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Infiltration Data Package for the E-Area Low-Level Waste Facility Performance Assessment

J. A. Dyer

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REVIEWS AND APPROVALS

AUTHORS:

____

J. A. Dyer, Environmental Modeling, SRNL Date

TECHNICAL REVIEW:

____

D. M. Boozer, Environmental Modeling, SRNL Date

____

B. T. Butcher, Environmental Modeling, SRNL Date

____

T. L. Danielson, Environmental Modeling, SRNL Date

____

L. L. Hamm, Threat Assessments, SRNL Date

____

J. L. Wohlwend, Environmental Modeling, SRNL Date

APPROVAL:

____

D. A. Crowley, Manager Date
Environmental Modeling, SRNL

____

A. P. Fellinger, Acting Director Date
Environmental Restoration Technologies, SRNL

EXECUTIVE SUMMARY

The infiltration data package contains the input parameters, the cap design and material properties assumptions, and the modeling results for the Hydrologic Evaluation of Landfill Performance (HELP) infiltration model simulations performed in support of the E-Area Low-Level Waste Facility Performance Assessment (PA). The infiltration estimates establish the upper boundary condition for the PORFLOW vadose-zone model and GoldSim model simulations for the following E-Area disposal unit types: Slit and Engineered Trenches, Low-Activity Waste Vault (LAWV), Intermediate-Level Vault (ILV), Component-in-Grout (CIG) special waste form trench segments, and the Naval Reactor Component Disposal Areas (NRCDAs). The infiltration data package builds upon relevant, foundational PA technical reports and memoranda from the past 15 years and is supported by three important components: the HELP model input parameter datasheets, HELP model input and output filenames and directory structure, and infiltration rates as a function of time for each scenario for each disposal unit type.

For Slit and Engineered Trenches, a single best-estimate Bahia-grass case of two-percent slope and 585-foot slope length represents an upper bound on intact closure-cap infiltration rates over a 10,000-year period. Building upon the single, bounding, and intact case, two different approaches were considered for incorporating the effect of localized cap subsidence on infiltration rates in the PORFLOW flow and transport model simulations. In the first approach, a Monte Carlo probabilistic model was developed to calculate infiltration rates for 0.54%, 2%, 3.6%, and 4.9% subsidence scenarios[a] reflecting historical and future non-crushable content for the Slit and Engineered Trenches. The resulting blended (spatially and slope-length averaged) infiltration rates become an inflow upper boundary condition for the PORFLOW vadose zone model simulations. In the second and preferred approach, a Monte Carlo rectangle packing algorithm (Danielson, 2019) and a simplified equation for the total mass flux of water draining into a subsided compartment (Equation 1) will be employed to implement a weighted blending of radionuclide fluxes to the water table using the results of deterministic PORFLOW vadose zone simulations representative of specific subsidence cases. Finally, HELP-model results from sensitivity studies of the intact infiltration case were fit to a log-logistic function to generate infiltration profiles over a 10,000-year period for most-optimistic, more-optimistic, best-estimate, more-pessimistic, and most-pessimistic cases, for both the intact and four subsidence scenarios.

For the LAWV and IL vaults, infiltration rate profiles for a 10,000-year period were developed for both an on-vault (above the concrete/metal vault roof) and an off-vault (10-foot soil zone adjacent to vault walls) scenario. The purpose of the off-vault simulations was to confirm that subsurface runoff from the concrete vault roof will adequately drain through the lowermost backfill layers adjacent to the vault walls. The LAWV and ILV infiltration profiles assume collapse of the concrete roof at relative Years 2,905 and 7,100, respectively.

The identical Bahia-grass case with two-percent slope and 585-foot slope length assumed for the Slit and Engineered Trenches will represent an upper bound on intact infiltration rates for the NRCDAs and CIG special waste form as well. While the NRCDA casks are assumed to remain structurally intact (i.e., non-

[a] Percent subsidence values reported in the infiltration data package are based on the total footprint area of the disposal unit, not the area of the waste zone alone. This is an important distinction for Slit Trenches. For closed units: % subsidence = (non-crushable area x 100%) / total footprint area. For partially filled units: % subsidence = (non-crushable area x 100%) / (total footprint area x fraction filled).

crushable) for 10,000 years, the concrete covers over the CIG special waste form trench segments are assumed to collapse 300 years after the end of operations. Because both rows of the existing CIG trench segments in ST23 (formerly CIG01) extend across the planned cap crest, the subsided CIG trench segments are treated conservatively in the HELP model as a 100%-subsidence case with zero subsurface run-on. The CIG special waste form trench segment infiltration profile, therefore, consists of an intact-cap period from relative Year 100 to Year 300, followed by a 100%-subsidence period from relative Year 300 to Year 10,100.

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LIST OF ABBREVIATIONS

CDF	Cumulative Distribution Function
CIG	Component-in-Grout
CLM	Central Climatology site
CLSM	Controlled Low-Strength Material
CN	Curve number
DOE	Department of Energy
ET	Engineered Trench
ETF	Effluent Treatment Facility
FTF	F-Area Tank Farm
GCL	Geosynthetic clay liner
HDPE	High-density polyethylene
HELP	Hydrologic Evaluation of Landfill Performance
ILT	Intermediate-Level Tritium
ILNT	Intermediate-Level Non-Tritium
ILV	Intermediate-Level Vault
K_{sat}	Saturated hydraulic conductivity
LAI	Leaf area index
LAWV	Low-Activity Waste Vault
LFRG	Low-Level Waste Disposal Facility Federal Review Group
LHS	Latin Hypercube Sampling
LLWF	Low-Level Waste Facility
NR	Naval Reactor
NRCDA	Naval Reactor Component Disposal Area
PA	Performance Assessment
SDF	Saltstone Disposal Facility
SRNL	Savannah River National Laboratory
SRS	Savannah River Site
ST and SLIT	Slit Trench
USACE	United States Army Corps of Engineers
USEPA	U.S. Environmental Protection Agency

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1.0 Introduction

1.1 Background

The Department of Energy's (DOE's) Low-Level Waste Disposal Facility Federal Review Group (LFRG) review team report (LFRG, 2008) for the 2008 E-Area Low-Level Waste Facility (LLWF) Performance Assessment (PA) raised a secondary issue regarding the input parameter assumptions and Hydrologic Evaluation of Landfill Performance (HELP) modeling results for the 2008 PA infiltration analysis. The secondary issue and the proposed resolution as summarized by McDowell-Boyer et al. (2011) were:

> *"7.2.3.1: The HELP code that provided the basis of the cap infiltration analyses is well tested, generally accepted, and has been benchmarked against a broad range of codes that perform similar calculations. However, there is no discussion of the HELP modeling results with respect to the results of other analyses. Input parameters for HELP were difficult to find and were found in multiple documents cited in Phifer (2006).*
>
> *Proposed Resolution: A discussion of the HELP modeling results with respect to other modeling results for other analyses using available site data and information should be added. These data should be compiled into a single data package in the PA."*

In response to the LFRG's secondary issue and proposed resolution, the strategic plan for the next E-Area LLWF PA (Butcher and Phifer, 2016) outlined a consolidated recommendation for the infiltration data package and new infiltration estimates:

> *"Produce a separate data package for the ELLWF closure cap and infiltration estimates generated by HELP modeling. Include closure cap material properties (e.g., hydraulic conductivity, porosity, field capacity, and wilting point), site-specific input data (e.g., precipitation, temperature, solar radiation, and evapotranspiration), and closure cap layer data (e.g., erosion, silting, holes in HDPE, geosynthetic clay liner (GCL), chemical degradation, pine tree root intrusion, etc.). As part of this data package, produce infiltration estimates for intact, degraded, and subsided-cap conditions based on the new closure cap conceptual design (profile, plot plan, and cross-sections) as inputs to the upper boundary conditions for PORFLOW models. This will include development of subsided infiltration estimates for individual disposal unit types, as applicable. This work should be performed prior to the time of execution of the next PA revision."*

The infiltration data package contains the input parameters, the cap design and material properties assumptions, and the modeling results for the HELP infiltration model simulations performed in support of the E-Area LLWF PA. The infiltration estimates establish the upper boundary condition for the PORFLOW vadose-zone model and GoldSim model simulations for the following E-Area disposal unit types: Slit and Engineered Trenches, Low-Activity Waste Vault (LAWV), Intermediate-Level Vault (ILV), Component-in-Grout (CIG) special waste form trench segments, and the Naval Reactor Component Disposal Areas (NRCDAs). The infiltration data package builds upon relevant, foundational PA technical reports and memoranda from the past 15 years and is supported by three important components:

- HELP model input parameter data sheets

- HELP model input and output filenames and directory structure
- Infiltration rates as a function of time for each scenario for each disposal unit type

1.2 HELP Model

The HELP model is a quasi-two-dimensional hydrologic model for conducting landfill water balance calculations. The model requires the input of weather, soil, and closure cap design data, and provides quantitative estimates of surface runoff, evapotranspiration, lateral drainage, vertical percolation (i.e., infiltration), hydraulic head build-up, and water storage for the evaluation of different landfill designs.

United States Army Corps of Engineers (USACE) personnel at the Waterways Experiment Station in Vicksburg, MS developed the HELP model under an interagency agreement (DW21931425) with the U.S. Environmental Protection Agency (USEPA). As such, the HELP model is a USEPA-approved model for conducting water balance analyses of landfills and other land disposal systems. HELP model version 3.07 (released November 1, 1997) is the most recent official-release public-domain version of the model available for download at https://www.epa.gov/land-research/hydrologic-evaluation-landfill-performance-help-model. The graphical user interface for HELP v3.07, however, is not compatible with Windows 7 or later; therefore, the user must execute the program using Windows XP or from within a virtual Windows XP environment.

USEPA and the USACE provide the following documentation for the HELP model:

- A user's guide (Schroeder et al., 1994a) that gives instructions on setting up and executing the HELP model.
- Engineering documentation (Schroeder et al., 1994b) that provides information on the FORTRAN source code, hardware necessary to operate the code, data generation methodologies available for use, and methods of solution.
- Verification test reports comparing the model's drainage layer estimates to the results of large-scale physical models (Schroeder and Peyton, 1987b) and water balance estimates to "field data from a total of 20 landfill cells at 7 sites in the United States" (Schroeder and Peyton, 1987a).

HELP v4.0 (Dixon, 2017) is an SRNL-recompiled version of HELP v3.07 that is compatible with 64-bit Windows 7/10 operating systems. HELP v3.07 was recompiled using the open source compiler GFORTRAN (GNU Compiler Collection, GNU Project). Dixon (2017) documents the successful completion of verification testing of the recompiled code in accordance with Q-SQA-A-00005, Rev. 1. HELP v4.0 was used to perform all infiltration calculations for the E-Area LLWF PA.

The origin and generation of the weather data input files for the HELP model simulations are explained in Appendix A.

1.3 Alternatives to the HELP Model

Whiteside et al. (2009) completed a literature review and basic infiltration model simulations to evaluate the HELP model against five alternative computer codes that use Richards' equation for variably-saturated flow. Of the five alternative codes reviewed (LEACHM, UNSAT-H, SVFlux, HYDRUS-2D3D, and VADOSE/W), only HYDRUS-2D3D and VADOSE/W were recommended for further evaluation. The evaluation involved a side-by-side comparison of infiltration rates through a one-layer soil column with two percent slope from right to left as predicted by HELP, HYDRUS-2D3D, and VADOSE/W. While the authors recommended use of HYDRUS-2D3D over VADOSE/W, they were inconclusive about replacing the HELP model with HYDRUS-2D3D pending more rigorous simulations of the proposed multilayer closure cap design.

Dyer (2019d) carefully evaluated the hydrologic model and design and performance recommendations for the planned Saltstone Disposal Facility (SDF) closure cap at the Savannah River Site (SRS) as described by Benson and Benavides (2018) and Benson (2018). In addition, Dyer (2019d) revisited the infiltration model evaluation by Whiteside et al. (2009) and subsequently conducted an independent evaluation of the HYDRUS-1D code to more definitively assess its capabilities to perform the wide variety of intact and subsidence infiltration model simulations across multiple disposal unit types as required for the E-Area LLWF PA. Dyer (2019d) concluded that the HELP model remains the preferred choice over other commercial and public-domain hydrologic models for the E-Area LLWF PA for a variety of practical reasons:

- Benson and Benavides (2018) chose to couple the Richards-equation-based, one-dimensional WinUNSAT-H model with the Giroud equations (Giroud and Houlihan, 1995; Giroud, 1997; Giroud et al., 2000; Giroud et al., 2004) to simulate the multilayer SDF cover system because WinUNSAT-H cannot simulate flow through lateral drainage and barrier layers. WinUNSAT-H was used to model water flow in the earthen layers above the lateral drainage layer, while the Giroud equations calculated drainage-layer flow and percolation through the composite barrier layer (i.e., geomembrane/GCL/finely textured foundation layer). Like the SDF, the E-Area LLWF is also located in a wetter climate and its final closure cap design will include a composite barrier providing the predominant resistance to flow at its base. As a result, any improvement in accuracy gained by switching to a Richards-equation-based model of the vadose zone is largely offset in a wet climate by the need to couple WinUNSAT-H or HYDRUS-2D3D with a separate model for the drainage and barrier layers.
- In addition, the HELP model bases its predictions of leakage rate through holes in the geomembrane barrier layer on the same family of semi-empirical Giroud equations referenced above. The HELP model selects from a set of empirical leakage rate equations developed originally by Giroud and Bonaparte (1989) that are chosen based on two user-specified input parameters: placement quality of the geomembrane and saturated hydraulic conductivity of the flow-controlling GCL below the geomembrane. If a placement quality of “good” is assumed, the Giroud equations as implemented by Benson and Benavides (2018) for the SDF cap predict a leakage rate through the barrier layer that is in close agreement with the leakage rate predicted by the HELP model for the same cap design. The leakage rate is quite sensitive to the placement quality assumption.
- The cap degradation and subsidence narratives for the E-Area LLWF closure cap demand a flexible, robust infiltration model that readily converges over a wide range of assumed cap and material design properties and conditions. Despite its limitations, the HELP model excels over models that use the Richards’ equation for variably-saturated flow including WinUNSAT-H and HYDRUS-1D and -2D3D. For example, the coupled WinUNSAT-H/Giroud equation model used by Benson and Benavides (2018) gave unrealistic predictions for leakage rate through the

composite barrier as the number of assumed defects in the geomembrane layer exceeded about 1000 holes per hectare.

- Benson and Benavides (2018) showed that the erosion layer in the SDF and E-Area LLWF closure cap designs will create a hydraulic choke that maintains nearly saturated conditions in the earthen layers below. Therefore, an assumption of unit gradient vertical flow below the erosion layer is reasonable and consistent with the use of a unit vertical hydraulic gradient in the HELP model which diminishes the importance of using a Richards-equation-based infiltration model in a wetter climate such as the SRS.
- The HELP model contains an internal weather generator that creates synthetic daily weather data for long-term simulations (e.g., 100 years) using historical monthly average precipitation, temperature, and solar radiation data. WinUNSAT-H and the HYDRUS software do not include a synthetic weather generator which makes data entry more cumbersome and limited to the availability of historical daily data.
- Sensitivity studies by Shipmon and Dyer (2017) using the HELP model identified primary drivers of the predicted infiltration rate for the F-Area Tank Farm (FTF) closure cap design. The primary drivers, which are all cap degradation model assumptions, include the degradation rate of the geomembrane liner (number of holes per unit area vs. time), the silting-in rate of the lateral drainage layer, the rate of pine tree intrusion and associated root penetration through the GCL, and the size and location of subsided areas due to non-crushable containers disposed in Slit and Engineered Trenches. These primary drivers change the infiltration rate by more than four orders of magnitude over a 10,000-year period. In contrast, Dyer (2019d) concluded that the choice of one hydrologic model over another is only a secondary driver of predicted infiltration rates (i.e., differences between WinUNSAT-H, HYDRUS-1D, and HELP model predictions for the same scenario are less than an order of magnitude).

In summary, HELP was designed specifically for simulating multilayer closure cap systems, and it remains the best option for modeling such systems in a wet climate where a unit hydraulic gradient is a reasonable assumption. HELP, which is a mass balance model, is also better suited for PA work where flexibility in model construction and ease of model convergence are important. Existing hydrologic models based on the Richards' equation, on the other hand, are not specifically designed for multilayer landfill cover systems, are more difficult to converge, and often must be coupled with a second model for the drainage and composite barrier layers. WinUNSAT-H and the HYDRUS software are more necessary for evapotranspiration cover designs that are common in an arid environment.

2.0 Slit and Engineered Trenches

2.1 Planned E-Area LLWF Closure

E-Area LLWF closure is planned in stages to accommodate ongoing operations for many more years, minimize infiltration into the underlying buried waste, and optimize future waste stabilization measures. Three stages of closure are envisioned: operational, interim and final closure.

Operational closure encompasses those closure actions taken immediately or within a few years of filling a trench unit. During the operational period for Engineered and Slit Trenches (i.e., earlier than relative year zero in the infiltration calculations when the trench is still accepting waste and is less than 100% full), the infiltration estimates assume the placement of a minimum four-foot thick clean soil cover over the filled portions of the Slit Trench and grading to provide positive drainage (i.e., no run-on from adjacent areas). When a trench unit is full and no longer accepting waste, operational closure occurs. As described in detail by Phifer et al. (2009), operational closure of a Slit Trench entails adding four feet of soil as a foundation layer followed by installation of a surface operational stormwater runoff cover integrated with a drainage system to optimize stormwater runoff and removal and to minimize infiltration into the underlying buried waste. The stormwater runoff cover currently installed over each of the first five Slit Trenches is a high-density polyethylene (HDPE) geomembrane which is also assumed to be used for future closures. On the other hand, an Engineered Trench receives no additional cover, beyond the four-foot soil cover, until some years later when a similar polymeric geomembrane material will be applied at interim closure to optimize stormwater runoff. As a result, Engineered Trenches will experience a longer period with only the operational soil cover present.

