82	17.5
AT1633405	14735	14740	10.1	1961	RURAL	GWClass01	0	
SI1633405	14735	14740	10.1	1961	RURAL	GWClass01	82	12.5
AT1635404	13723	03812	6.1	1973	RURAL	GWClass01	0	
SI1635404	13723	03812	6.1	1973	RURAL	GWClass01	59	17.5
AT1721603	24232	24229	6.1	1961	RURAL	GWClass02	0	
SI1721603	24232	24229	6.1	1961	RURAL	GWClass02	114	12.5

**Appendix 16B. Regional Hydrogeologic Data**

Hydrogeologic Setting (GWClass)	Hydraulic Conductivity (m/y) AquSatK	Unsaturated Thickness (m) VadThick	Saturated Thickness (m) AquThick	Hydraulic Gradient (m/m) AquGrad	
1	-999	2.59E+01	-999	1.66E-02	
1	3.15E+00	1.68E+01	1.52E+02	-999	
1	-999	1.52E+01	1.52E+01	-999	
1	-999	6.10E+02	-999	1.00E-04	
1	-999	5.79E+00	9.14E+00	5.00E-02	
1	9.46E+02	4.57E+00	-999	1.40E-02	
1	1.58E+03	3.05E+00	-999	1.40E-02	
1	6.31E+01	4.88E+00	1.22E+01	7.00E-02	
1	3.47E+03	6.10E+00	1.52E+02	3.00E-02	
1	2.84E+01	2.04E+00	9.14E+00	1.00E-02	
1	1.26E+02	6.10E+00	7.32E+00	3.00E-02	
1	1.58E+01	3.81E+00	3.29E+01	9.00E-02	
1	3.15E+02	2.13E+01	3.05E+00	-999	
1	-999	6.10E+00	6.10E+00	7.00E-06	
1	1.10E+04	3.05E+00	1.83E+01	2.00E-02	
1	9.46E+01	1.83E+00	4.27E+00	4.00E-02	
1	-999	1.22E+00	9.14E+00	1.00E-02	
1	7.57E+03	1.52E+00	3.05E+00	7.00E-06	
1	6.31E+00	9.14E-01	6.10E+00	3.80E-02	
1	6.31E+00	1.83E+00	7.62E+00	1.00E-01	
1	3.15E+01	6.10E+00	-999	6.00E-02	
1	3.15E+01	3.05E-01	6.10E+00	5.00E-03	
1	-999	9.14E+00	1.52E+02	8.00E-03	
1	-8.52129	2.81441	3.76962	-3.97399	mean
1	6.82319	1.07478	1.80348	-0.39418	covariance matrix
1	1.07478	0.8005	0.55257	0.4367	
1	1.80348	0.55257	1.1956	0.17788	
1	-0.39418	0.4367	0.17788	0.81424	
1	3.15	0.305	3.05	7.00E-06	minimum
1	11000	610	152	0.81424	maximum
2	6.31E+01	6.10E+00	2.29E+01	8.00E-02	
2	2.84E+01	6.10E+00	7.93E+01	-999	
2	1.89E+03	7.65E+01	-999	8.00E-03	
2	5.99E+03	3.05E+01	1.83E+02	1.00E-03	
2	3.15E+02	6.55E+01	4.57E+01	5.70E-03	
2	3.15E+01	1.52E+01	2.13E+01	1.00E-01	
2	1.58E+03	1.74E+02	3.05E+01	-999	
2	3.15E+02	5.97E+00	3.60E+00	-999	
2	2.21E+01	1.22E+01	1.07E+01	2.80E-02	
2	2.84E+02	1.68E+01	3.05E+00	3.20E-03	

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Appendix 16B. (continued)

Hydrogeologic Setting (GWClass)	Hydraulic Conductivity (m/y) AquoSatK	Unsaturated Thickness (m) VadThick	Saturated Thickness (m) AquoThick	Hydraulic Gradient (m/m) AquoGrad	
2	9.46E+00	6.10E+00	1.52E+02	3.10E-02	
2	2.21E+02	9.14E+00	-999	8.00E-03	
2	3.15E+00	3.96E+00	4.57E+00	1.00E-02	
2	3.15E+00	4.57E+00	9.14E+01	1.00E-03	
2	2.21E+03	1.52E+01	3.05E+01	3.30E-02	
2	1.10E+04	1.83E+01	9.14E+01	-999	
2	1.26E+02	1.34E+01	7.62E+00	4.00E-03	
2	1.33E+03	6.10E+00	2.13E+01	5.00E-03	
2	3.15E+04	1.83E+00	3.05E+00	-999	
2	-999	4.27E+00	8.90E+01	-999	
2	1.89E+03	5.36E+01	6.10E+00	4.30E-02	
2	9.78E+03	1.83E+01	3.05E+01	1.20E-02	
2	6.31E+00	1.22E+01	2.44E+01	1.50E-02	
2	3.15E+00	1.22E+01	1.22E+01	2.50E-02	
2	1.26E+01	3.70E+00	3.00E+01	1.00E-02	
2	2.21E+07	9.14E+00	1.52E+00	1.00E+00	
2	3.47E+04	1.22E+01	4.57E+00	8.00E-03	
2	3.15E+04	1.52E+01	6.10E+00	5.00E-02	
2	3.15E+00	3.66E+00	9.14E+00	4.00E-02	
2	3.15E+02	9.14E+00	2.13E+01	5.00E-03	
2	3.15E+02	8.53E+00	1.90E+01	2.50E-02	
2	-999	4.88E+00	-999	-999	
2	-999	3.05E+00	-999	2.40E-02	
2	6.31E+01	4.57E+00	1.98E+01	4.00E-02	
2	1.89E+02	6.10E+00	6.10E+01	2.30E-02	
2	2.21E+07	4.57E+00	1.83E+00	1.00E+00	
2	-999	1.83E+02	1.22E+01	4.00E-04	
2	2.21E+01	2.74E+00	3.05E+00	-999	
2	1.89E+02	1.52E+01	6.10E+01	1.20E-02	
2	1.10E+04	1.52E+01	2.29E+01	5.00E-04	
2	-999	3.66E+00	1.83E+01	-999	
2	6.31E+01	8.23E+00	5.18E+02	7.00E-03	
2	1.26E+02	4.57E+00	1.07E+02	3.00E-02	
2	-999	1.52E+00	9.14E+01	-999	
2	-7.68877	3.4698	4.2618	-4.42479	mean
2	12.3279	1.32509	0.47331	-1.46902	covariance matrix
2	1.32509	0.54208	-0.01357	-0.1757	
2	0.47331	-0.01357	1.61831	-0.39626	
2	-1.46902	-0.1757	-0.39626	1.75145	
2	3.15E+00	1.52E+00	1.52E+00	4.00E-04	minimum
2	2.21E+07	1.83E+02	5.18E+02	1.00E+00	maximum

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## Appendix 16B. (continued)

Hydrogeologic Setting (GWClass)	Hydraulic Conductivity (m/y) AquoSatK	Unsaturated Thickness (m) VadThick	Saturated Thickness (m) AquoThick	Hydraulic Gradient (m/m) AquoGrad	
3	2.55E+04	3.66E+00	3.66E+00	9.00E-04	
3	9.46E+02	9.14E+00	5.33E+00	5.00E-03	
3	1.26E+03	1.77E+00	6.10E+00	4.00E-09	
3	2.84E+01	6.10E+00	-999	3.40E-02	
3	3.78E+03	1.68E+01	1.52E+00	4.00E-02	
3	2.68E+03	6.71E+00	2.44E+00	9.00E-03	
3	3.15E+01	9.45E+00	-999	5.00E-02	
3	-999	7.62E+00	-999	1.00E-02	
3	6.31E+01	2.30E+00	4.12E+00	7.00E-03	
3	6.62E+03	3.05E+01	2.13E+01	2.00E-02	
3	1.26E+02	3.06E+00	1.52E+01	1.00E-02	
3	3.15E+01	-999	-999	1.00E-02	
3	8.83E+03	5.33E+00	4.57E+01	5.00E-04	
3	1.58E+02	9.14E-01	4.57E+00	3.00E-03	
3	6.31E+00	1.37E+00	3.66E+00	2.70E-02	
3	9.46E+00	2.56E+00	2.74E+00	4.20E-02	
3	-7.81342	2.72776	2.93298	-4.6888	mean
3	21.2765	2.78074	0.6463	-1.30916	covariance matrix
3	2.78074	1.07038	0.17468	0.29718	
3	0.6463	0.17468	0.96341	-0.64536	
3	-1.30916	0.29718	-0.64536	1.9708	
3	6.31E+00	9.14E-01	1.52E+00	4.00E-09	minimum
3	2.55E+04	3.05E+01	4.57E+01	5.00E-02	maximum
4	5.08E+04	4.57E+00	9.14E+00	5.00E-03	
4	1.39E+04	-999	3.35E+01	2.80E-02	
4	-999	6.10E+00	-999	-999	
4	-999	1.22E+01	4.57E+00	1.00E-02	
4	1.58E+03	2.13E+00	1.22E+01	1.00E-03	
4	3.15E+00	1.98E+01	2.44E+00	7.00E-03	
4	1.26E+01	4.57E+00	1.07E+01	7.00E-02	
4	-999	9.14E-01	6.10E+00	4.30E-02	
4	2.52E+03	1.52E+00	3.05E+00	2.00E-02	
4	3.15E+03	2.44E+00	-999	2.00E-06	
4	9.46E+00	1.83E+00	6.04E+00	5.50E-02	
4	9.46E+01	6.10E-01	3.96E+00	6.00E-03	
4	-999	6.98E+00	5.33E+01	-999	
4	1.16E+05	1.52E+01	7.62E+01	4.00E-03	
4	1.26E+04	7.62E+00	6.40E+00	4.90E-02	
4	4.10E+03	2.13E+00	3.20E+01	3.00E-03	
4	-999	1.07E+01	8.53E+00	6.00E-04	
4	-999	6.10E-01	7.62E+00	1.00E-03	