Interim closure begins a nominal 100-year period of institutional control when close to 100 percent of E-Area is filled with waste. Interim closure is currently assumed to commence on September 30, 2040 for all Slit and Engineered Trenches that are completely filled by that date, and September 30, 2065 for all trenches that remain open beyond 2040. The SRS Nuclear Materials Management Plan FY 2016-2030 (SRS, 2016) currently assumes that Environmental Management operations cease in the Year 2065. Infiltration rates in the data package are presented as a function of a relative year, rather than an absolute year, and assume an institutional control period of 100 years duration. For simplification, relative Year 0 corresponds to absolute Year 2065, and marks the beginning of the institutional control period. Relative Year 100 corresponds to absolute Year 2165, which is defined as the date of final closure when installation of the final multilayer soil-geomembrane cover occurs. For those trench units where interim closure begins in 2040, the institutional control period will instead last 125 years, beginning in relative Year -25.

Before the start of interim closure in either 2040 or 2065, a surface interim stormwater runoff cover(s) will be placed over the closed Slit and Engineered Trench units. As outlined by Phifer et al. (2009), the HDPE cover(s) will be integrated with the E-Area stormwater drainage system to expedite excess stormwater runoff removal. The operational stormwater runoff covers in place at that time may transition into the interim runoff cover if their continued performance and serviceability are demonstrated. Otherwise, an alternative cover(s) may be introduced to serve as a more durable interim runoff cover. In either case, surface stormwater covers are assumed to be maintained at intact conditions until final closure in 2165 (relative Year 100) when installation of the final multilayer soil-geomembrane cover occurs.

The final stage of closure occurs at relative Year 100 in the infiltration calculations. Final closure consists of waste layer stabilization measures (e.g., dynamic compaction) followed by installation of a multilayered soil-geomembrane cover. The stabilization measures taken are assumed to sufficiently consolidate the underlying waste layer and eliminate subsidence except in the presence of "non-crushable" containers as described in Section 2.3, Subsidence Infiltration Scenarios. The following section describes the infiltration through an intact final closure cap assuming the absence of non-crushable containers.

2.2 Intact Infiltration Scenario

Dyer (2017) used the HELP model to analyze ten intact infiltration model scenarios based on the FTF closure cap design which bracket the minimum and maximum slope and slope-length design conditions (two to four percent slope and 150-foot to 600-foot slope length) for the planned E-Area closure cap. Figure 2-1 shows that a single bounding case of 2% slope and 585-foot slope length represents an upper bound on infiltration rates for the ten scenarios. Building upon this analysis, Shipmon and Dyer (2017) again used the HELP model to perform a detailed sensitivity analysis of rainfall infiltration through the planned intact E-Area LLWF closure cap. The purpose of the evaluation was to identify the cap design and material property parameters that most significantly impact intact infiltration rates over a 10,000-year simulation period. Results showed that saturated hydraulic conductivity (K_{sat}) for select cap layers, precipitation rate, surface vegetation type, and geomembrane layer defect density are dominant factors affecting intact infiltration rate. As detailed in Section 2.4.1 below, Dyer (2018a) further considered the impacts of vegetative cover type, geomembrane layer defects, and pine tree intrusion on infiltration rate using the HELP model for five closure-cap scenarios: F-Area Tank Farm Bahia grass (Phifer et al., 2007), E-Area Bahia grass with the 2008 E-Area PA timeline for pine tree intrusion, E-Area Bahia grass using a more aggressive timeline for pine tree intrusion, E-Area unmanaged bamboo cover, and E-Area managed bamboo cover. Dyer (2018a) further affirmed that the Bahia grass case with two percent slope and 585-foot slope length represents a reasonable upper bound on intact infiltration rates for the E-Area LLWF final closure cap design shown in Figure 2-2 (C-CT-E-00083, 2016). It is important to note that an upper bound on infiltration rate may be a conservative assumption for some radionuclides, but not all.

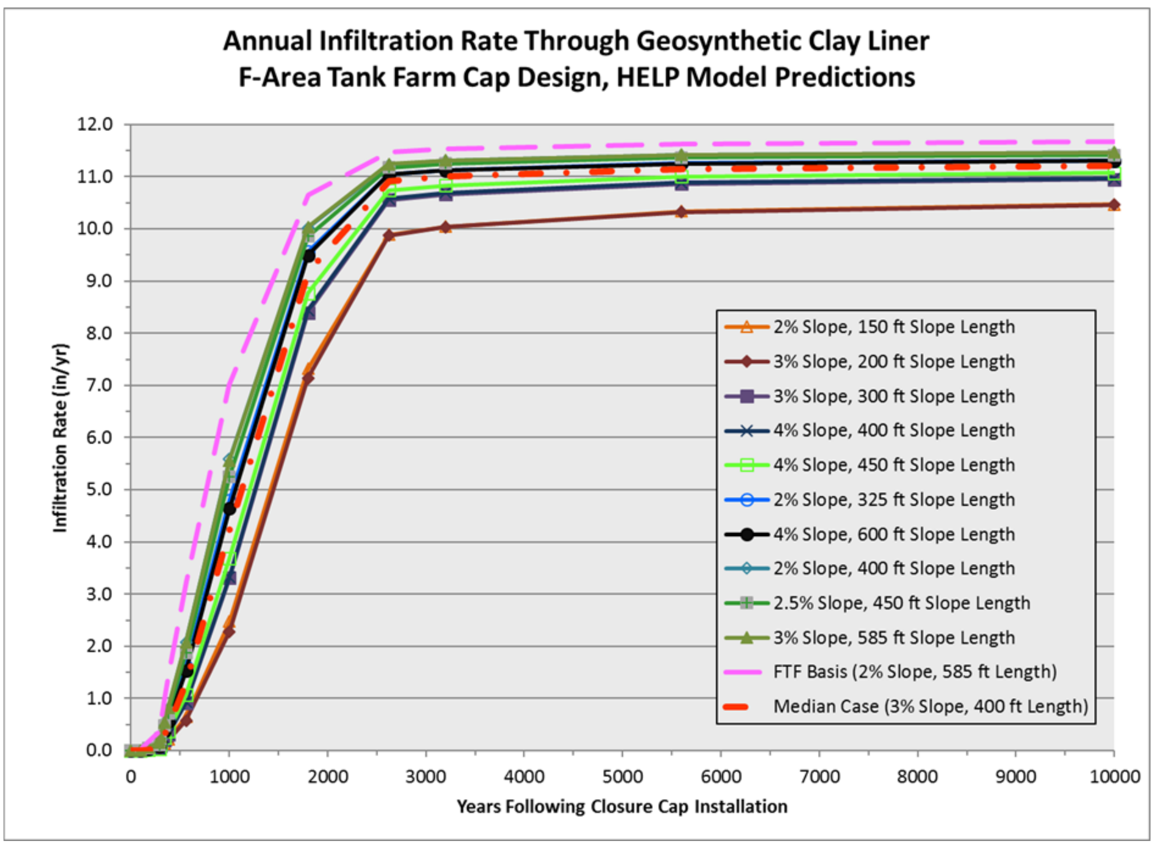

Figure 2-1. Annual Infiltration Rate as a Function of Percent Slope and Slope Length (Dyer, 2017).

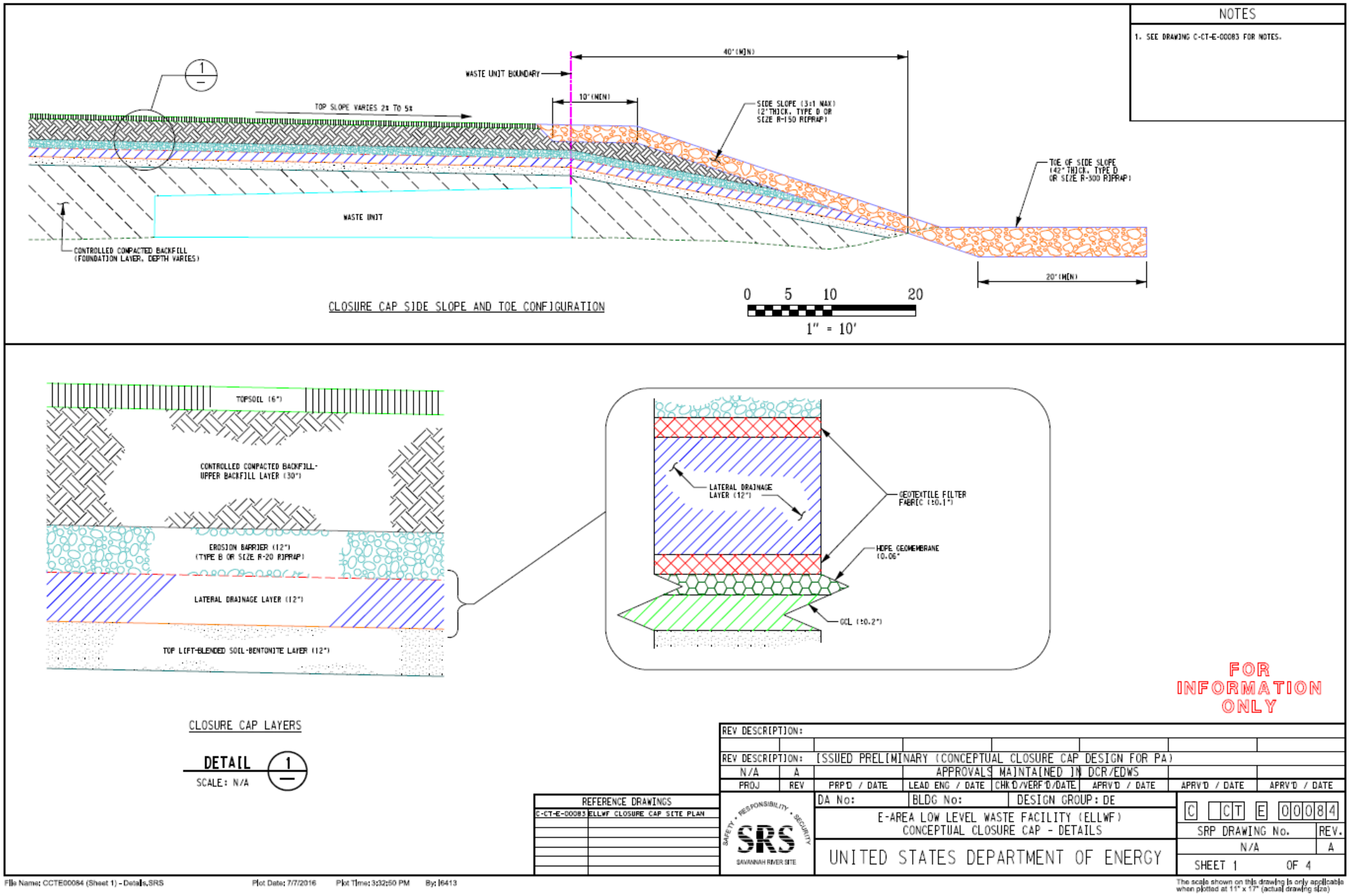

Figure 2-2. Planned Final Closure Cap Design for E-Area LLWF (C-CT-E-00084, 2016).

The final closure cap design for E-Area will include the following ten layers from bottom to top:

- Foundation layer (varying thickness)
- Blended soil-bentonite layer (12 inches)
- GCL (200 mil)
- HDPE geomembrane (60 mil)
- Geotextile filter fabric (100 mil)
- Lateral drainage layer (12 inches)
- Geotextile filter fabric (100 mil)
- Erosion barrier (12 inches)
- Upper backfill layer (30 inches)
- Topsoil (6 inches)

The minimum foundation layer thickness is one foot for the Slit and Engineered Trenches and assumes the presence of a pre-existing minimum four-foot thick operational soil cover. The middle backfill layer in the original FTF cap design is not included in the E-Area LLWF cap design to ensure that the average cap thickness above the LAWV and ILV satisfies differential settlement and maximum seismic load considerations.

The use of a single intact infiltration case reduces the number of more computationally intensive vadose- and aquifer-zone PORFLOW simulations for both the intact- and subsided-cap scenarios. Version 4.0 of the HELP model (Dixon, 2017) was used to generate the desired intact infiltration time profile (closure cap degradation curve) based on the same (or slight modifications thereof) cap design and degradation parameters employed for the FTF infiltration calculations (Phifer et al., 2007). The simulation period of interest for the E-Area LLWF final closure cap is 100 to 10,100 years, where relative Year 100 is the installation date of the final closure cap. The actual period of performance for the PA is 1,000 years following final closure (i.e., relative Year 1,100); however, infiltration estimates are extended to 10,000 years (i.e., relative Year 10,100) to ensure steady-state infiltration conditions are captured in support of transport calculations employed to capture concentration peaks. Dyer and Flach (2018) and Phifer et al. (2007) describe in greater detail the formulation and execution of the HELP model for the intact infiltration case, including degradation assumptions for the barrier and lateral drainage layers.

HELP v4.0 model files for the E-Area LLWF intact infiltration case (two percent slope, 585-foot slope length, 100 to 10,100 years, Bahia grass) were stored in the parent directory C:\Help4.0 in three subdirectories[b] (see Appendix B for a diagram of the file hierarchy):

- C:\Help4.0\Hweather stores input parameters for evapotranspiration calculations (FEVAP.D11) as well as HELP-model-generated weather input files containing 100 years of daily precipitation (FPREC.D4), temperature (FTEMP.D7), and solar radiation (FSOLAR.D13) data. Appendix A provides additional background information on weather data input for the HELP model.

[b] The as-written batch execution files embedded in the HELP directories for this data package require the HELP model to be executed from the C: drive. If executed from another directory or drive, then the Python script and the .bat files in the parent directory and each of the subdirectories for each case will need to be edited for the new directory pathway.

- C:\Help4.0\STET_INTACT contains the input and output files for each intact-infiltration time step (stored in separate subdirectories labeled C:\Help4.0\STET_INTACT\ST00 for Year 100 through C:\Help4.0\STET_INTACT\ST13 for Year 10,100).
- C:\Help4.0\Source contains the executable Fortran files for the HELP model.

All 14 intact infiltration timesteps were executed simultaneously by double-clicking the HELP.bat Windows batch file stored in the subdirectory C:\Help4.0\STET_INTACT. Overall summary files labeled ST.OUT, ST_DRAINAGE.OUT, ST_PERC.OUT, and ST_RUNOFF.OUT were created by double-clicking the Python-based model cat_FC.py stored in the subdirectory C:\Help4.0\STET_INTACT. Output files for each individual time-step were stored in C:\Help4.0\ STET_INTACT\STxx\Output, where xx ranges from 00 to 13.

Table 2-1 lists technical reports relevant to the calculation of intact infiltration rates for the E-Area LLWF. Appendix B provides the HELP model input parameter data sheets for each time step in the intact infiltration degradation curve. Table 2-2 and Figure 2-3 provide the infiltration rates for the bounding intact case for a 10,000-year period. Figure 2-4 is a log-log version of Figure 2-3 and is provided to highlight the much lower estimated infiltration rates during the first few hundred years. Included in Table 2-2 are the HELP model input (xx.D10), output (xx.OUT), and weather input data (xx.D4, xx.D7, xx.D11, xx.D13) filenames corresponding to each time step. Reported infiltration rates from the HELP model are temporally (annually) and spatially (585-foot total slope length) averaged.

Table 2-1. Technical Reports Relevant to the Calculation of Infiltration Rates for the Bounding Intact Case for Slit and Engineered Trenches.

Report Number	Authors/Year	Title	Relevance
SRNL-STI-2017-00104, Rev. 0	Dixon, K. L. (2017)	HELP 4.0 Documentation Updates for Software and Data	HELP model adaptations to run on Windows 10
SRNL-STI-2017-00678, Rev. 0	Dyer, J. A. (2017)	Conceptual Modeling Framework for E-Area PA HELP Infiltration Model Simulations	Basis for percent slope and slope length assumptions
SRNL-STI-2018-00141, Rev. 0	Dyer, J. A. (2018a)	Impact of Different Vegetative Cover Scenarios on Infiltration Rates for the E-Area PA Intact Case	Basis for Bahia grass vegetative cover
SRNL-STI-2018-00121, Rev. 0	Dyer, J. A. (2018c)	Method for Including Uncertainty in Infiltration Rates in the E-Area PA System Model	Basis for upper bounding case
SRNL-STI-2018-00327, Rev. 0	Dyer, J. A., and Flach, G. P. (2018)	Infiltration Time Profiles for E-Area LLWF Intact and Subsidence Scenarios [1]	Intact infiltration rates and HELP model assumptions
SRNL-STI-2017-00506, Rev. 0	Shipmon, J. C., and Dyer, J. A. (2017)	Analysis of Factors that Influence Infiltration Rates using the HELP Model.	Basis for upper bounding case
WSRC-STI-2007-00184, Rev. 2	Phifer, M. A., et al. (2007)	FTF Closure Cap Concept and Infiltration Estimates	Cap degradation narrative, cap design, and HELP model assumptions
SRNL-RP-2009-00075, Rev. 0	Phifer, M. A. et al. (2009)	Closure Plan for the E-Area Low-Level Waste Facility	Operational and interim covers

[1] The intact infiltration rates reported in SRNL-STI-2018-00327, Rev. 0 were based on the FTF closure cap design which includes a middle backfill layer. The planned closure cap design for E-Area no longer includes a middle backfill layer, which was removed to ensure that the average cap thickness above the LAWV and ILV satisfies differential settlement and maximum seismic load considerations. As a result, the calculated intact infiltration rates decreased slightly.

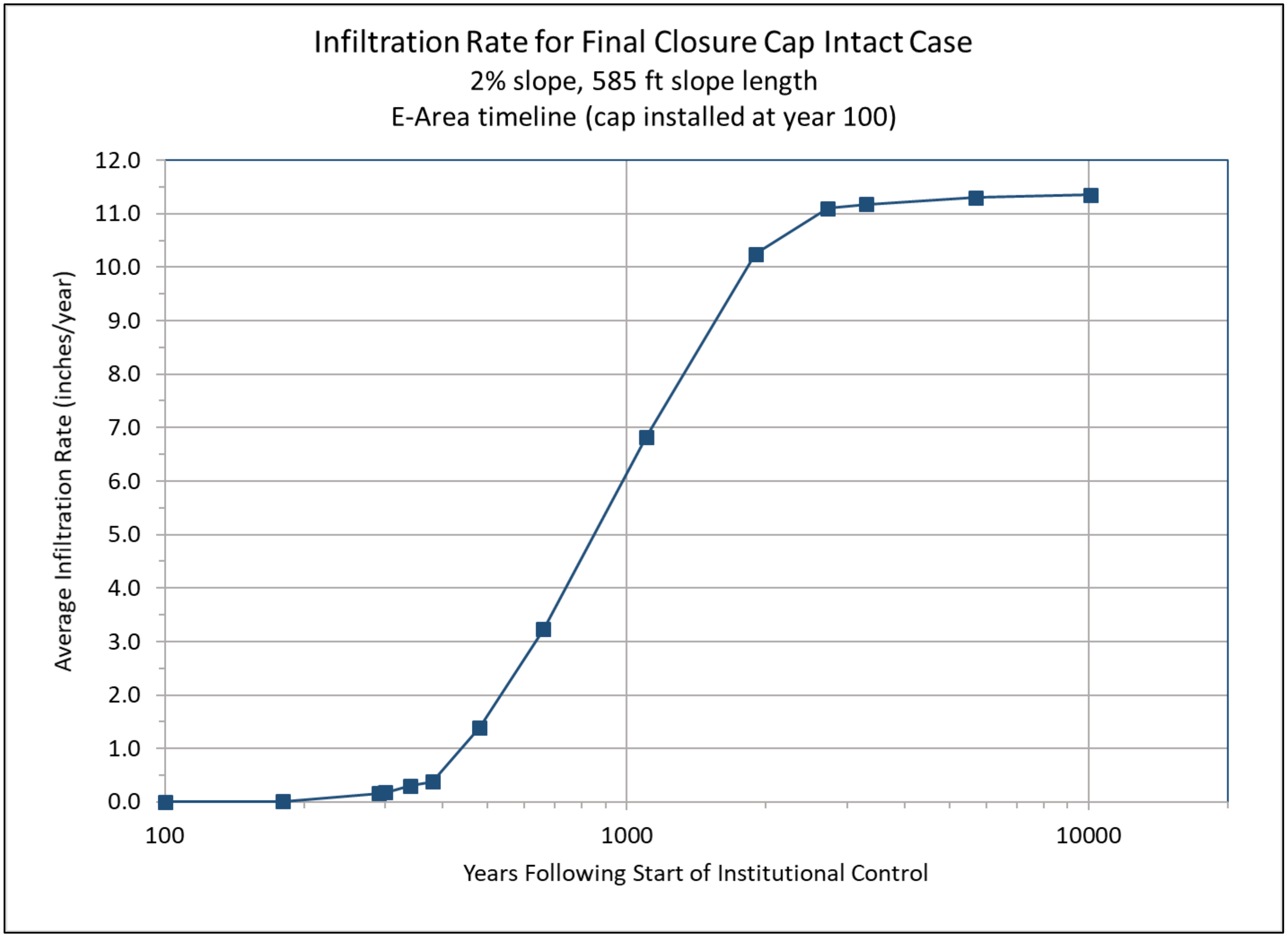

Figure 2-3. Linear-Log Plot of Infiltration Rate vs. Time for Slit and Engineered Trench Bounding Intact Case.

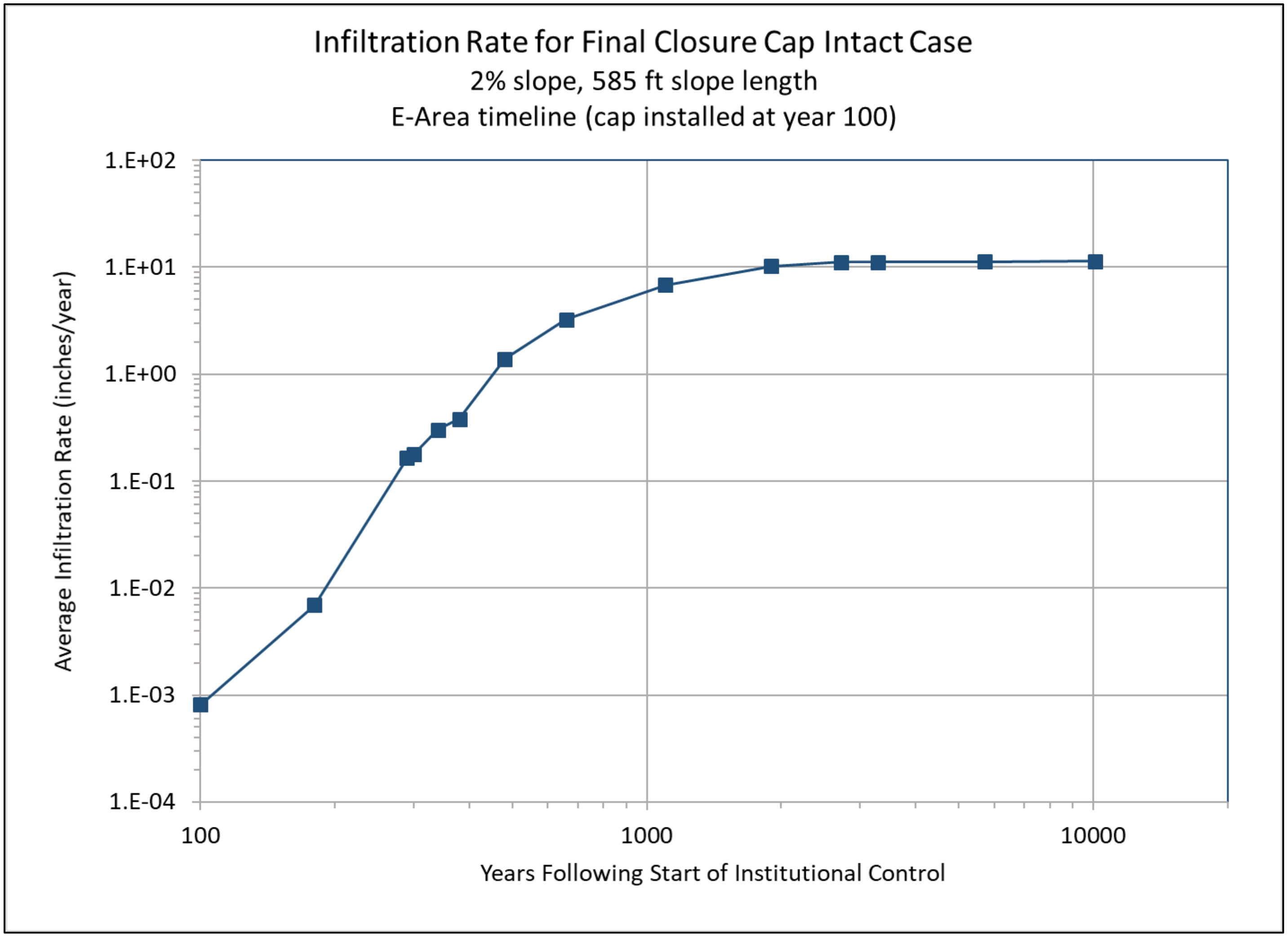

Figure 2-4. Log-Log Plot of Infiltration Rate vs. Time for Slit and Engineered Trench Bounding Intact Case.

Table 2-2. Slit and Engineered Trench Bounding Intact Infiltration Rates and Associated HELP Model Input and Output Files.

Relative Year [1]	Cover Type	HELP Model Input, Output, and Weather Files [2]	PC Directory Location for Execution	Infiltration Rate (inches/year)
-30 to 0	Operational (4 feet soil)	ST_OpCover.D10 ST_OpCover.OUT	C:\Help4.0\SLIT_OpCover\ ST_OpCover	15.78
0 to 100	Interim (HDPE)	ST_IC.D10 ST_IC.OUT ICEVAP.D11 [2]	C:\Help4.0\SLIT_IC\ST_IC	0.1
100	Closure Cap	ST00.D10 ST00.OUT	C:\Help4.0\STET_INTACT\ST00	0.0008
180	Closure Cap	ST01.D10 ST01.OUT	C:\Help4.0\STET_INTACT\ST01	0.007
290	Closure Cap	ST02.D10 ST02.OUT	C:\Help4.0\STET_INTACT\ST02	0.16
300	Closure Cap	ST03.D10 ST03.OUT	C:\Help4.0\STET_INTACT\ST03	0.18
340	Closure Cap	ST04.D10 ST04.OUT	C:\Help4.0\STET_INTACT\ST04	0.30
380	Closure Cap	ST05.D10 ST05.OUT	C:\Help4.0\STET_INTACT\ST05	0.38
480	Closure Cap	ST06.D10 ST06.OUT	C:\Help4.0\STET_INTACT\ST06	1.39
660	Closure Cap	ST07.D10 ST07.OUT	C:\Help4.0\STET_INTACT\ST07	3.23
1,100	Closure Cap	ST08.D10 ST08.OUT	C:\Help4.0\STET_INTACT\ST08	6.82
1,900	Closure Cap	ST09.D10 ST09.OUT	C:\Help4.0\STET_INTACT\ST09	10.24
2,723	Closure Cap	ST10.D10 ST10.OUT	C:\Help4.0\STET_INTACT\ST10	11.10
3,300	Closure Cap	ST11.D10 ST11.OUT	C:\Help4.0\STET_INTACT\ST11	11.18
5,700	Closure Cap	ST12.D10 ST12.OUT	C:\Help4.0\STET_INTACT\ST12	11.30
10,100	Closure Cap	ST13.D10 ST13.OUT	C:\Help4.0\STET_INTACT\ST13	11.35

[1] Year 0: Beginning of institutional control period. Interim runoff cover is installed and maintained for next 100 years (i.e., any subsidence is repaired). Infiltration rate for interim cover is assumed to equal 0.1 inches/year. Year 100: End of institutional control period; installation date of final closure cap.

[2] HELP Weather files are FPREC.D4, FTEMP.D7, FEVAP.D11, and FSOLAR.D13 except where noted in the table.

2.3 Subsidence Infiltration Scenarios

Non-crushable packages are defined as containers and equipment that do not collapse during previous waste stabilization measures, including dynamic compaction, but that fail catastrophically immediately upon installation of the final multilayer closure cap. The collapse is assumed to result in localized failures that create subsidence areas (or holes) in the closure cap surface. Subsidence refers specifically to the non-crushable containers that fail catastrophically; therefore, percent subsidence is synonymous with percent non-crushable packages. Excluded from the list of "non-crushable packages" are Effluent Treatment Facility (ETF vessels, heat exchangers, and reactor vessels that remain structurally intact for thousands of years and will not fail.

Two different approaches are presented for incorporating the effect of localized cap subsidence on infiltration rates in the PORFLOW flow and transport model simulations: (1) spatial and slope-length averaging of infiltration rates based on a Monte Carlo probabilistic model to establish the upper inflow boundary condition for the PORFLOW vadose zone model simulations; and (2) weighted blending of radionuclide fluxes to the water table using the results of less than a dozen PORFLOW vadose zone simulations representative of specific subsidence cases determined from reviewing historical Slit and Engineered Trench inventory data for non-crushable packages.

2.3.1 *Spatially Averaged and Slope-Length-Weighted Averaged Infiltration Rates*

Dyer and Flach (2017, 2018) describe a Python-based probabilistic model that employs Monte Carlo sampling to calculate a spatially averaged infiltration rate for each subsidence case based on infiltration rates generated by the HELP model for the intact case. Percent subsidence can range from zero to 100 percent. Spatial averaging of infiltration rates is implemented in the model by averaging across both the user-specified length (slope length) and width (100,000 Monte Carlo realizations or cap slices) of the cap surface. Slope-length-weighted averaging is a post-processing step that occurs outside the probabilistic model using Microsoft Excel. For closure-cap transects with two sides of unequal slope length, the probabilistic model was executed twice (once for each slope length) at each percent subsidence of interest. A single slope-length-weighted, spatially averaged infiltration-rate time profile for each percent-subsidence case was then calculated using the probabilistic model output for the two slope lengths.

Dyer (2017) found that two cases (150-foot slope length at 2% slope and 585-foot slope length at 2% slope) represented the lower and upper bounds, respectively, for the ten intact infiltration cases which bracket the minimum and maximum slope and slope-length design conditions (two to four percent slope and 150-foot to 600-foot slope length) for the planned E-Area closure cap. The same two bounding intact cases also served as the basis for the slope-length-weighted averaging calculations for the subsidence cases.

A key component of the probabilistic model is the generation of statistical distributions of an upslope-intact-area to subsided-area ratio ($Area_{UAi}/Area_{SAi}$) for closure cap subsidence scenarios that differ in assumed percent subsidence, compartment size, and the total number of intact plus subsided compartments. Mean values for $Area_{UAi}/Area_{SAi}$ can be utilized to calculate the mass flux of water that will drain into a subsided compartment or hole. Mass inflows to a hole include the mean run-on (lateral drainage layer plus surface runoff) from the area of the intact closure cap located upslope of the hole as well as the net influx of precipitation (average annual rainfall minus evapotranspiration) from directly above the hole. Equation (1), which is embedded within the probabilistic model, gives the approximate total mass flux of water, I_{hole}, that is assumed to drain into a subsided compartment of the E-Area LLWF final closure cap:

$$I_{hole}\ (\text{inches/year}) = 16.5 + (Area_{UAi}/Area_{SAi})(16.5 - I_{intact}) \quad (1)$$

where I_{intact} is the intact infiltration rate (inches/year) at time, *t*, and 16.5 inches/year is an approximation based on HELP model simulations of average annual rainfall (49.14 inches/year) minus evapotranspiration (32.64 inches/year) for the SRS. Equation (1) is a reasonable upper-bound approximation of the total mass inflow of water into a subsided area of the cap that avoids having to execute the HELP model at every time step for each different subsidence scenario.

The probabilistic infiltration model consists of two files: SubsideAverage_rev6.py (Python source code) and runPython_rev6D.bat (Windows batch file). The Windows batch file contains the required input parameters and model/output filenames for each simulation case and can be set up to generate multiple infiltration-rate time profiles in one model execution step. Fourteen timesteps were included for each infiltration-rate time profile; however, the number of timesteps can be changed as needed. Appendix C provides the batch input file (runPython_rev6D.bat) including definitions of the required input parameters (i.e., Python source code file, output file prefix, compartment size, total number of compartments, percent subsidence, average annual rainfall minus average evapotranspiration rate from HELP, intact infiltration rate from HELP, and the number of realizations).

Table 2-3 summarizes the percent subsidence[c] assumptions for individual Slit and Engineered Trenches. The bases for these assumptions are:

- For trench units with less than or equal to two percent non-crushable items, hole (or compartment) size is set at ten feet in the infiltration model simulations. As discussed by Dyer and Flach (2017), a minimum hole size of ten feet is considered reasonable based on typical non-crushable container dimensions. For trench units with more than two percent non-crushable items, a larger hole size may be more realistic and warranted. For example, six percent non-crushable items spread across a 500-foot slope length equates to a total subsided length of 30 feet. In this situation, the infiltration model could assume three ten-foot holes, two 15-foot holes, or one 30-foot hole.
- Two percent subsidence is assumed universally for all future trench units (including those to be constructed in Plot 8) based on input from E-Area Solid Waste Engineering.
- Two percent subsidence is also assumed for partially filled, currently operating (open) trench units with a non-crushable content to date of less than two percent. These trench units will be capped at two percent non-crushable packages.
- For closed trench units, percent subsidence is based on the actual recorded area of non-crushable packages, which will be greater than two percent for ST03 and ST04.

There are no open trench units with greater than two percent non-crushable packages.

[c] Percent subsidence values reported in the infiltration data package are based on the total footprint area of the disposal unit, not the area of the waste zone alone. This is an important distinction for Slit Trenches where the waste footprint is roughly 63% of the total disposal unit footprint.

Table 2-3. Percent Subsidence Assumptions for Slit and Engineered Trench Units.

Trench ID	Original Name	Percent Filled[1] (1/31/18)	Total Disposal Unit Footprint Area[2] (ft^2)	Actual Trench Waste Area[2] (ft^2)	Non-Crush Area[3] (ft^2)	Calculated Percent Non-Crushable Packages [4] (%)	Assumed Percent Subsidence (%)
ET01	Engineered Trench #1	100%	96,840	96,840	0	0.00%	0%
ET02 [5]	Engineered Trench #2	76.8%	104,592	104,592	34	0.04%	2%
ET03 [6]	Engineered Trench #3	53.4%	80,848	80,848	0	0.00%	0%
ET04	Engineered Trench #4	Future	103,320			2%	2%
ET05	Slit Trench 15	Future	102,992			2%	2%
ET06	Slit Trench 16	Future	101,705			2%	2%
ET07	Plot 8 West Unit	Future	96,000			2%	2%
ET08	Plot 8 Center Unit	Future	96,000			2%	2%
ET09	Plot 8 East Unit	Future	96,000			2%	2%
ST01	Slit Trench 1	100%	103,430	65,000	0	0.00%	0%
ST02	Slit Trench 2	100%	103,336	65,000	2,046	1.98%	2%
ST03	Slit Trench 3	100%	102,992	65,000	5,019	4.87%	4.9%
ST04	Slit Trench 4	100%	102,992	65,000	3,710	3.60%	3.6%
ST05	Slit Trench 5	100%	102,992	65,000	557	0.54%	0.54%
ST06 [5]	Slit Trench 6	90.6%	102,992	65,000	1,866	2.00%	2%
ST07 [5]	Slit Trench 7	66.4%	102,992	65,000	435	0.64%	2%
ST08 [5]	Slit Trench 8	95.0%	102,992	65,000	13	0.013%	2%
ST09 [5]	Slit Trench 9	87.7%	102,992	65,000	0	0.00%	2%
ST10	Slit Trench 10	Future	93,572			2%	2%
ST11	Slit Trench 11	Future	80,278			2%	2%
ST14 [5]	Slit Trench 14	65.9%	102,989	65,000	383	0.59%	2%
ST17	Slit Trench 17	Future	101,705			2%	2%
ST18	Slit Trench 18	Future	101,705			2%	2%
ST19	Slit Trench 19	Future	101,705			2%	2%
ST20	Slit Trench 20	Future	101,705			2%	2%
ST21	Slit Trench 21 North	Future	84,780			2%	2%
ST22	Slit Trench 21 South	Future	70,650			2%	2%
ST23 [7]	CIG Trench 1 (CIG-1)	~20% as CIG	102,992			Prorated 2% [8]	Prorated 2% [8]
ST24 [7]	CIG Trench 2 (CIG-2)	Future	102,992			2%	2%

[1] From SWE January 2018 LLW review memo (SRNS-N4222-2018-00002, Stewart to Mooneyhan, 02/01/2018). Orange highlighting (100%) indicates that the unit is closed. Purple highlighting identifies units that are still open. Green highlighting indicates future trench units.

[2] Calculated areas for Engineered Trench units based on as-built corner coordinates of trench base summarized by Hamm (2019). Slit Trench areas based on nominal five trench segments each 20 feet wide by 650 feet long.