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## Appendix 16B. (continued)

Hydrogeologic Setting (GWClass)	Hydraulic Conductivity (m/y) AquoSatK	Unsaturated Thickness (m) VadThick	Saturated Thickness (m) AquoThick	Hydraulic Gradient (m/m) AquoGrad	
4	3.15E+03	3.05E-01	9.14E+00	3.00E-03	
4	2.21E+02	1.52E+00	7.62E+00	4.00E-03	
4	-999	4.57E+00	2.74E+01	1.50E-02	
4	3.15E+00	3.05E+00	3.05E+00	2.00E-02	
4	6.31E+02	2.44E+00	7.62E+00	5.00E-03	
4	-999	5.08E+01	1.45E+02	9.20E-02	
4	-999	1.52E+01	6.10E+00	1.00E-07	
4	3.15E+01	3.35E+01	-999	2.30E-02	
4	3.15E+02	9.14E+00	3.05E+00	2.00E-03	
4	4.42E+03	1.52E+00	1.98E+01	2.00E-03	
4	6.31E+02	2.21E+00	3.32E-01	1.00E-03	
4	-999	1.22E+00	-999	-999	
4	-999	9.14E+00	3.05E+00	5.00E-03	
4	7.88E+03	2.29E+01	3.05E+00	2.00E-02	
4	5.36E+03	3.05E+00	6.10E+00	1.00E-03	
4	-6.82634	2.65875	3.3063	-4.9212	mean
4	9.60704	0.51036	1.46619	-1.4956	covariance matrix
4	0.51036	1.5223	-0.01024	0.0939	
4	1.46619	-0.01024	1.28413	-0.02391	
4	-1.4956	0.0939	-0.02391	1.83998	
4	3.15E+00	3.05E-01	3.32E-01	1.00E-07	minimum
4	1.16E+05	5.08E+01	1.45E+02	9.20E-02	maximum
5	5.68E+03	3.05E+00	2.13E+01	2.00E-03	
5	-999	9.14E-01	3.96E+00	-999	
5	9.46E+02	-999	1.52E+01	9.30E-02	
5	-999	3.05E+00	6.10E+00	1.00E-02	
5	1.58E+05	6.10E+00	3.05E+00	1.00E-04	
5	6.31E+04	5.18E+00	1.52E+00	5.00E-03	
5	-999	6.10E+00	3.05E+00	5.00E-03	
5	1.56E+01	3.81E+01	1.52E+00	2.50E-02	
5	1.26E+05	4.57E+00	4.57E+00	1.00E-03	
5	-999	4.57E+00	2.29E+01	3.00E-02	
5	7.57E+03	3.05E+01	-999	-999	
5	-999	1.01E+02	1.52E+01	5.00E-02	
5	1.58E+03	3.35E+01	9.14E+02	1.00E-03	
5	3.15E+04	3.05E+01	2.44E+01	1.00E-03	
5	-999	9.75E+00	1.52E+01	-999	
5	6.31E+00	3.38E+00	7.62E+00	3.00E-03	
5	-999	3.29E+01	4.57E+00	-999	
5	2.37E+04	4.27E+01	6.10E+00	3.00E-03	
5	-999	1.07E+01	1.07E+00	-999	

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## Appendix 16B. (continued)

Hydrogeologic Setting (GWClass)	Hydraulic Conductivity (m/y) AquoSatK	Unsaturated Thickness (m) VadThick	Saturated Thickness (m) AquoThick	Hydraulic Gradient (m/m) AquoGrad
5	1.58E+03	1.98E+01	2.44E+01	5.00E-03
5	1.26E+03	2.44E+00	-999	-999
5	3.15E+03	1.22E+01	3.81E+00	-999
5	1.26E+02	1.52E+01	4.57E+00	2.00E-03
5	9.46E+02	3.05E+00	3.05E+00	2.00E-03
5	-999	4.57E+00	-999	-999
5	-999	2.44E+00	-999	-999
5	1.39E+03	3.41E+01	9.14E+01	3.00E-03
5	-999	1.22E+01	8.53E+01	-999
5	-999	3.66E+00	-999	-999
5	-999	2.74E+01	-999	6.00E-03
5	-999	1.59E+01	1.62E+01	4.00E-04
5	9.46E+01	7.01E+00	9.14E+00	3.00E-04
5	2.84E+03	4.27E+01	3.05E+01	2.00E-03
5	1.58E+02	1.30E+01	1.30E+02	1.00E-03
5	-999	1.83E+01	3.66E+00	1.00E-02
5	1.26E+03	7.32E+00	1.83E+01	1.00E-04
5	6.31E+01	8.23E+01	-999	-999
5	1.58E+04	3.66E+01	-999	1.00E-03
5	3.47E+03	7.62E+00	1.52E+01	2.00E-02
5	-999	1.22E+01	1.52E+01	1.00E-03
5	1.26E+02	1.83E+00	1.10E+01	2.00E-03
5	2.21E+03	1.52E+01	9.14E+00	-999
5	3.15E+00	3.66E+00	2.44E+00	5.00E-03
5	-999	1.22E+01	4.88E+01	1.00E-02
5	-999	3.66E+01	-999	6.80E-02
5	6.37E+04	6.10E+01	-999	-999
5	3.15E+00	6.10E+01	1.52E+01	1.50E-02
5	-999	7.01E+00	1.83E+01	-999
5	6.31E+02	1.46E+01	2.44E+01	3.00E-03
5	3.19E+06	9.14E+00	3.05E-01	2.00E-06
5	3.15E+03	1.07E+01	3.05E+00	6.00E-03
5	3.15E+00	4.72E+00	1.83E+01	7.00E-02
5	9.46E+02	1.37E+01	6.10E+00	8.00E-03
5	3.15E+03	7.62E+00	7.62E+00	-999
5	3.15E+02	4.88E+00	9.14E+00	1.70E-02
5	1.10E+04	2.44E+00	6.10E+00	-999
5	-999	2.44E+00	5.18E+00	4.00E-02
5	-999	3.96E+00	1.83E+01	-999
5	1.26E+01	2.13E+00	6.10E-01	-999
5	2.21E+03	9.14E+00	1.52E+00	2.50E-02

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## Appendix 16B. (continued)

Hydrogeologic Setting (GWClass)	Hydraulic Conductivity (m/y) AquoSatK	Unsaturated Thickness (m) VadThick	Saturated Thickness (m) AquoThick	Hydraulic Gradient (m/m) AquoGrad	
5	-999	3.05E+00	6.10E+00	1.30E-02	
5	2.21E+04	6.10E+00	9.14E+01	1.00E-03	
5	-5.61434	3.43835	3.53678	-5.61773	mean
5	9.98295	0.28014	0.08839	-2.96927	covariance matrix
5	0.28014	0.8396	0.54136	0.0448	
5	0.08839	0.54136	2.05569	-0.71488	
5	2.96927	0.0448	-0.71488	4.17328	
5	3.15E+00	9.14E-01	3.05E-01	2.00E-06	minimum
5	3.19E+06	1.01E+02	9.14E+02	9.30E-02	maximum
6	-999	1.52E+01	1.83E+01	5.00E-03	
6	-999	1.83E+00	9.14E+00	2.00E-03	
6	3.15E+02	4.88E+00	1.52E+01	1.00E-03	
6	6.31E+02	8.53E+00	9.14E+00	1.00E-02	
6	1.07E+05	3.51E+00	7.32E+00	5.00E-03	
6	1.89E+03	2.44E+01	3.66E+01	1.00E-03	
6	3.15E+00	2.74E+00	3.66E+00	3.00E-03	
6	-999	2.13E+01	7.62E+00	1.00E-03	
6	4.10E+03	2.74E+01	3.05E+00	1.00E-03	
6	1.67E+04	2.44E+00	6.40E+00	4.00E-03	
6	1.10E+04	5.49E+00	1.31E+01	2.00E-03	
6	3.15E+02	1.52E+00	3.05E+00	2.00E-03	
6	-999	1.22E+00	1.83E+00	8.00E-03	
6	1.10E+04	5.79E+00	-999	5.00E-04	
6	-999	3.96E+00	4.27E+00	1.70E-02	
6	-999	1.22E+01	1.68E+01	2.00E-03	
6	1.58E+03	4.57E+00	7.62E+00	4.00E-02	
6	3.31E+04	3.05E+01	2.29E+01	1.00E-02	
6	-999	4.57E+00	7.62E+00	1.00E-01	
6	2.52E+02	1.15E+01	-999	5.00E-03	
6	1.42E+04	4.57E+00	1.83E+01	7.00E-04	
6	3.15E+03	1.52E+00	1.52E+00	4.00E-07	
6	5.68E+03	3.05E+00	6.10E+00	1.00E-03	
6	1.89E+03	3.66E+00	6.10E+00	2.00E-03	
6	3.15E+02	3.66E+00	6.10E-01	1.00E-06	
6	3.15E+01	1.52E+00	-999	2.00E-08	
6	3.15E+03	1.19E+00	3.66E+00	-999	
6	1.55E+04	5.18E+00	7.93E+00	6.00E-03	
6	5.52E+03	3.66E+00	5.49E+00	1.00E-02	
6	3.15E+03	3.05E+00	1.68E+01	1.30E-02	
6	1.58E+02	1.52E+00	3.05E+00	1.20E-02	
6	2.21E+01	1.22E+00	1.37E+01	4.00E-03	