[3] From 02/01/2018 WITS report.

[4] Percent non-crushable values are based on total footprint area of the disposal unit, not area of the waste zone alone. Percent non-crushable packages for closed units equals: (non-crushable area x 100%) / total footprint area. Percent non-crushable packages for partially filled units equals: (non-crushable area x 100%) / (total footprint area x fraction filled) to normalize the non-crushable area to 100% filled. Percent non-crushable packages is assumed to be two percent for all future trench units. Excluded from the list of non-crushable packages are ETF vessels, heat exchangers, and reactor vessels that remain structurally intact for thousands of years and will not fail.

[5] Allow for two percent non-crushable packages as conservative assumption in setting limits for open trenches with less than two percent non-crushable packages to date (exception is ET03).

[6] ET03 has a current restriction of zero percent non-crushable packages based on an earlier Unreviewed Disposal Question Evaluation. ET03 will almost certainly be filled by 2022 when the next PA revision is approved.

[7] The remaining portion of ST23 (formerly CIG01) will be used as a Slit Trench for remainder of its life. ST24 (formerly CIG02) will now be used as a future Slit Trench.

[8] Two percent subsidence is assumed for the remaining ~80% of ST23 that will function as a future Slit Trench.

Table 2-4 lists technical reports relevant to the calculation of subsidence infiltration rates for the E-Area LLWF. Appendix C contains the batch input file (runPython_rev6D.bat) and simulation results (Table C-1 through Table C-4) for the eight Slit and Engineered Trench subsidence cases: 0.54%, 2%, 3.6%, and 4.9% subsidence for waste-zone-only slope lengths of 545 feet (585-foot slope length – 40-foot overhang) and 110 feet (150-foot slope length – 40-foot overhang) each. The 40-foot cap overhangs are not included in the probabilistic model simulations because no waste is buried beneath them.

Table 2-4. Technical Reports Relevant to the Calculation of Infiltration Rates for Slit and Engineered Trench Subsidence Cases.

Report Number	Authors/Year	Title	Relevance
SRNL-STI-2017-00729, Rev. 0	Dyer, J. A., and Flach, G. P. (2017)	E-Area LLWF Vadose Zone Model: Probabilistic Model for Estimating Subsided-Area Infiltration Rates	Genesis of the probabilistic model for subsidence infiltration calculations
SRNL-STI-2018-00327, Rev. 0	Dyer, J. A., and Flach, G. P. (2018)	Infiltration Time Profiles for E-Area LLWF Intact and Subsidence Scenarios	Current probabilistic model for subsidence infiltration rates

Table 2-5, Figure 2-5, and Figure 2-6 present slope-length-weighted, spatially averaged infiltration rates as a function of relative time for the intact and 0.54%, 2%, 3.6%, and 4.9% subsidence cases for the E-Area LLWF closure cap design. The intact infiltration-rate profile is based on an upper bound case of two percent slope and 585-foot slope length as described above. The reported infiltration rates for the four subsidence cases are slope-length-weighted spatial averages for slope lengths of 545 feet and 110 feet (i.e., portion of the total cap length that overlies the waste footprint). More specifically, for PORFLOW vadose-zone simulations of closure-cap transects with two sides of unequal slope length, the probabilistic model was executed twice (once for each slope length) at each percent subsidence of interest. A single slope-length-weighted, spatially averaged infiltration-rate time profile for each percent-subsidence case was then calculated using the model output for the two different slope lengths. A Microsoft Excel spreadsheet was used for slope-length averaging. Table 2-6 provides the input and output filenames and storage directory for the probabilistic subsidence model executed cases. The Python script can be executed from any PC directory or subdirectory.

2.3.2 *Weighted Averaging of Radionuclide Fluxes for Specific Subsidence Cases*

An alternative approach for addressing subsidence and its impact on infiltration in Slit and Engineered Trenches is to blend radionuclide fluxes for specific deterministic PORFLOW subsidence cases at the water table rather than to blend infiltration rates based on a probabilistic infiltration model as was presented in Section 2.3.1 above. This alternative approach may be preferable because flux through the vadose zone is nonlinear with respect to infiltration at the upper boundary.

Table 2-5. Spatially Averaged Infiltration Rates for E-Area LLWF Subsidence Cases (Intact Case: 2% slope, 585-foot slope length).

Relative Year	Intact Infiltration Rate (in/yr)	Slope-Length-Weighted, Spatially Averaged Infiltration Rate (in/yr)			
		0.54% Subsidence (ST5)	2.0% Subsidence (ST2, ST6-11, ST14, ST17-24, ET02, ET04-09)	3.6% Subsidence (ST4)	4.9% Subsidence (ST3)
0	0.1	N/A	N/A	N/A	N/A
100	0.0008	1.99	5.82	8.47	9.90
180	0.0070	1.99	5.83	8.49	9.87
290	0.16	2.10	5.92	8.56	9.96
300	0.18	2.13	5.92	8.55	9.96
340	0.30	2.24	6.05	8.61	10.00
380	0.38	2.32	6.06	8.65	10.04
480	1.39	3.20	6.74	9.15	10.44
660	3.23	4.82	7.93	10.03	11.17
1100	6.82	7.97	10.25	11.79	12.61
1900	10.24	11.00	12.45	13.46	13.98
2723	11.10	11.74	13.01	13.87	14.34
3300	11.18	11.82	13.06	13.90	14.37
5700	11.30	11.92	13.15	13.97	14.41
10100	11.35	11.97	13.18	13.99	14.43

Year 0: Beginning of institutional control period. Interim runoff cover is installed and maintained for next 100 years (i.e., any subsidence is repaired). Infiltration rate for interim cover is estimated to equal 0.1 inches/year.

Year 100: End of institutional control period; installation date of final closure cap.

For PORFLOW vadose-zone simulations of closure-cap transects with two sides of unequal slope length, the probabilistic model was executed twice (once each for waste-zone-only slope lengths of 545 feet and 110 feet) at each percent subsidence of interest. A single slope-length-weighted, spatially averaged infiltration-rate time profile for each percent-subsidence case was then calculated using the model output for the two different slope lengths.

Danielson (2019) separately developed a Monte Carlo rectangle packing algorithm for generating most probable spatial distributions of non-crushable packages based on the historical E-Area LLWF inventory data for Slit and Engineered Trenches. The Python-based algorithm provides a reasonable, logistical filling pattern that would likely result from normal Solid Waste Management disposal operations. The heat maps for several test cases indicated that the most probable spatial locations for non-crushable packages within a 157-foot-wide Engineered Trench are along the outside edges. In contrast, Monte Carlo packing simulations for a 20-foot-wide Slit Trench geometry showed that the non-crushable filling pattern is essentially insensitive to any modifications of the waste inventory distribution.

As suggested by Danielson (2019), the Monte Carlo rectangle packing algorithm can be implemented in tandem with post-processing of profiles for radionuclide flux to the water table for subsidence geometries that were selected based on additional data that includes the package placement date of each non-crushable package. Such data, when coupled with the opening and closing dates for each disposal unit, will provide more insight on the location of the non-crushable packages and whether they are isolated or

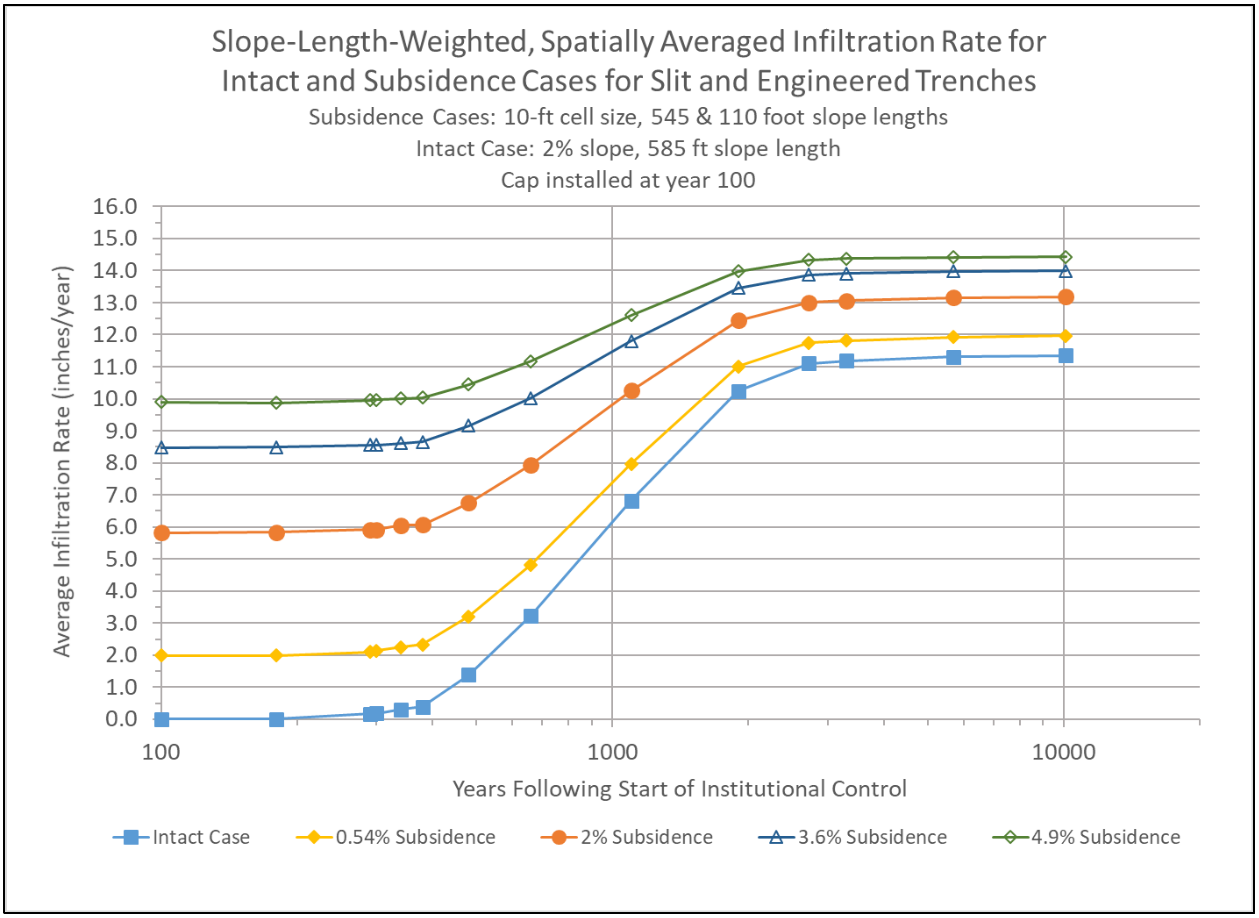

Figure 2-5. Linear-Log Plot of Slope-Length-Weighted, Spatially Averaged Infiltration Rates vs. Time for Slit and Engineered Trench Subsidence Cases.

clustered. Once specific subsidence geometries are selected and groundwater radionuclide transport simulations are performed in PORFLOW for each deterministic case, the probability heat maps from the Monte Carlo rectangle packing algorithm can be consulted to generate weighting factors for blending flux to the water table. In this approach, the upper boundary condition for the vadose zone simulations in PORFLOW will be based instead on the actual intact infiltration rates from Table 2-2 and hole- and case-specific infiltration rates as calculated using Equation (1), rather than using the slope-length-weighted, spatially averaged infiltration rates from Section 2.3.1.

2.4 Method for Quantifying Uncertainty in Infiltration Rates

Dyer (2018c) developed a method for generating uncertainty distributions for intact infiltration cases for inclusion in the GoldSim probabilistic system model. The method combines sensitivity analysis of cover system infiltration rate using the HELP model with nonlinear regression of the resulting infiltration rate versus time profiles using Minitab® 17 to obtain a bounding set of log-logistic growth curves for pessimistic, best estimate, and optimistic cases. Specific recommendations were to:

- Conduct HELP model simulations of intact infiltration scenarios for both best-estimate and sensitivity-analysis cases to generate a reasonable and defensible distribution of infiltration rate versus time profiles.
- Identify three HELP infiltration profiles that represent the most pessimistic, best estimate, and most optimistic cases.
- Use Minitab® 17 or equivalent statistical software to fit the above three infiltration profiles to a four-parameter log-logistic growth curve.
- Add two additional cases (more pessimistic and more optimistic) via manual adjustment of the four fitting parameters to arrive at a set of five log-logistic growth curves that represents the uncertainty distribution for the closure-cap scenario of interest.

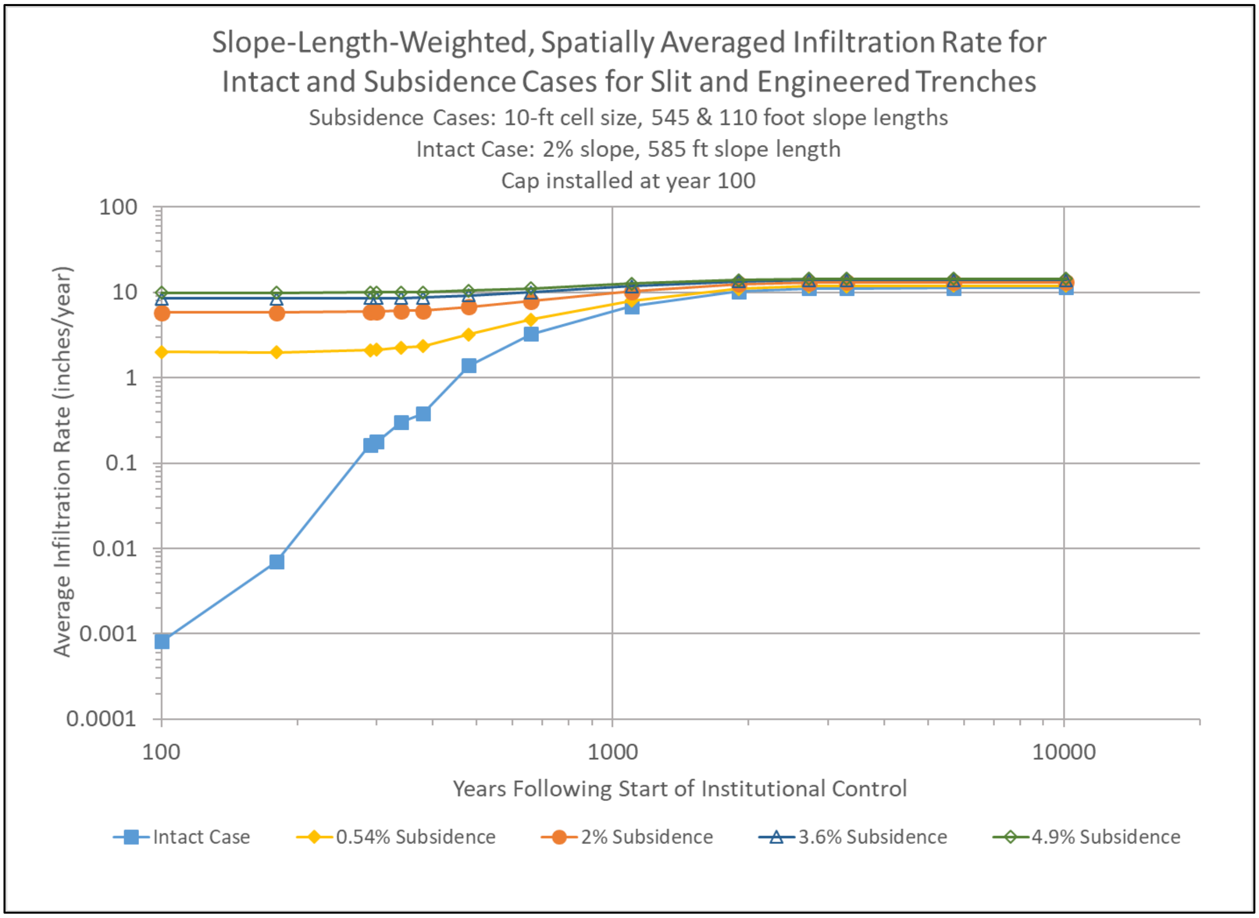

Figure 2-6. Log-Log Plot of Slope-Length-Weighted, Spatially Averaged Infiltration Rates vs. Time for Slit and Engineered Trench Subsidence Cases.

Table 2-6. Probabilistic Subsidence Model Input and Output Files for Slit and Engineered Trenches.

Description	Filename	Storage Directory on Server
Python model	SubsidedAverage_rev6.py	\Infiltration_Python
Batch input file	runPython_rev6D.bat	\Infiltration_Python
Output files		
0.54% subsidence (ST05)	Case_0.54_Per_550ft.out Case_0.54_Per_550ft.sum Case_0.54_Per_550ft.tab Case_0.54_Per_110ft.out Case_0.54_Per_110ft.sum Case_0.54_Per_110ft.tab	\Infiltration_Python
2% subsidence (ST02, ST6-11, ST14, ST17-24, ET02, ET04-09)	Case_2_Per_550ft.out Case_2_Per_550ft.sum Case_2_Per_550ft.tab Case_2_Per_110ft.out Case_2_Per_110ft.sum Case_2_Per_110ft.tab	\Infiltration_Python
3.6% subsidence (ST04)	Case_3.6_Per_550ft.out Case_3.6_Per_550ft.sum Case_3.6_Per_550ft.tab Case_3.6_Per_110ft.out Case_3.6_Per_110ft.sum Case_3.6_Per_110ft.tab	\Infiltration_Python
4.9% subsidence (ST03)	Case_4.9_Per_550ft.out Case_4.9_Per_550ft.sum Case_4.9_Per_550ft.tab Case_4.9_Per_110ft.out Case_4.9_Per_110ft.sum Case_4.9_Per_110ft.tab	\Infiltration_Python

2.4.1 *HELP Model Sensitivity Analysis*

Shipmon and Dyer (2017) used the HELP model to conduct a sensitivity analysis of rainfall infiltration through the proposed intact E-Area LLWF closure cap. The objective of the analysis was to identify the cap design and material property parameters that most significantly impact intact infiltration rates over a 10,000-year simulation period. The results of the sensitivity analysis showed that saturated hydraulic conductivity (Ksat) for select cap layers, precipitation rate, surface vegetation type, and geomembrane layer defect density are dominant factors affecting intact infiltration rate. Interestingly, calculated intact infiltration rates were substantially influenced by changes in the saturated hydraulic conductivity of the Upper Foundation and Lateral Drainage layers. For example, an order-of-magnitude decrease in K_{sat} for the Upper Foundation layer lowered the maximum infiltration rate from a base-case 11 inches per year to only two inches per year, while an order-of-magnitude increase in K_{sat} led to an increase in infiltration rate from 11 to 15 inches per year.

Figure 2-7 (linear-linear plot) and Figure 2-8 (log-log plot of same data) present the intact infiltration rate versus time curves for the following sensitivity parameters evaluated by Shipmon and Dyer (2017):

- Closure cap slope (2% minimum, 3% base case, 5% maximum)
- Closure cap slope length (150 feet minimum, 400 ft base case, 600 feet maximum)
- Surface vegetation type, which affects evapotranspiration (bare ground, base-case grass, pine trees)
- Surface run-off factor (lesser run-off: CN=30; base-case run-off: CN=50; greater run-off: CN=70, where CN is the Soil Conservation Service curve number[d])
- Mean (μ) monthly precipitation (μ - 0.5σ, μ, μ + 0.5σ)
- Linear rate of increase (X) in number of geomembrane defects (0.5X, base-case X, 2X)
- Saturated hydraulic conductivity (K_{sat}) of upper foundation layer (0.5K_{sat}, base-case K_{sat}, 2K_{sat})
- Saturated hydraulic conductivity of lateral drainage layer (0.5K_{sat}, base-case K_{sat}, 2K_{sat})

Shipmon and Dyer (2017) provide a much more detailed description of the parameter values used in the HELP model simulations for each sensitivity case.

2.4.2 *Log-Logistic Growth Curve*

A four-parameter log-logistic growth curve or Fisk distribution is commonly used by hydrologists to represent stream flow and precipitation, which are both characterized by a rate that increases initially and then decreases with time. The functional form of a four-parameter log-logistic growth curve is given by:

$$\text{Infiltration Rate (in/yr)} = \theta_1 + \left(\frac{\theta_2 - \theta_1}{1 + e^{(\theta_4 * \ln(t/\theta_3))}}\right) \quad (1)$$

where t equals time in years, and θ_1, θ_2, θ_3, and θ_4 are the four fitting parameters. Figure 2-9 shows a generalized depiction of a log-logistic growth curve. The log-logistic growth curve is also quite effective at capturing the sigmoidal shape of the infiltration rate versus time curves generated by the HELP model as part of the final closure cap degradation analysis.

The cover system degradation analysis considers: loss of permeability in lateral drainage layers due to "silting in," erosion of surface layer(s), subsidence of the cap due to waste compaction, and degradation of the geomembrane and geosynthetic clay liners due to oxidation, tears, and tree-root penetration over 10,000 years.

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[d] The Soil Conservation Service curve number (CN) is calculated internally within the HELP model and accounts for the effect of surface soil texture and vegetation type on surface runoff. A higher value for CN is indicative of increased runoff and, hence, a decrease in the infiltration rate.

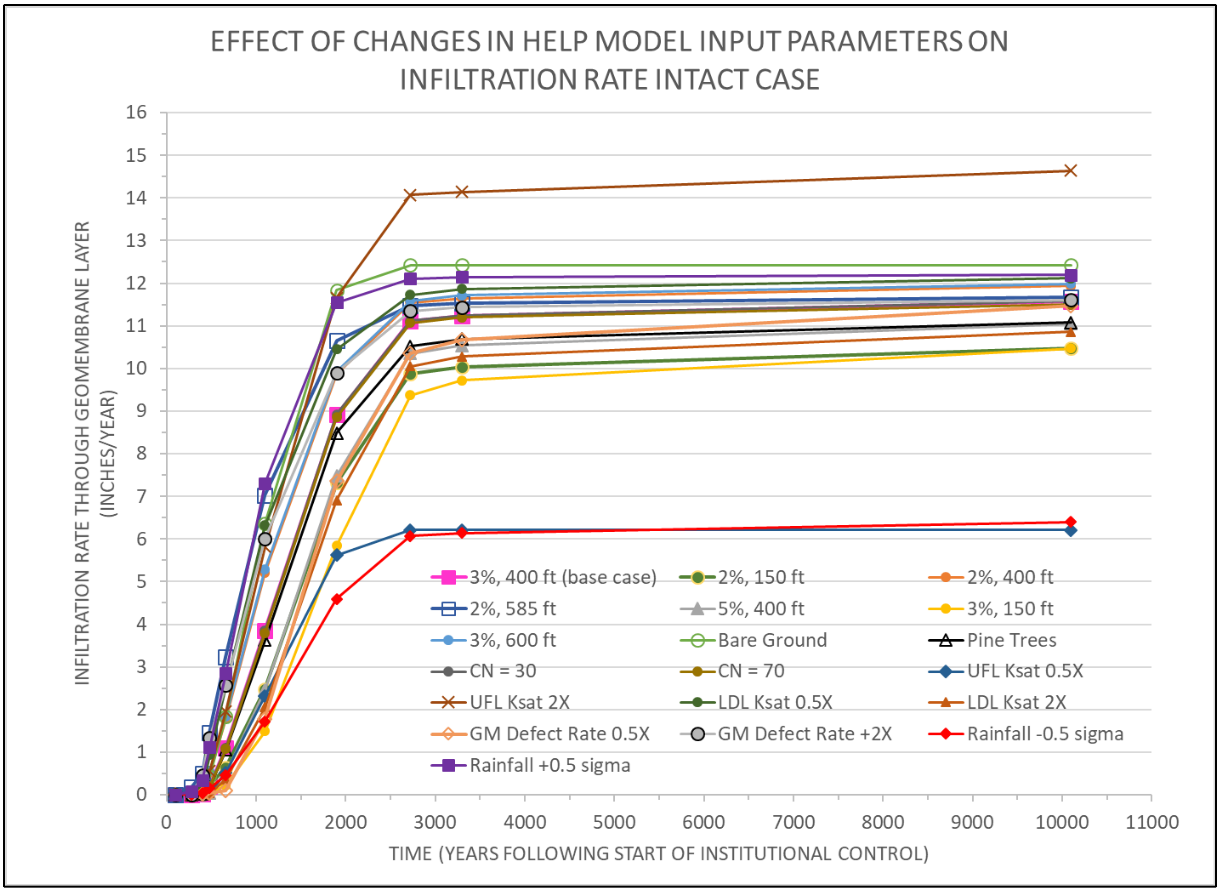


Figure 2-7. Effect of Changes in HELP Input Parameters on Intact Infiltration Rates (linear-linear plot).

The goal was to build upon the sensitivity analysis results above and generate a set of five log-logistic growth curves that represents a reasonable and defensible uncertainty distribution for the intact infiltration case of interest. The set of five log-logistic curves seeks to capture the most pessimistic, more pessimistic, best estimate, more optimistic, and most optimistic infiltration rates over the initial 1,000 years of most importance in the PA. By way of example, visual inspection of Figure 2-8 indicates that the cases below represent a reasonable uncertainty distribution for the intact scenario during the first 1,000 years following closure cap installation:

- Most pessimistic: 2% slope, 585-foot slope length
- Best estimate: 3% slope and 400-foot slope length
- Most optimistic: 3% slope, 150-foot slope length

The method used to arrive at an uncertainty distribution for the intact infiltration case includes two steps:

- Nonlinear regression of HELP model infiltration data for the most pessimistic, best estimate, and most optimistic cases in Figure 2-8 using Minitab® 17 to generate the log-logistic growth curves (Figure 2-10, Figure 2-11, and Figure 2-12) and associated regression parameters (Table 2-7). Note that the nonlinear regressions were performed assuming a timeline where relative Year 0 is the installation date of the final closure cap rather than the start of the institutional control period.

- Manual adjustment of the theta parameters, using the values listed in Table 2-7 for the most pessimistic, best estimate, and most optimistic cases as guidance, to arrive at log-logistic growth curves for the more pessimistic and more optimistic cases shaded in light blue.

The method assumes (1) a log-triangular uncertainty distribution for infiltration rate (I), i.e., log I has a triangular distribution, (2) the triangular distribution for log I is symmetric, and (3) a modified one-dimensional Latin hypercube sampling (LHS) technique with five (5) samples. In traditional one-dimensional LHS, the cumulative distribution function (CDF) is divided into an equal number of partitioned regions (N); one sample point is then randomly selected from each of the N partitioned regions. For the modified LHS technique proposed here, the five samples are not randomly selected from each CDF partition, but are instead positioned at the midpoint of each equally sized partitioned region as shown in Figure 2-13. The five non-random samples correspond to the following uncertainty cases: most optimistic (CDF = 0.1), more optimistic (CDF = 0.3), best estimate (CDF = 0.5), more pessimistic (CDF = 0.7), and most pessimistic (CDF = 0.9). In Figure 2-13, variable *x* represents one of the four theta fitting parameters (θ_1, θ_2, θ_3, and θ_4) in the log-logistic function whose value is equal to zero for the best-estimate case and is normalized to -1 and +1 for the most optimistic and most pessimistic cases, respectively. The more optimistic and more pessimistic cases are situated at -0.41 and +0.41, respectively, which is -41% and +41% of the distance between the best estimate and the most optimistic and most pessimistic cases, respectively.

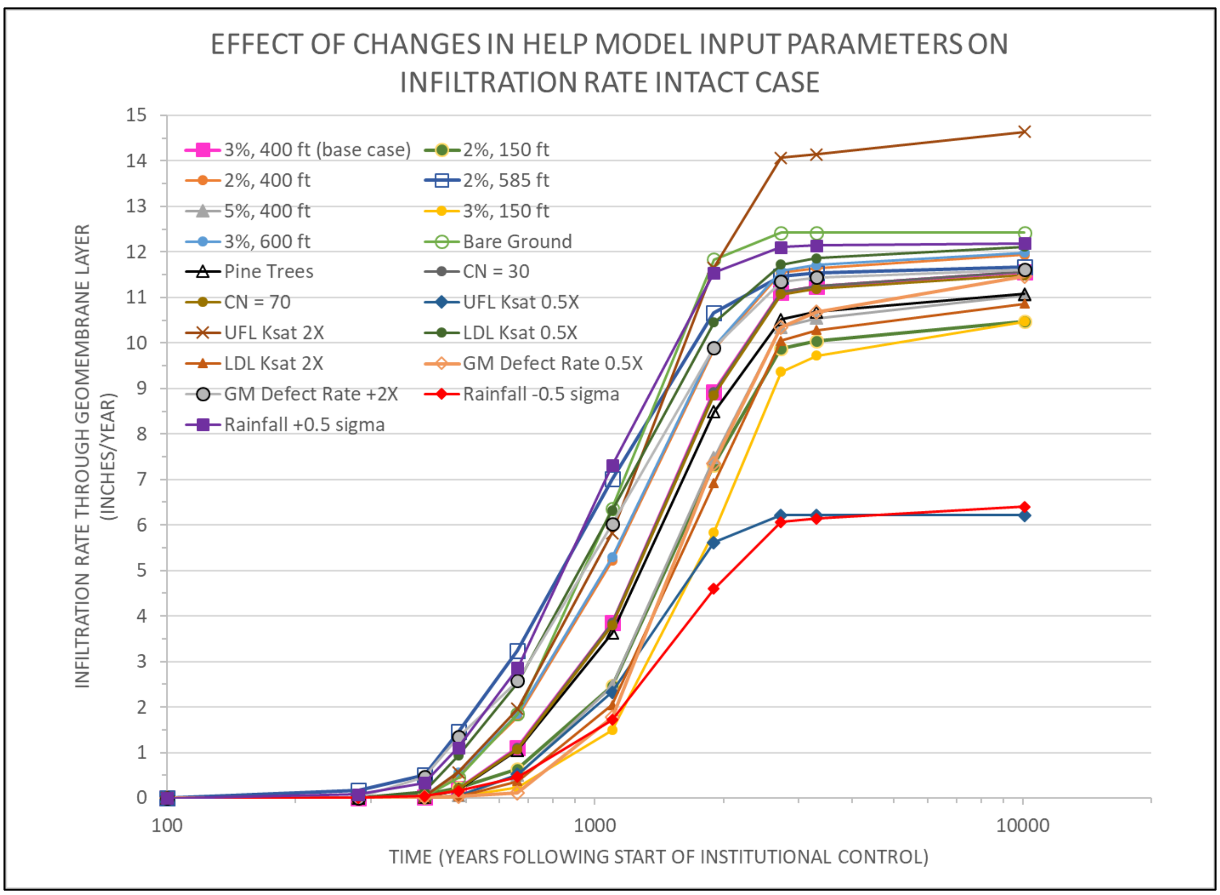


Figure 2-8. Effect of Changes in HELP Input Parameters on Intact Infiltration Rates (log-log plot).

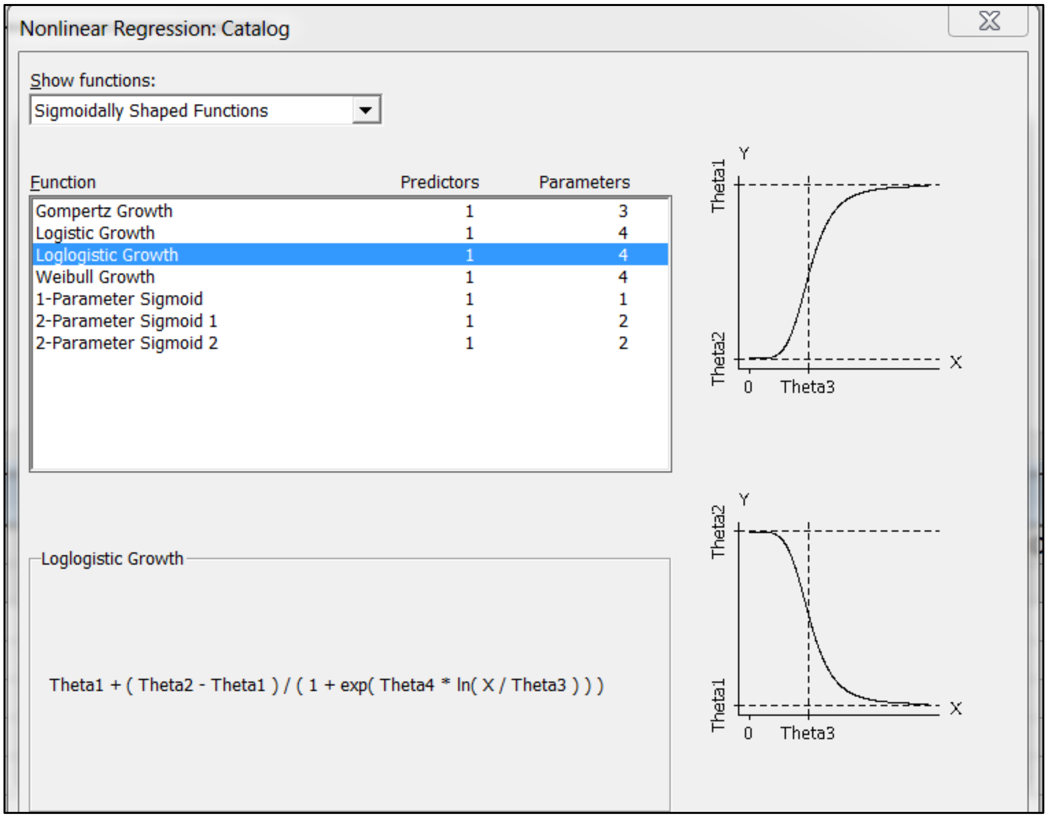


Figure 2-9. Log-Logistic Growth Curve from Minitab® 17 Nonlinear Regression Catalog.

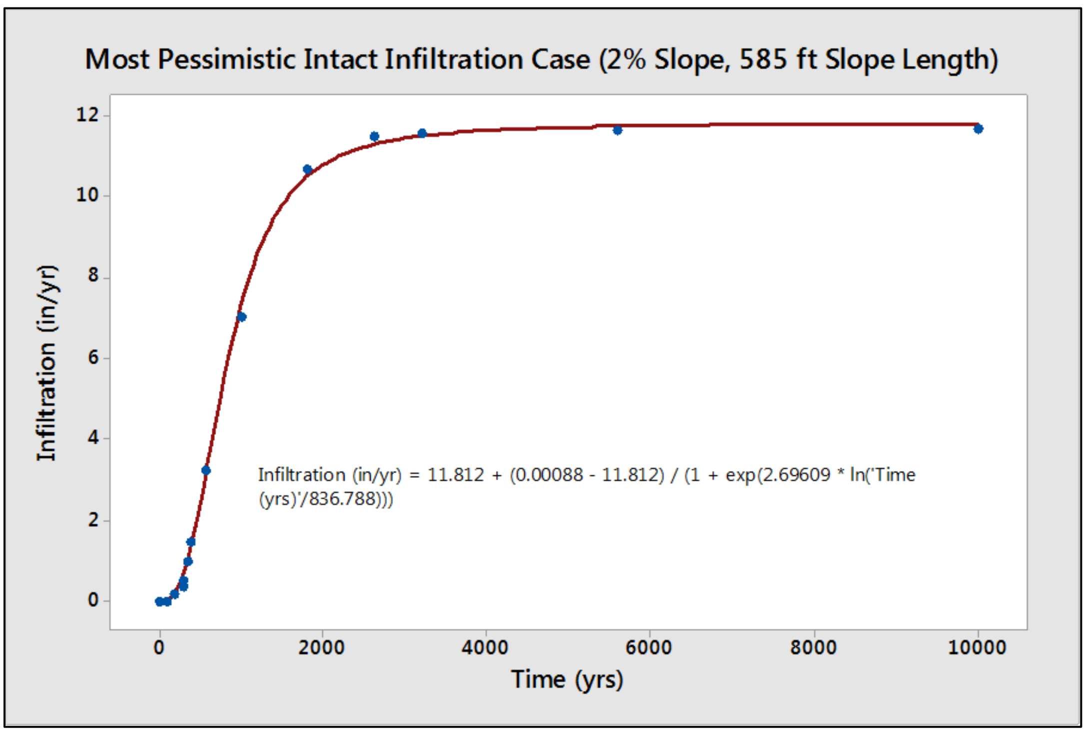


Figure 2-10. Log-Logistic Fit of HELP Model Results for 2% Slope and 585-foot Slope Length (Note: Year 0 is the installation date of the final closure cap).