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## Appendix 16B. (continued)

Hydrogeologic Setting (GWClass)	Hydraulic Conductivity (m/y) AquoSatK	Unsaturated Thickness (m) VadThick	Saturated Thickness (m) AquoThick	Hydraulic Gradient (m/m) AquoGrad	
6	-999	1.83E+00	9.14E+00	1.10E-02	
6	9.46E+00	9.14E-01	6.10E+00	8.00E-03	
6	-999	1.07E+01	1.52E+01	8.00E-05	
6	-999	1.22E+01	1.22E+01	1.00E-06	
6	-6.7624	2.65846	3.15814	-5.6184	mean
6	13.8058	1.67704	2.14642	-0.09303	covariance matrix
6	1.67704	0.8987	0.34951	-0.23716	
6	2.14642	0.34951	0.86919	0.00252	
6	-0.09303	-0.23716	0.00252	1.23921	
6	3.15	0.914	0.61	2.00E-08	minimum
6	107000	30.5	36.6	0.1	maximum
7	9.46E+02	2.44E+00	8.23E+00	2.00E-03	
7	1.26E+03	2.13E+00	3.05E+02	3.00E-03	
7	-999	3.54E+01	-999	-999	
7	6.94E+03	-999	2.29E+01	3.00E-03	
7	2.33E+04	1.52E+01	3.66E+01	4.00E-03	
7	4.42E+03	1.83E+00	3.81E+01	7.00E-04	
7	5.61E+04	3.05E+00	1.01E+01	2.00E-03	
7	5.52E+04	3.05E+00	6.10E+01	-999	
7	9.46E+03	5.79E+01	9.14E+00	1.00E-06	
7	-999	9.14E+00	9.14E+00	2.00E-04	
7	-999	1.22E+01	9.14E+00	2.00E-03	
7	9.46E+02	3.05E+00	3.05E+00	8.00E-03	
7	9.78E+03	3.05E+00	3.05E+00	1.30E-02	
7	-999	5.18E+00	1.22E+01	2.00E-03	
7	4.42E+03	3.66E+00	1.52E+01	5.00E-03	
7	4.42E+03	2.44E+01	2.13E+01	1.00E-02	
7	1.58E+03	1.52E+00	2.44E+01	1.00E-02	
7	8.20E+04	1.49E+01	8.53E+00	3.00E-03	
7	9.46E+02	1.22E+01	1.83E+01	2.00E-06	
7	1.10E+04	3.05E+00	4.57E+00	-999	
7	-999	4.57E+00	1.37E+01	1.00E-02	
7	6.94E+03	2.13E+00	7.99E+00	4.00E-03	
7	6.31E+03	7.01E+00	5.18E+00	4.90E-02	
7	2.37E+04	4.88E+00	1.83E+01	3.30E-02	
7	1.77E+04	5.79E+00	4.27E+01	2.00E-03	
7	1.89E+03	4.57E+00	1.07E+01	4.00E-06	
7	1.45E+04	1.52E+00	1.83E+01	1.20E-02	
7	1.20E+05	2.20E+01	-999	1.00E-02	
7	2.52E+03	1.52E+00	6.10E+00	1.10E-02	
7	1.26E+01	5.79E+00	4.27E+00	2.10E-02	

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Appendix 16B. (continued)

Hydrogeologic Setting (GWClass)	Hydraulic Conductivity (m/y) AquoSatK	Unsaturated Thickness (m) VadThick	Saturated Thickness (m) AquoThick	Hydraulic Gradient (m/m) AquoGrad	
7	3.15E+02	6.10E-01	4.57E+00	6.00E-03	
7	3.15E+01	4.57E-01	-999	1.00E-03	
7	-999	4.57E+01	3.05E+00	-999	
7	-5.22204	2.81441	3.78819	-5.30668	mean
7	13.0649	-1.10808	0.50353	-0.73884	covariance matrix
7	-1.10808	1.13841	0.0496	0.26902	
7	0.50353	0.0496	1.11517	-0.46202	
7	-0.73884	0.26902	-0.46202	1.11713	
7	1.26E+01	4.57E-01	3.05E+00	1.00E-06	minimum
7	1.20E+05	5.79E+01	3.05E+02	4.90E-02	maximum
8	6.31E+03	7.62E+00	6.10E+01	1.00E-03	
8	2.40E+04	4.88E+00	2.29E+01	2.00E-03	
8	3.00E+04	2.99E+00	1.89E+01	4.00E-03	
8	-999	1.22E+01	6.71E+00	1.00E-03	
8	2.52E+03	3.05E+00	2.13E+01	8.00E-07	
8	1.10E+05	9.14E+00	2.13E+01	4.00E-03	
8	1.33E+04	5.49E+00	1.22E+01	6.00E-03	
8	3.78E+04	4.57E+00	9.14E+00	3.00E-03	
8	1.26E+03	1.07E+01	-999	8.00E-03	
8	2.21E+03	3.05E+00	2.29E+01	9.00E-04	
8	9.78E+03	3.35E+00	1.52E+01	7.00E-04	
8	1.89E+03	4.88E+01	3.20E+01	3.00E-02	
8	3.44E+04	7.62E+00	2.62E+01	6.00E-03	
8	4.42E+04	4.88E+00	1.86E+01	2.00E-03	
8	1.58E+04	2.90E+01	2.44E+01	1.00E-03	
8	7.25E+03	9.14E+00	3.96E+01	6.00E-04	
8	1.39E+04	1.22E+01	1.22E+02	2.00E-03	
8	2.90E+04	2.74E+00	1.01E+01	-999	
8	9.97E+04	2.13E+00	7.01E+00	7.00E-04	
8	-999	4.57E+00	6.10E+00	3.00E-03	
8	1.48E+04	1.83E+00	6.10E+01	1.00E-03	
8	7.88E+03	2.44E+00	3.05E+00	3.00E-02	
8	-999	1.52E+01	7.62E+01	9.00E-04	
8	5.68E+03	2.44E+00	6.10E+00	1.00E-03	
8	1.89E+04	4.57E+00	7.62E+00	5.00E-03	
8	3.88E+03	3.66E+00	7.62E+00	4.00E-03	
8	-999	2.20E+01	1.83E+01	6.00E-04	
8	4.73E+02	6.10E+00	4.57E+00	1.70E-02	
8	1.04E+04	7.62E+00	3.05E+01	1.00E-03	
8	2.21E+04	9.14E+00	7.62E+00	5.00E-03	
8	2.78E+04	7.62E+00	2.44E+01	2.00E-03	

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## Appendix 16B. (continued)

Hydrogeologic Setting (GWClass)	Hydraulic Conductivity (m/y) AquoSatK	Unsaturated Thickness (m) VadThick	Saturated Thickness (m) AquoThick	Hydraulic Gradient (m/m) AquoGrad	
8	2.78E+04	7.62E+00	2.44E+01	2.00E-03	
8	-999	6.10E+00	4.57E+00	4.00E-05	
8	1.10E+04	1.22E+01	3.05E+00	7.50E-02	
8	1.92E+04	5.33E+00	1.22E+01	8.00E-03	
8	6.31E+02	9.14E-01	1.07E+01	1.00E-02	
8	1.92E+04	1.83E+01	1.07E+01	1.30E-02	
8	5.05E+03	6.10E-01	1.22E+01	3.00E-03	
8	-999	7.62E+00	3.05E+01	2.00E-03	
8	3.31E+04	1.52E+01	3.05E+01	4.00E-04	
8	-999	4.57E+00	2.29E+01	1.00E-02	
8	2.21E+03	2.13E+00	3.66E+00	2.00E-02	
8	6.09E+04	2.00E+01	3.05E+01	3.00E-03	
8	-3.59646	2.97372	3.92385	-5.86511	mean
8	5.02	0.48626	0.15471	-0.8019	covariance matrix
8	0.4862	0.85551	0.26963	0.07004	
8	0.1547	0.26963	0.75329	-0.62236	
8	-0.8019	0.07004	-0.62236	1.62199	
8	4.73E+02	6.10E-01	3.05E+00	8.00E-07	minimum
8	1.10E+05	4.88E+01	1.22E+02	7.50E-02	maximum
9	9.46E+02	2.10E+00	1.37E+01	5.00E-02	
9	3.15E+02	1.37E+01	1.22E+01	1.00E-03	
9	1.89E+01	3.66E+00	5.49E+00	8.00E-03	
9	2.18E+04	6.10E+00	1.52E+01	4.00E-03	
9	3.47E+03	3.96E+01	5.49E+01	1.70E-02	
9	3.15E+03	2.13E+01	4.57E+00	1.00E-02	
9	1.26E+02	1.00E+00	3.00E+01	-999	
9	3.15E+01	7.62E+00	3.05E+00	9.00E-03	
9	-999	3.05E+00	3.05E+01	5.00E-07	
9	3.15E+01	5.18E+00	1.07E+01	3.00E-02	
9	3.15E+02	3.96E+00	2.29E+01	7.00E-03	
9	6.31E+01	4.57E+00	2.96E+00	2.20E-02	
9	9.15E+02	2.44E+00	1.22E+01	7.00E-04	
9	-999	7.32E+00	1.22E+01	-999	
9	1.89E+03	1.83E+00	9.14E-01	5.00E-03	
9	3.15E+03	7.62E+00	7.62E+00	-999	
9	6.31E+02	3.66E+00	2.13E+00	-999	
9	6.31E+03	2.44E+00	9.14E+00	4.00E-08	
9	-999	2.13E+00	7.62E+00	9.00E-03	
9	4.10E+03	1.52E+00	6.10E+00	1.00E-02	
9	1.26E+02	3.05E+00	4.57E+00	5.00E-02	
9	1.26E+02	3.05E+00	7.62E+00	2.00E-02	