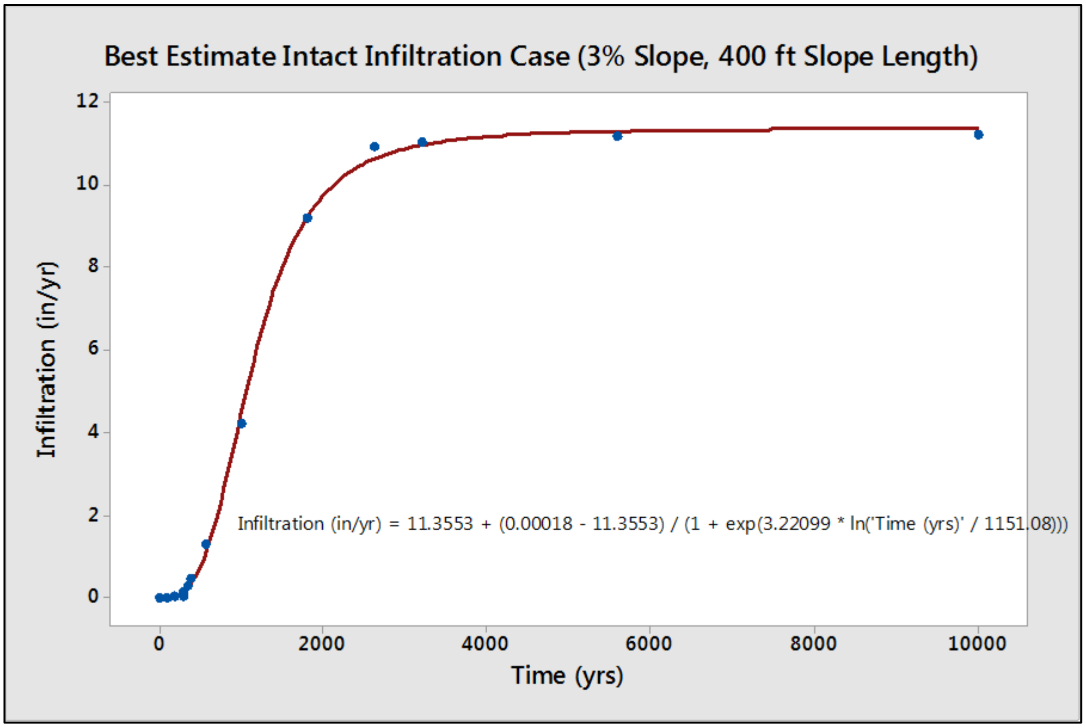


Figure 2-11. Log-Logistic Fit of HELP Model Results for 3% Slope and 400-foot Slope Length (Note: Year 0 is the installation date of the final closure cap).

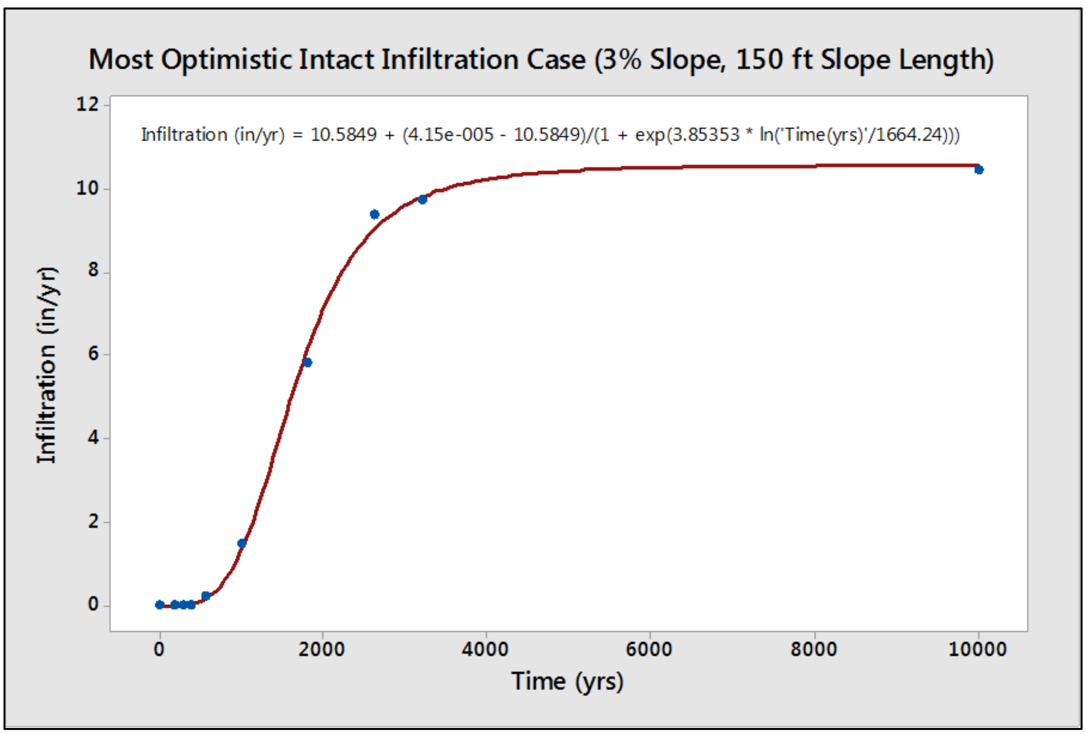


Figure 2-12. Log-Logistic Fit of HELP Model Results for 3% Slope and 150-foot Slope Length (Note: Year 0 is the installation date of the final closure cap).

Table 2-7. Best-Fit Log-Logistic Growth Curve Parameters and Predicted Infiltration Rates for Final Closure Cap Intact Uncertainty Cases.

	Theta Parameters for Log-Logistic Growth Curve				
	Most Pessimistic	More Pessimistic	Best Estimate	More Optimistic	Most Optimistic
θ_1	11.812	11.542547	11.3553	11.039436	10.5849
θ_2	0.00088	0.000467	0.00018	0.0001232	4.15E-05
θ_3	836.788	1022.22028	1151.08	1361.4756	1664.24
θ_4	2.69609	3.005781	3.22099	3.4803314	3.85353

	Infiltration Rate (inches/year)				
Time	Most Pessimistic	More Pessimistic	Best Estimate	More Optimistic	Most Optimistic
100	0.00088	0.0005	0.0002	0.0001	0.00004
200	0.0392	0.0111	0.0045	0.0014	0.0002
280	0.1855	0.0625	0.0289	0.0098	0.0020
390	0.6425	0.2563	0.1325	0.0506	0.0126
400	0.7002	0.2831	0.1476	0.0569	0.0144
440	0.9582	0.4076	0.2194	0.0877	0.0233
480	1.2573	0.5614	0.3112	0.1286	0.0356
660	2.9887	1.6253	1.0155	0.4797	0.1569
1100	7.2983	5.5810	4.4128	2.8114	1.3036
1900	10.4829	9.7608	9.1804	8.0088	6.0861
2723	11.2932	10.9009	10.6080	10.0171	9.0221
3300	11.5028	11.1805	10.9488	10.5029	9.7962
5700	11.7422	11.4734	11.2862	10.9596	10.4872
10100	11.7973	11.5304	11.3446	11.0288	10.5744

Regression parameters for the more pessimistic and optimistic cases are located -41% and +41% of the distance between the best estimate and the most optimistic and pessimistic cases, respectively, as shown in Figure 2-12. Time zero is the start of the institutional control period, which lasts 100 years. The final closure cap is installed at relative Year 100.

Figure 2-14 and Figure 2-15 are linear-linear and log-log plots, respectively, displaying the five log-logistic growth curves for the intact infiltration case included in Table 2-7. This set of five infiltration-rate-versus-time profiles depicts the reasonable and defensible uncertainty distribution for the intact closure-cap scenario considered by Shipmon and Dyer (2017).

Similar sets comprised of five infiltration curves each were generated for the 0.54%, 2%, 3.6%, and 4.9% subsidence scenarios using the Python-based probabilistic subsidence model together with the five intact infiltration rate uncertainty distributions from Table 2-7. The slope-length-weighted, spatially averaged infiltration rate uncertainty distributions for the four subsidence scenarios are summarized in Table 2-8, Table 2-9, Table 2-10, Table 2-11, and Table 2-12 for the most optimistic, more optimistic, best estimate, more pessimistic, and most pessimistic cases, respectively. Figure 2-16, Figure 2-17, Figure 2-18, and Figure 2-19 plot the same subsided-case infiltration data sorted by percent subsidence. As percent subsidence increases, the impact of uncertainty in the intact infiltration rates on the uncertainty in the subsidence infiltration rates decreases (i.e., the infiltration rate profiles for the five uncertainty cases become more tightly grouped).

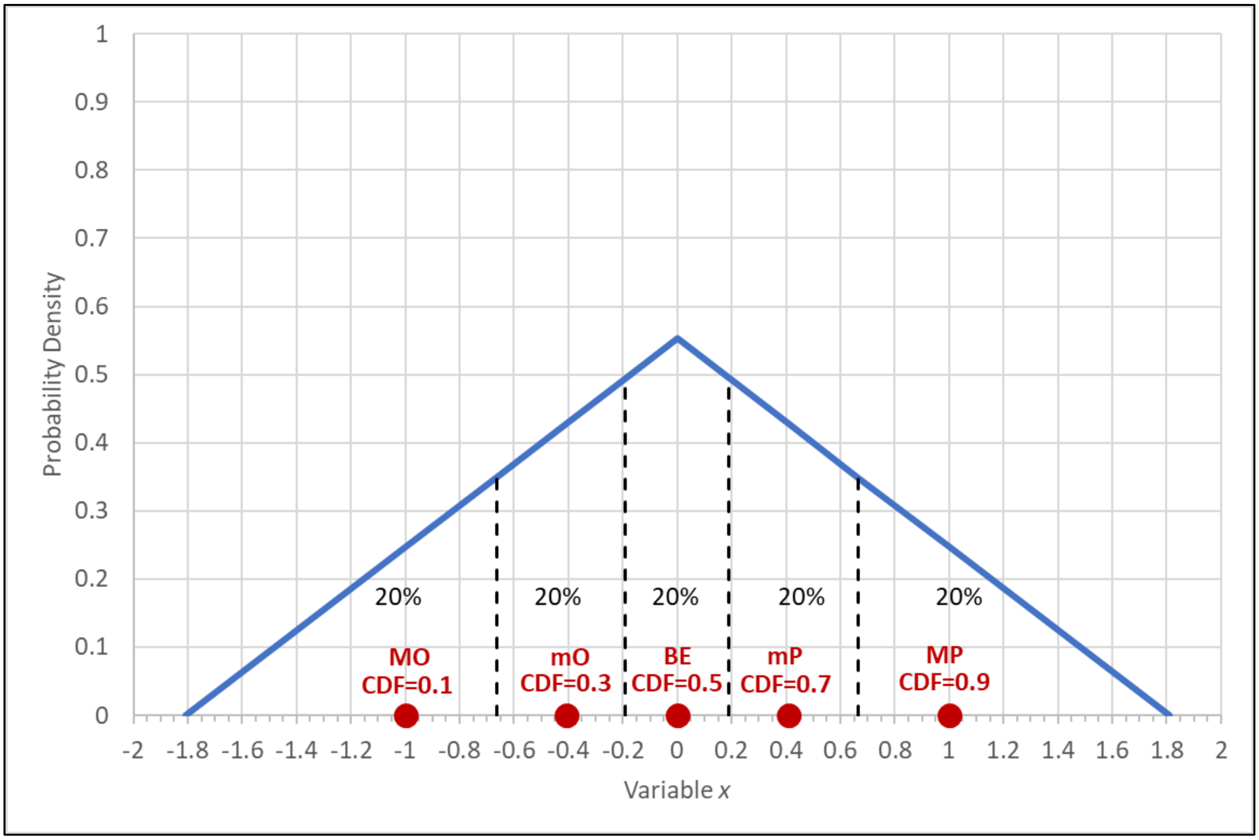


Figure 2-13. Representative Symmetric Probability Density Function for a Modified One-Dimensional Latin Hypercube Sampling Technique with Five Non-Random Samples (the partitioned regions are indicated by dashed vertical lines with each representing 20% of the total area under the PDF; CDF = cumulative distribution function; MO = most optimistic; mO = more optimistic; BE = best estimate; mP = more pessimistic; MP = most pessimistic).

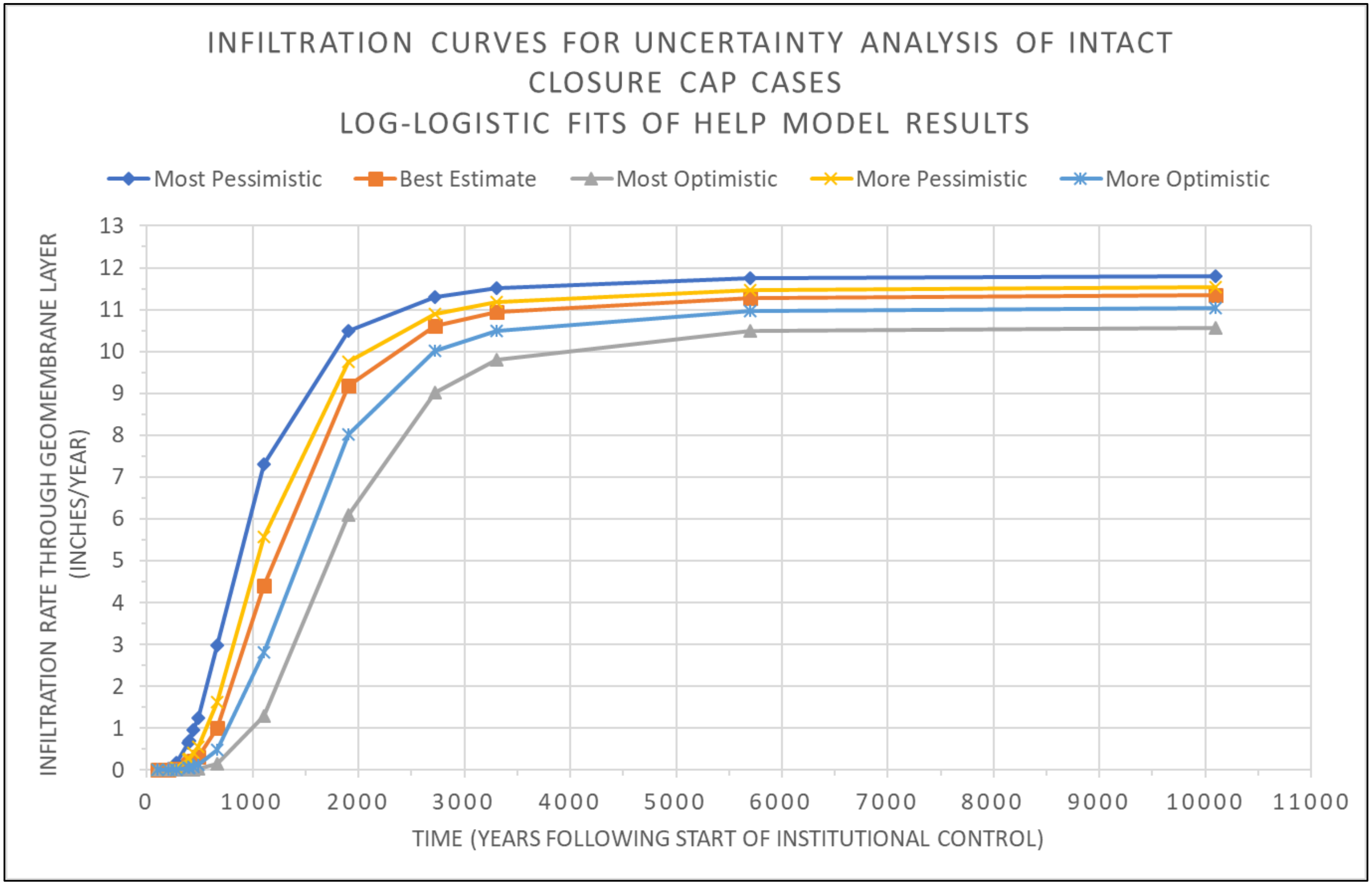


Figure 2-14. Proposed Intact Infiltration Rate Profiles for Uncertainty Analysis (linear-linear plot).

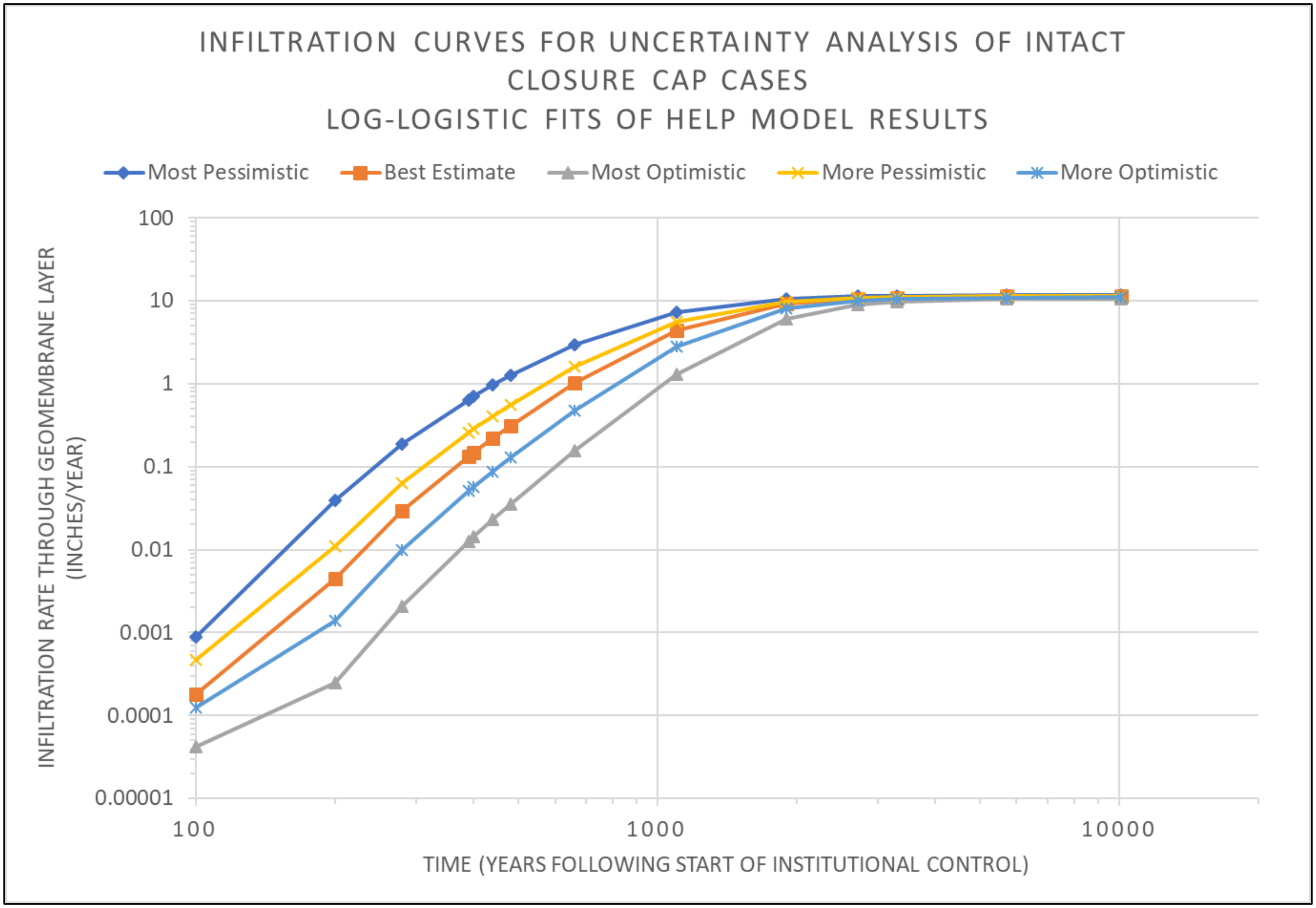


Figure 2-15. Proposed Intact Infiltration Rate Profiles for Uncertainty Analysis (log-log plot).