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Appendix 16B. (continued)

Hydrogeologic Setting (GWClass)	Hydraulic Conductivity (m/y) AquoSatK	Unsaturated Thickness (m) VadThick	Saturated Thickness (m) AquoThick	Hydraulic Gradient (m/m) AquoGrad	
9	-999	6.10E-01	1.83E+00	-999	
9	1.26E+01	1.83E+00	-999	4.00E-02	
9	8.83E+03	1.52E+00	1.83E+01	4.00E-03	
9	3.15E+02	1.52E+00	6.10E+00	-999	
9	2.84E+02	1.74E+00	9.14E+00	1.00E-02	
9	9.46E+00	1.83E+01	2.44E+00	3.00E-03	
9	1.58E+03	3.35E+00	6.10E+00	4.00E-06	
9	-7.67984	2.48552	3.22796	-4.68545	mean
9	11.259	0.17085	0.72472	-0.72109	covariance matrix
9	0.17085	0.87319	0.13478	-0.12094	
9	0.72472	0.13478	0.81983	-0.0043	
9	-0.72109	-0.12094	-0.0043	1.28625	
9	9.46E+00	6.10E-01	9.14E-01	4.00E-08	minimum
9	2.18E+04	3.96E+01	5.49E+01	5.00E-02	maximum
10	-999	3.35E+00	1.46E+01	3.00E-02	
10	4.42E+03	1.16E+01	5.49E+01	5.00E-03	
10	2.84E+02	4.57E+00	7.62E+00	1.00E-02	
10	1.96E+04	3.96E+01	2.14E+01	3.00E-04	
10	1.58E+02	4.57E+00	3.05E+00	6.00E-04	
10	3.15E+02	1.52E+00	6.10E+00	4.00E-03	
10	-999	6.10E+00	3.66E+00	1.00E-06	
10	1.26E+02	7.62E+00	2.29E+00	5.00E-03	
10	3.15E+02	1.52E+01	1.07E+01	1.00E-02	
10	3.15E+01	2.74E+00	6.86E+00	1.70E-02	
10	1.26E+02	3.05E+00	4.12E+00	3.00E-03	
10	-999	3.81E+00	6.10E+00	1.00E-05	
10	-999	3.66E+00	1.52E+01	1.00E-01	
10	6.31E+02	4.57E+00	9.14E-01	5.00E-03	
10	3.47E+03	3.05E+00	3.05E+00	2.00E-03	
10	2.21E+03	2.59E+01	7.62E+00	1.00E-05	
10	-999	1.52E+00	1.52E+01	2.00E-03	
10	2.84E+03	2.74E+00	4.57E+00	-999	
10	-999	1.83E+00	2.44E+00	8.00E-03	
10	2.21E+03	1.37E+01	7.62E+00	1.00E-02	
10	1.26E+02	1.22E+01	1.22E+01	2.50E-02	
10	-999	3.81E+00	1.68E+01	2.00E-03	
10	-999	3.32E+00	1.83E+00	6.00E-02	
10	3.15E+00	3.66E+00	1.16E+01	1.00E-02	
10	2.52E+01	1.83E+00	4.57E+00	9.50E-03	
10	4.42E+03	1.07E+01	9.14E+00	1.40E-02	
10	-999	6.10E+00	4.27E+01	1.75E-03	

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Appendix 16B. (continued)

Hydrogeologic Setting (GWClass)	Hydraulic Conductivity (m/y) AquoSatK	Unsaturated Thickness (m) VadThick	Saturated Thickness (m) AquoThick	Hydraulic Gradient (m/m) AquoGrad	
10	-6.97635	2.80942	3.15655	-5.57335	mean
10	4.99889	1.27993	0.51266	-1.74813	covariance matrix
10	1.27993	0.86035	0.40799	-0.71454	
10	0.51266	0.40799	0.8467	0.03369	
10	-1.74813	-0.71454	0.03369	3.61694	
10	3.15E+00	1.52E+00	9.14E-01	1.00E-06	minimum
10	19600	39.6	54.9	0.1	maximum
11	9.46E+02	2.13E+00	3.05E+02	1.00E-02	
11	6.31E+01	2.74E+00	3.05E+01	3.00E-02	
11	7.25E+03	9.14E+00	3.66E+01	6.00E-04	
11	2.43E+04	4.57E+00	1.07E+01	6.80E-03	
11	-999	1.52E+00	3.05E+02	1.00E-03	
11	7.57E+03	3.05E+00	4.57E+01	6.00E-03	
11	1.26E+04	9.14E-01	4.57E+00	5.00E-03	
11	6.31E+02	9.14E-01	6.10E+00	1.00E-02	
11	3.15E+03	1.52E+00	6.10E+00	-999	
11	1.26E+03	1.22E+00	1.07E+01	2.00E-03	
11	3.15E+01	9.14E-01	1.52E+01	5.00E-03	
11	1.39E+04	1.52E+00	6.10E+01	2.00E-03	
11	-999	1.68E+00	1.52E+01	2.00E-03	
11	2.52E+03	2.00E+00	2.00E+00	2.00E-03	
11	1.26E+03	1.22E+00	3.05E+00	1.70E-02	
11	-999	9.14E-01	7.62E+00	-999	
11	3.15E+02	1.52E+00	1.52E+00	5.00E-02	
11	1.58E+03	2.74E+00	4.57E+00	2.30E-02	
11	-999	3.35E+00	4.27E+00	1.90E-02	
11	3.15E+02	3.05E+00	2.44E+01	1.00E-03	
11	2.84E+02	1.07E+00	3.05E+01	3.00E-03	
11	9.46E+02	2.13E+00	1.68E+00	2.00E-04	
11	-999	2.74E+00	2.13E+01	3.00E-05	
11	8.17E+03	7.01E+00	6.10E+00	3.30E-03	
11	-999	-999	6.71E+00	-999	
11	-999	3.05E+00	4.27E+01	5.00E-04	
11	-5.38023	1.8991	3.7492	-5.61773	mean
11	3.48349	0.52513	-0.00422	-0.63963	covariance matrix
11	0.52513	0.46903	0.18069	-0.2284	
11	-0.00429	0.18069	2.02612	-0.08327	
11	-0.63963	-0.2284	-0.08327	1.97797	
11	3.15E+01	9.14E-01	1.52E+00	3.00E-05	minimum
11	2.43E+04	9.14E+00	3.05E+02	5.00E-02	maximum
12	1.58E+05	3.00E+01	3.00E+01	6.00E-03	

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## Appendix 16B. (continued)

Hydrogeologic Setting (GWClass)	Hydraulic Conductivity (m/y) AquoSatK	Unsaturated Thickness (m) VadThick	Saturated Thickness (m) AquoThick	Hydraulic Gradient (m/m) AquoGrad	
12	-999	5.00E+01	1.00E+01	5.00E-03	
12	1.58E+03	5.08E+01	1.44E+02	2.30E-02	
12	-999	1.52E+01	9.14E+01	-999	
12	-999	3.05E+00	-999	1.20E-02	
12	1.58E+03	4.57E+01	-999	-999	
12	1.26E+02	3.05E+00	1.52E+01	5.00E-05	
12	3.15E+02	1.22E+01	6.10E+01	3.30E-02	
12	-999	3.05E+01	-999	2.00E-02	
12	-999	3.20E+02	-999	9.00E-03	
12	-999	5.33E+00	1.52E+01	1.00E-03	
12	1.58E+04	2.93E+01	1.95E+01	-999	
12	-999	1.83E+01	-999	-999	
12	2.21E+02	-999	3.96E+01	2.00E-03	
12	3.15E+02	3.96E+00	3.05E+00	1.80E-02	
12	2.49E+04	1.52E+00	-999	2.00E-03	
12	1.23E+04	3.96E+00	1.83E+01	9.00E-03	
12	-999	3.05E+00	3.05E+02	1.00E-03	
12	9.46E+01	7.62E+00	1.98E+01	1.00E-02	
12	1.26E+03	4.00E+02	1.80E+01	2.00E-06	
12	2.18E+03	1.68E+00	7.32E+00	4.20E-04	
12	6.31E+03	1.22E+00	3.05E+00	-999	
12	-5.6496	3.47765	4.32063	-5.49537	mean
12	12.0503	1.43257	0.53279	0.79733	covariance matrix
12	1.43257	1.25667	0.99541	1.35511	
12	0.53279	0.99541	1.2437	0.81321	
12	0.79733	1.35511	0.81132	4.45451	
12	9.46E+01	1.22E+00	3.05E+00	2.00E-06	minimum
12	1.58E+05	4.00E+02	3.05E+02	3.30E-02	maximum
13	1890	5.18	10.1	5.70E-03	
13	-5.6496	3.47765	4.32063	-5.49537	mean
13	12.0503	1.43257	0.53279	0.79733	covariance matrix
13	1.43257	1.25667	0.99541	1.35511	
13	0.53279	0.99541	1.2437	0.81321	
13	0.79733	1.35511	0.81132	4.45451	
13	3.15	0.305	0.305	4.00E-09	minimum
13	22100000	610	914	1	maximum