Table 2-8. Slit and Engineered Trench Infiltration Rates for Most Optimistic Probabilistic Subsidence Cases.

Relative Year	Slope-Length-Weighted, Spatially Averaged Infiltration Rate (inches/year)			
	0.54% Subsidence (ST05)	2.0% Subsidence (ST2, ST6-11, ST14, ST17-24, ET02, ET04-09)	3.6% Subsidence (ST04)	4.9% Subsidence (ST03)
0	N/A	N/A	N/A	N/A
100	1.98	5.85	8.48	9.89
180	1.98	5.82	8.45	9.90
290	1.97	5.86	8.46	9.90
300	1.97	5.84	8.47	9.88
340	2.00	5.84	8.47	9.90
380	1.99	5.84	8.47	9.87
480	2.00	5.84	8.47	9.89
660	2.11	5.95	8.53	9.97
1100	3.14	6.68	9.12	10.41
1900	7.34	9.77	11.45	12.34
2723	9.91	11.68	12.86	13.50
3300	10.60	12.16	13.24	13.82
5700	11.21	12.62	13.57	14.09
10100	11.28	12.67	13.62	14.13

Year 0: Beginning of institutional control period. Interim runoff cover is installed and maintained for next 100 years (i.e., any subsidence is repaired). Infiltration rate for interim cover is estimated to equal 0.1 inches/year.

Year 100: End of institutional control period; installation date of final closure cap.

For PORFLOW vadose-zone simulations of closure-cap transects with two sides of unequal slope length, the probabilistic model was executed twice (once each for waste-zone-only slope lengths of 545 feet and 110 feet) at each percent subsidence of interest. A single slope-length-weighted, spatially averaged infiltration-rate time profile for each percent-subsidence case was then calculated using the model output for the two different slope lengths.

Table 2-9. Slit and Engineered Trench Infiltration Rates for More Optimistic Probabilistic Subsidence Cases.

Relative Year	Slope-Length-Weighted, Spatially Averaged Infiltration Rate (inches/year)			
	0.54% Subsidence (ST05)	2.0% Subsidence (ST2, ST6-11, ST14, ST17-24, ET02, ET04-09)	3.6% Subsidence (ST04)	4.9% Subsidence (ST03)
0	N/A	N/A	N/A	N/A
100	1.98	5.87	8.47	9.89
180	1.98	5.83	8.49	9.86
290	1.97	5.85	8.49	9.89
300	2.03	5.88	8.49	9.92
340	2.04	5.85	8.48	9.91
380	2.05	5.92	8.51	9.90
480	2.09	5.93	8.54	9.92
660	2.41	6.16	8.73	10.09
1100	4.44	7.63	9.85	11.01
1900	9.03	11.02	12.36	13.10
2723	10.80	12.31	13.34	13.90
3300	11.21	12.63	13.57	14.10
5700	11.63	12.92	13.80	14.28
10100	11.68	12.97	13.83	14.31

Year 0: Beginning of institutional control period. Interim runoff cover is installed and maintained for next 100 years (i.e., any subsidence is repaired). Infiltration rate for interim cover is estimated to equal 0.1 inches/year.

Year 100: End of institutional control period; installation date of final closure cap.

For PORFLOW vadose-zone simulations of closure-cap transects with two sides of unequal slope length, the probabilistic model was executed twice (once each for waste-zone-only slope lengths of 545 feet and 110 feet) at each percent subsidence of interest. A single slope-length-weighted, spatially averaged infiltration-rate time profile for each percent-subsidence case was then calculated using the model output for the two different slope lengths.

Table 2-10. Slit and Engineered Trench Infiltration Rates for Best Estimate Probabilistic Subsidence Cases.

Relative Year	Slope-Length-Weighted, Spatially Averaged Infiltration Rate (inches/year)			
	0.54% Subsidence (ST05)	2.0% Subsidence (ST2, ST6-11, ST14, ST17-24, ET02, ET04-09)	3.6% Subsidence (ST04)	4.9% Subsidence (ST03)
0	N/A	N/A	N/A	N/A
100	1.97	5.84	8.47	9.90
180	1.99	5.85	8.48	9.90
290	2.00	5.85	8.49	9.90
300	2.10	5.91	8.53	9.93
340	2.11	5.91	8.54	9.95
380	2.18	5.97	8.56	9.97
480	2.26	6.04	8.64	10.00
660	2.87	6.48	8.98	10.29
1100	5.87	8.68	10.61	11.67
1900	10.06	11.76	12.94	13.57
2723	11.31	12.68	13.64	14.13
3300	11.62	12.91	13.79	14.27
5700	11.90	13.13	13.96	14.41
10100	11.96	13.17	13.99	14.43

Year 0: Beginning of institutional control period. Interim runoff cover is installed and maintained for next 100 years (i.e., any subsidence is repaired). Infiltration rate for interim cover is estimated to equal 0.1 inches/year.

Year 100: End of institutional control period; installation date of final closure cap.

For PORFLOW vadose-zone simulations of closure-cap transects with two sides of unequal slope length, the probabilistic model was executed twice (once each for waste-zone-only slope lengths of 545 feet and 110 feet) at each percent subsidence of interest. A single slope-length-weighted, spatially averaged infiltration-rate time profile for each percent-subsidence case was then calculated using the model output for the two different slope lengths.

Table 2-11. Slit and Engineered Trench Infiltration Rates for More Pessimistic Probabilistic Subsidence Cases.

Relative Year	Slope-Length-Weighted, Spatially Averaged Infiltration Rate (inches/year)			
	0.54% Subsidence (ST05)	2.0% Subsidence (ST2, ST6-11, ST14, ST17-24, ET02, ET04-09)	3.6% Subsidence (ST04)	4.9% Subsidence (ST03)
0	N/A	N/A	N/A	N/A
100	1.99	5.84	8.46	9.87
180	1.96	5.83	8.45	9.87
290	2.03	5.87	8.48	9.91
300	2.20	5.98	8.58	9.99
340	2.23	6.00	8.60	10.00
380	2.32	6.12	8.67	10.06
480	2.47	6.21	8.75	10.12
660	3.41	6.90	9.25	10.54
1100	6.87	9.46	11.19	12.13
1900	10.57	12.15	13.22	13.80
2723	11.57	12.88	13.78	14.26
3300	11.82	13.06	13.91	14.37
5700	12.07	13.25	14.05	14.49
10100	12.12	13.29	14.09	14.51

Year 0: Beginning of institutional control period. Interim runoff cover is installed and maintained for next 100 years (i.e., any subsidence is repaired). Infiltration rate for interim cover is estimated to equal 0.1 inches/year.

Year 100: End of institutional control period; installation date of final closure cap.

For PORFLOW vadose-zone simulations of closure-cap transects with two sides of unequal slope length, the probabilistic model was executed twice (once each for waste-zone-only slope lengths of 545 feet and 110 feet) at each percent subsidence of interest. A single slope-length-weighted, spatially averaged infiltration-rate time profile for each percent-subsidence case was then calculated using the model output for the two different slope lengths.

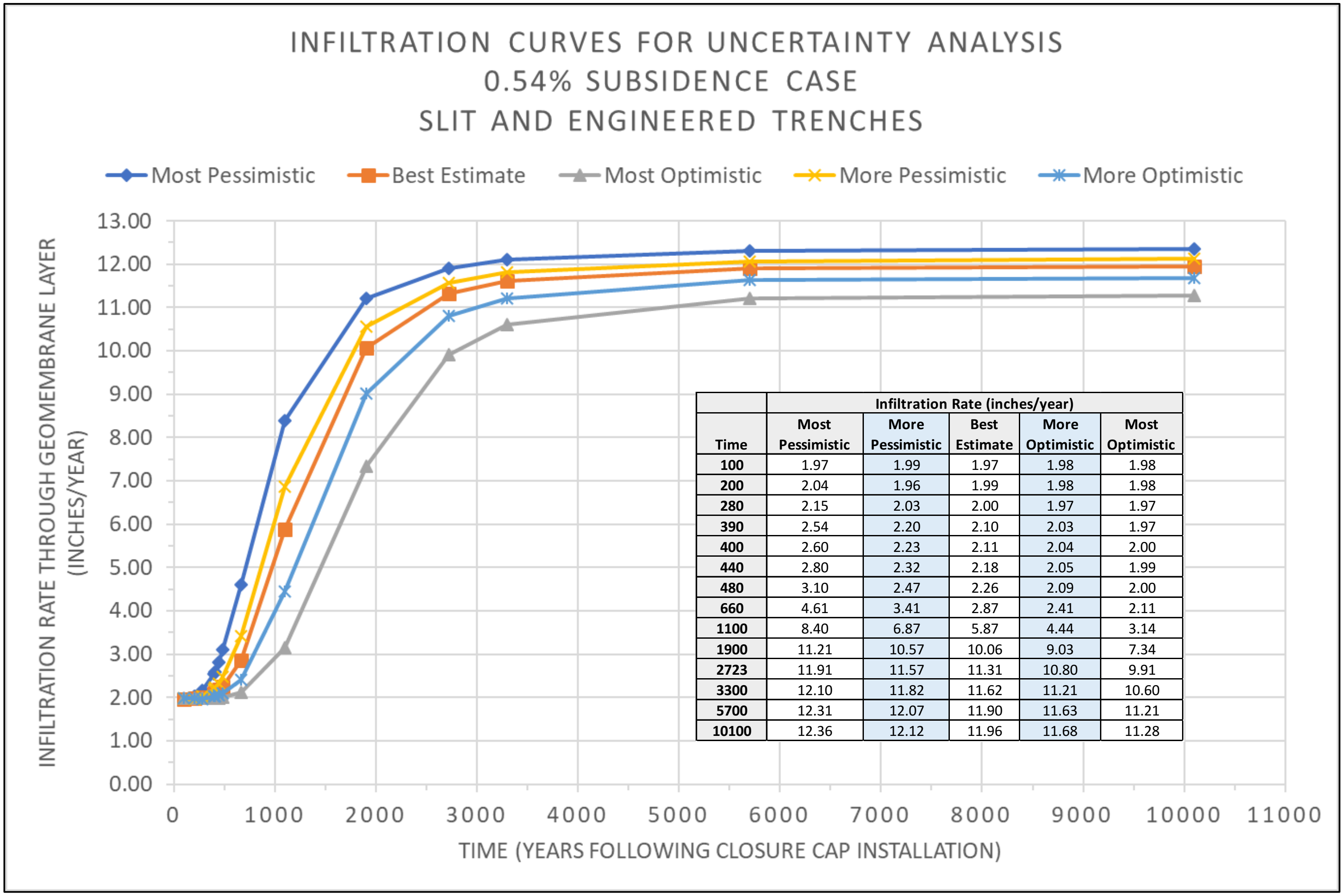
Table 2-12. Slit and Engineered Trench Infiltration Rates for Most Pessimistic Probabilistic Subsidence Cases.

Relative Year	Slope-Length-Weighted, Spatially Averaged Infiltration Rate (inches/year)			
	0.54% Subsidence (ST05)	2.0% Subsidence (ST2, ST6-11, ST14, ST17-24, ET02, ET04-09)	3.6% Subsidence (ST04)	4.9% Subsidence (ST03)
0	N/A	N/A	N/A	N/A
100	1.97	5.84	8.49	9.88
180	2.04	5.83	8.49	9.93
290	2.15	5.93	8.57	9.96
300	2.54	6.24	8.78	10.14
340	2.60	6.30	8.79	10.16
380	2.80	6.45	8.95	10.28
480	3.10	6.64	9.09	10.42
660	4.61	7.77	9.94	11.10
1100	8.40	10.56	12.01	12.82
1900	11.21	12.60	13.57	14.09
2723	11.91	13.14	13.97	14.41
3300	12.10	13.27	14.07	14.49
5700	12.31	13.43	14.19	14.59
10100	12.36	13.46	14.21	14.61

Year 0: Beginning of institutional control period. Interim runoff cover is installed and maintained for next 100 years (i.e., any subsidence is repaired). Infiltration rate for interim cover is estimated to equal 0.1 inches/year.

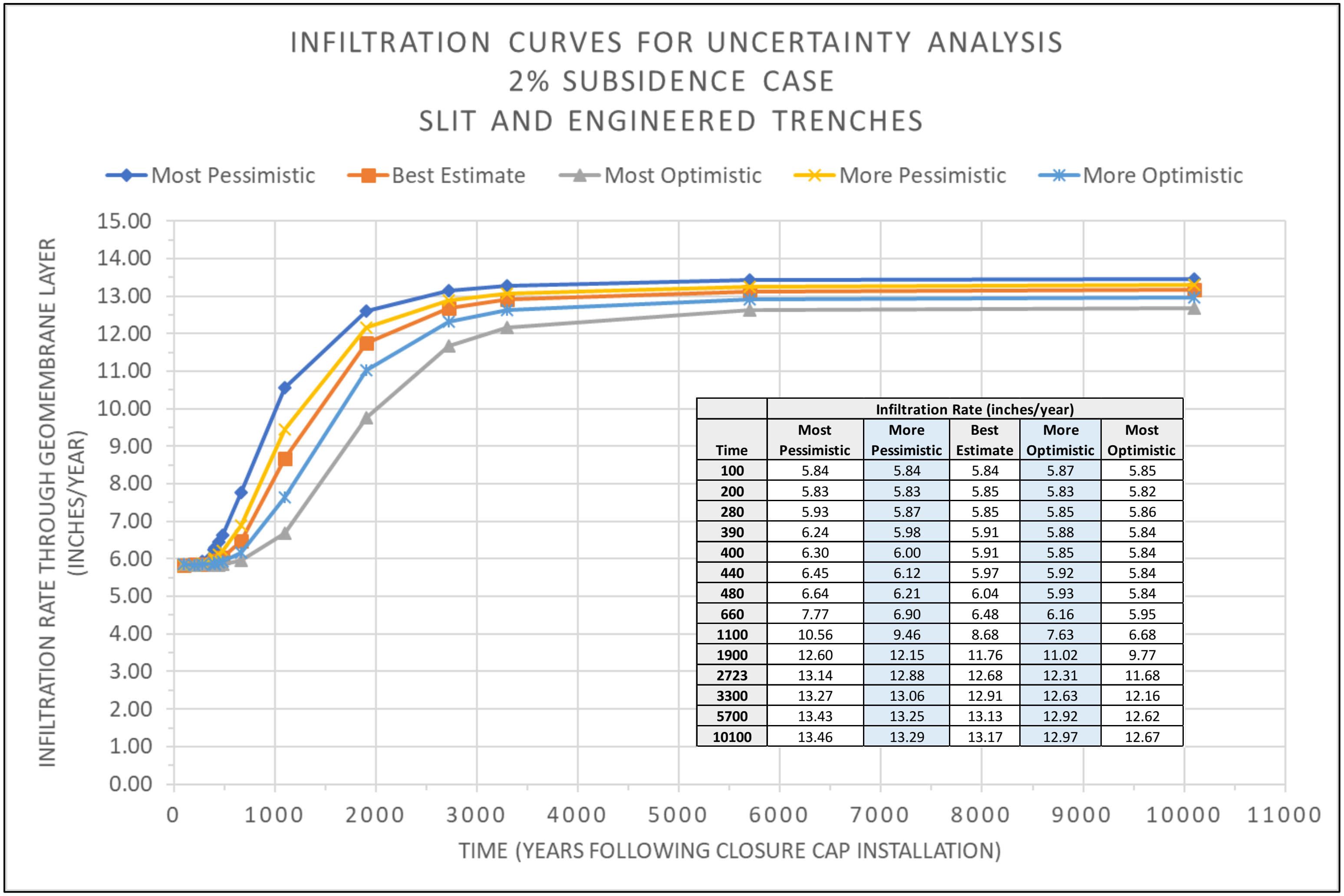
Year 100: End of institutional control period; installation date of final closure cap.

For PORFLOW vadose-zone simulations of closure-cap transects with two sides of unequal slope length, the probabilistic model was executed twice (once each for waste-zone-only slope lengths of 545 feet and 110 feet) at each percent subsidence of interest. A single slope-length-weighted, spatially averaged infiltration-rate time profile for each percent-subsidence case was then calculated using the model output for the two different slope lengths.



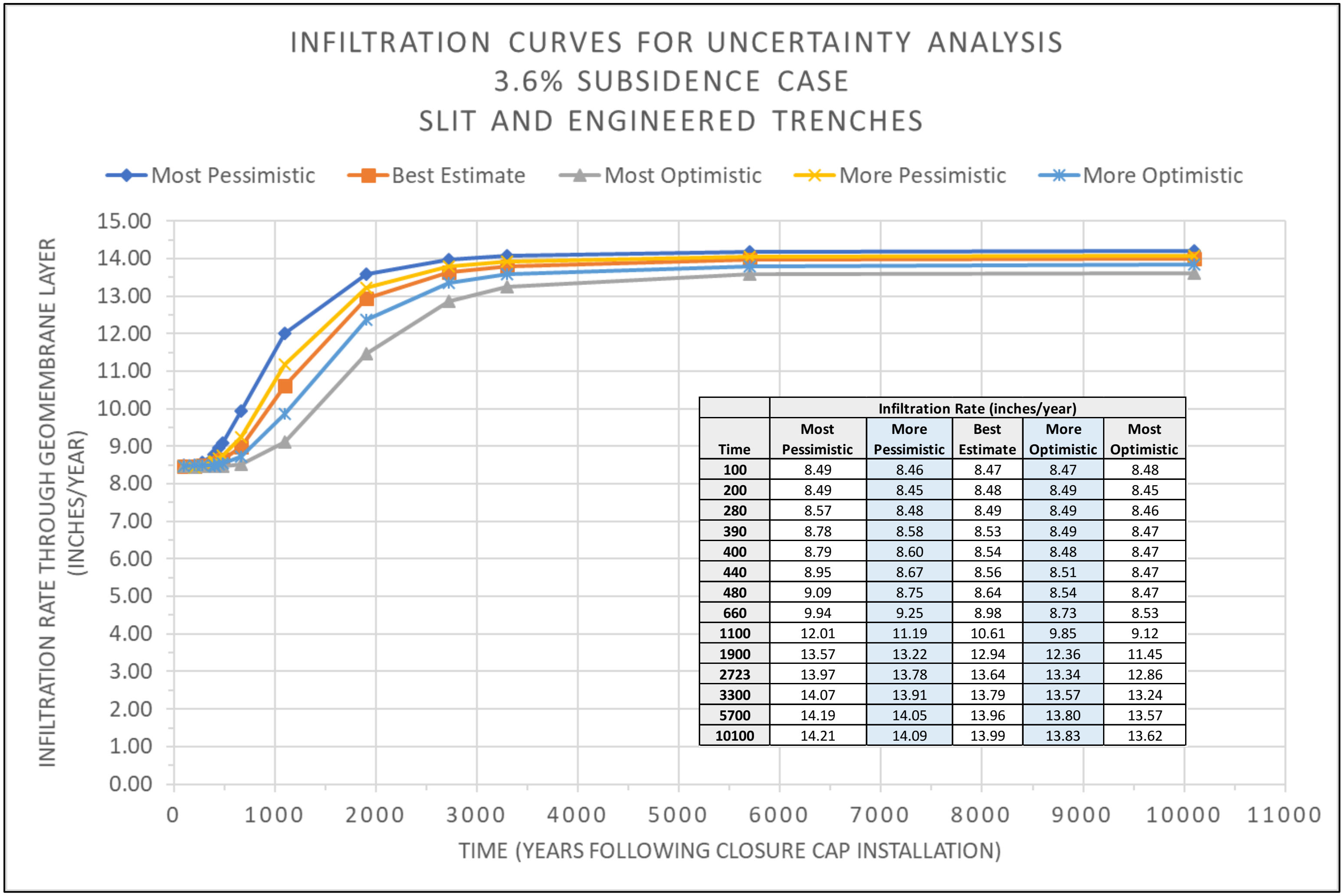
	Infiltration Rate (inches/year)				
Time	Most Pessimistic	More Pessimistic	Best Estimate	More Optimistic	Most Optimistic
100	1.97	1.99	1.97	1.98	1.98
200	2.04	1.96	1.99	1.98	1.98
280	2.15	2.03	2.00	1.97	1.97
390	2.54	2.20	2.10	2.03	1.97
400	2.60	2.23	2.11	2.04	2.00
440	2.80	2.32	2.18	2.05	1.99
480	3.10	2.47	2.26	2.09	2.00
660	4.61	3.41	2.87	2.41	2.11
1100	8.40	6.87	5.87	4.44	3.14
1900	11.21	10.57	10.06	9.03	7.34
2723	11.91	11.57	11.31	10.80	9.91
3300	12.10	11.82	11.62	11.21	10.60
5700	12.31	12.07	11.90	11.63	11.21
10100	12.36	12.12	11.96	11.68	11.28

Figure 2-16. Slit and Engineered Trench Probabilistic Infiltration Rate Profiles for 0.54% Subsidence Case.



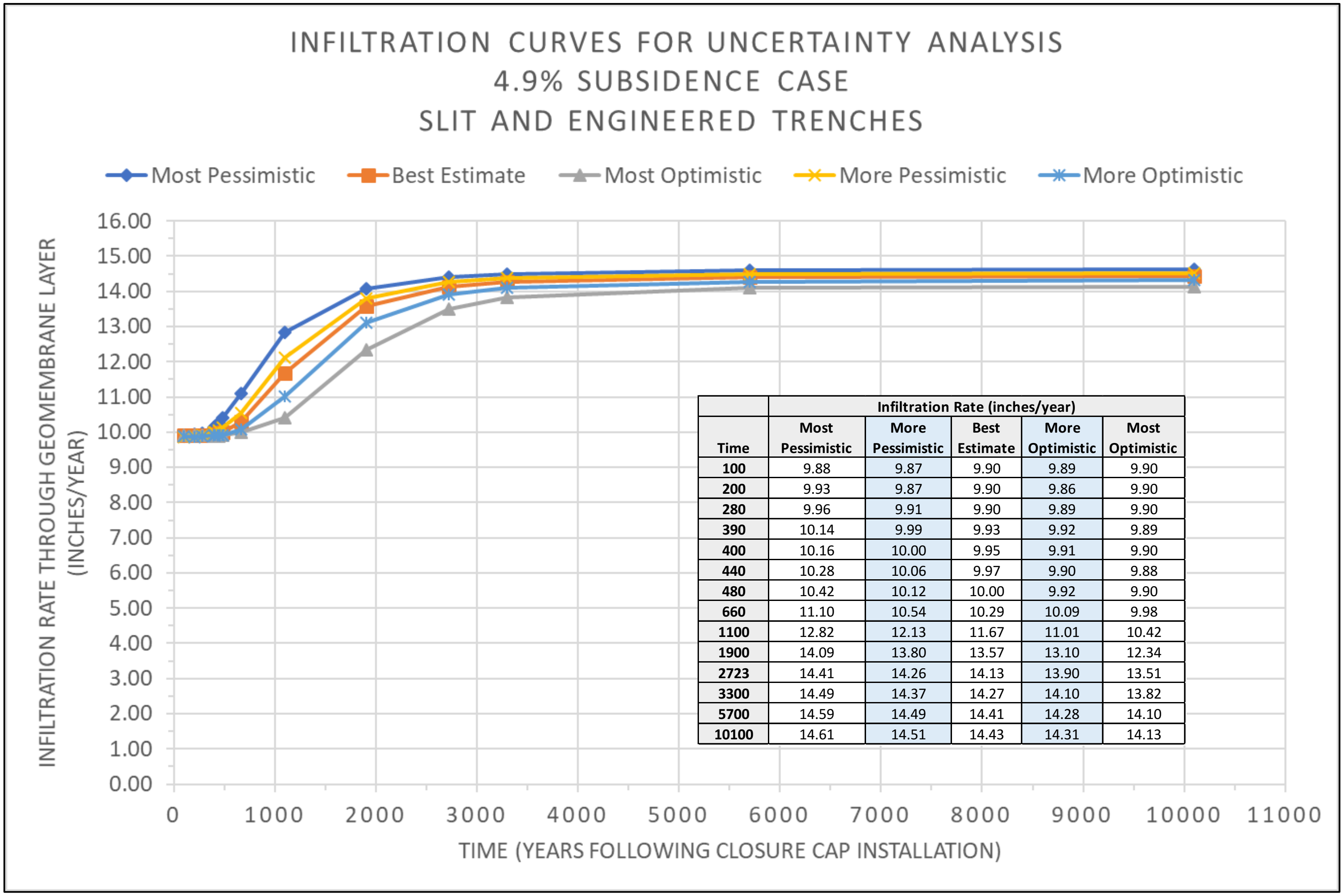
	Infiltration Rate (inches/year)				
Time	Most Pessimistic	More Pessimistic	Best Estimate	More Optimistic	Most Optimistic
100	5.84	5.84	5.84	5.87	5.85
200	5.83	5.83	5.85	5.83	5.82
280	5.93	5.87	5.85	5.85	5.86
390	6.24	5.98	5.91	5.88	5.84
400	6.30	6.00	5.91	5.85	5.84
440	6.45	6.12	5.97	5.92	5.84
480	6.64	6.21	6.04	5.93	5.84
660	7.77	6.90	6.48	6.16	5.95
1100	10.56	9.46	8.68	7.63	6.68
1900	12.60	12.15	11.76	11.02	9.77
2723	13.14	12.88	12.68	12.31	11.68
3300	13.27	13.06	12.91	12.63	12.16
5700	13.43	13.25	13.13	12.92	12.62
10100	13.46	13.29	13.17	12.97	12.67

Figure 2-17. Slit and Engineered Trench Probabilistic Infiltration Rate Profiles for 2% Subsidence Case.



	Infiltration Rate (inches/year)				
Time	Most Pessimistic	More Pessimistic	Best Estimate	More Optimistic	Most Optimistic
100	8.49	8.46	8.47	8.47	8.48
200	8.49	8.45	8.48	8.49	8.45
280	8.57	8.48	8.49	8.49	8.46
390	8.78	8.58	8.53	8.49	8.47
400	8.79	8.60	8.54	8.48	8.47
440	8.95	8.67	8.56	8.51	8.47
480	9.09	8.75	8.64	8.54	8.47
660	9.94	9.25	8.98	8.73	8.53
1100	12.01	11.19	10.61	9.85	9.12
1900	13.57	13.22	12.94	12.36	11.45
2723	13.97	13.78	13.64	13.34	12.86
3300	14.07	13.91	13.79	13.57	13.24
5700	14.19	14.05	13.96	13.80	13.57
10100	14.21	14.09	13.99	13.83	13.62

Figure 2-18. Slit and Engineered Trench Probabilistic Infiltration Rate Profiles for 3.6% Subsidence Case.



	Infiltration Rate (inches/year)				
Time	Most Pessimistic	More Pessimistic	Best Estimate	More Optimistic	Most Optimistic
100	9.88	9.87	9.90	9.89	9.90
200	9.93	9.87	9.90	9.86	9.90
280	9.96	9.91	9.90	9.89	9.90
390	10.14	9.99	9.93	9.92	9.89
400	10.16	10.00	9.95	9.91	9.90
440	10.28	10.06	9.97	9.90	9.88
480	10.42	10.12	10.00	9.92	9.90
660	11.10	10.54	10.29	10.09	9.98
1100	12.82	12.13	11.67	11.01	10.42
1900	14.09	13.80	13.57	13.10	12.34
2723	14.41	14.26	14.13	13.90	13.51
3300	14.49	14.37	14.27	14.10	13.82
5700	14.59	14.49	14.41	14.28	14.10
10100	14.61	14.51	14.43	14.31	14.13

Figure 2-19. Slit and Engineered Trench Probabilistic Infiltration Rate Profiles for 4.9% Subsidence Case.

3.0 Low-Activity Waste Vault (LAWV)

3.1 Planned E-Area LLWF Closure

Operational closure of the LAWV will occur in stages whereby individual cells will be closed as they are filled with stacks of containerized waste and the entire vault will be closed after it is full. Operational closure involves filling the interior collection trench and exterior sump with grout as well as sealing exterior vault openings (including those between modules) with reinforced concrete equivalent to the concrete used for the vault floor, walls and roof. The reinforcing steel will be tied into the reinforcing steel of the vault itself, forming a unified structure with continuous walls. No additional closure actions beyond operational closure are anticipated for the LAWV during the 100-year institutional control period (i.e., interim closure).

Final closure of the LAWV will take place at final closure of the entire E-Area LLWF which will occur at the end of the 100-year institutional control period. Final closure will consist of installation of an integrated closure system designed to minimize moisture contact with the waste and to provide an intruder deterrent. The integrated closure system will consist of a multilayer soil-geomembrane closure cap installed over all the disposal units as described in more detail below as well as a run-off drainage system. The crest lines of the closure cap will be approximately centered over the long and short axes of the vault and sloped a minimum 1.3% away from the apex to minimize the overburden loads on the vault and maximize runoff and lateral drainage from the overlying closure cap.

Following installation of the final closure cap, but before vault structural failure, the final closure cap, along with the structurally intact concrete vault, will minimize infiltration into the vault. During this period, the hydraulic properties of the closure cap are assumed to degrade, resulting in increased infiltration through the closure cap over time. In addition, cracks are assumed to develop in the roof slab upon placement of the closure cap load, resulting in increased infiltration through the vault roof (Jones and Phifer, 2007).

3.2 LAWV Infiltration Scenario

The LAWV is positioned parallel to and between the future ET05 and ET06 (originally ST15 and ST16) footprints. The same Bahia grass case with two percent slope and 585-foot slope length assumed for the Slit and Engineered Trenches will also represent an upper bound on intact infiltration rates for the portions of the closure cap over the LAWV as shown in Figure 3-1. The final closure cap design above the LAWV will include the following layers from bottom to top:

- Foundation layer (minimal thickness)
- Blended soil-bentonite layer (12 inches)
- GCL (200 mil)
- HDPE geomembrane (60 mil)
- Geotextile filter fabric (100 mil)
- Lateral drainage layer (12 inches)
- Geotextile filter fabric (100 mil)
- Erosion barrier (12 inches)
- Upper backfill layer (30 inches)

- Topsoil (6 inches)

The earthen foundation layer thickness above the LAWV will be minimal as shown in Figure 3-1 because the waste below is encased in a concrete vault enclosure with a concrete roof. As depicted in Figure 3-2, the vault consists of two-foot thick, cast-in-place, reinforced, interior and exterior concrete walls structurally mated to a continuous 30-inch thick footer and a 16-inch thick concrete roof fabricated from 3-½ inch thick precast deck panels overlaid by a 12-½ inch thick cast-in-place, reinforced concrete slab. At operational closure, openings will be sealed with reinforced concrete, a bonded-in-place layer of fiberboard insulation and a layer of waterproof membrane roofing will be placed on top of the roof slab, and a gutter/downspout system will be added to drain the roof. In addition, the average closure cap thickness above the LAWV will be maintained at nine feet or less to satisfy differential settlement and maximum seismic load considerations.

Version 4.0 of the HELP model (Dixon, 2017) was used to generate the desired infiltration rate time profiles for both on-vault and off-vault locations as described by Jones and Phifer (2007) and McDowell-Boyer et al. (2011). On-vault locations refer to those areas overlying the vault roof; off-vault locations

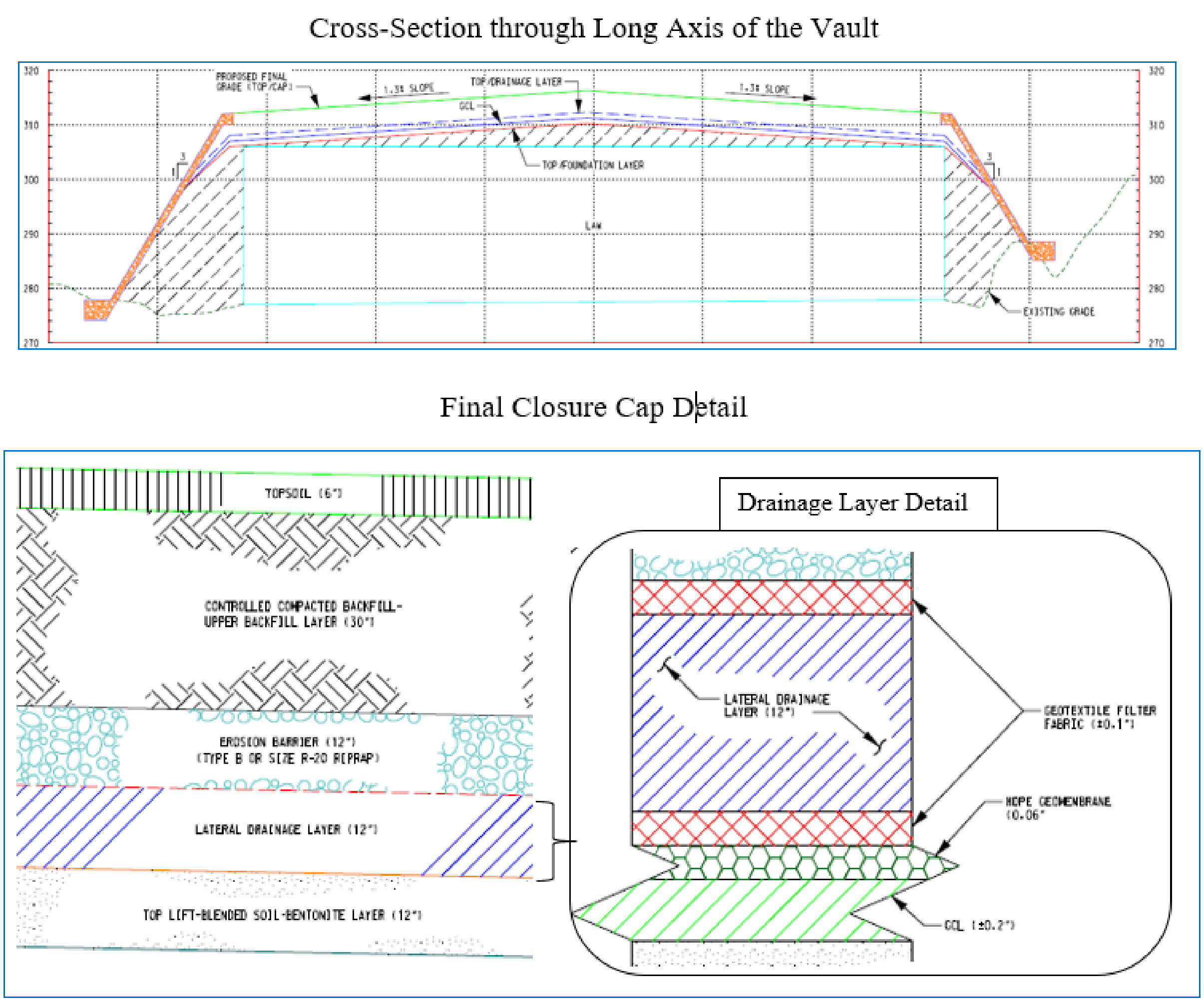


Figure 3-1. LAWV Disposal Unit Final Closure Cap Configuration (C-CT-E-00084, 2016).

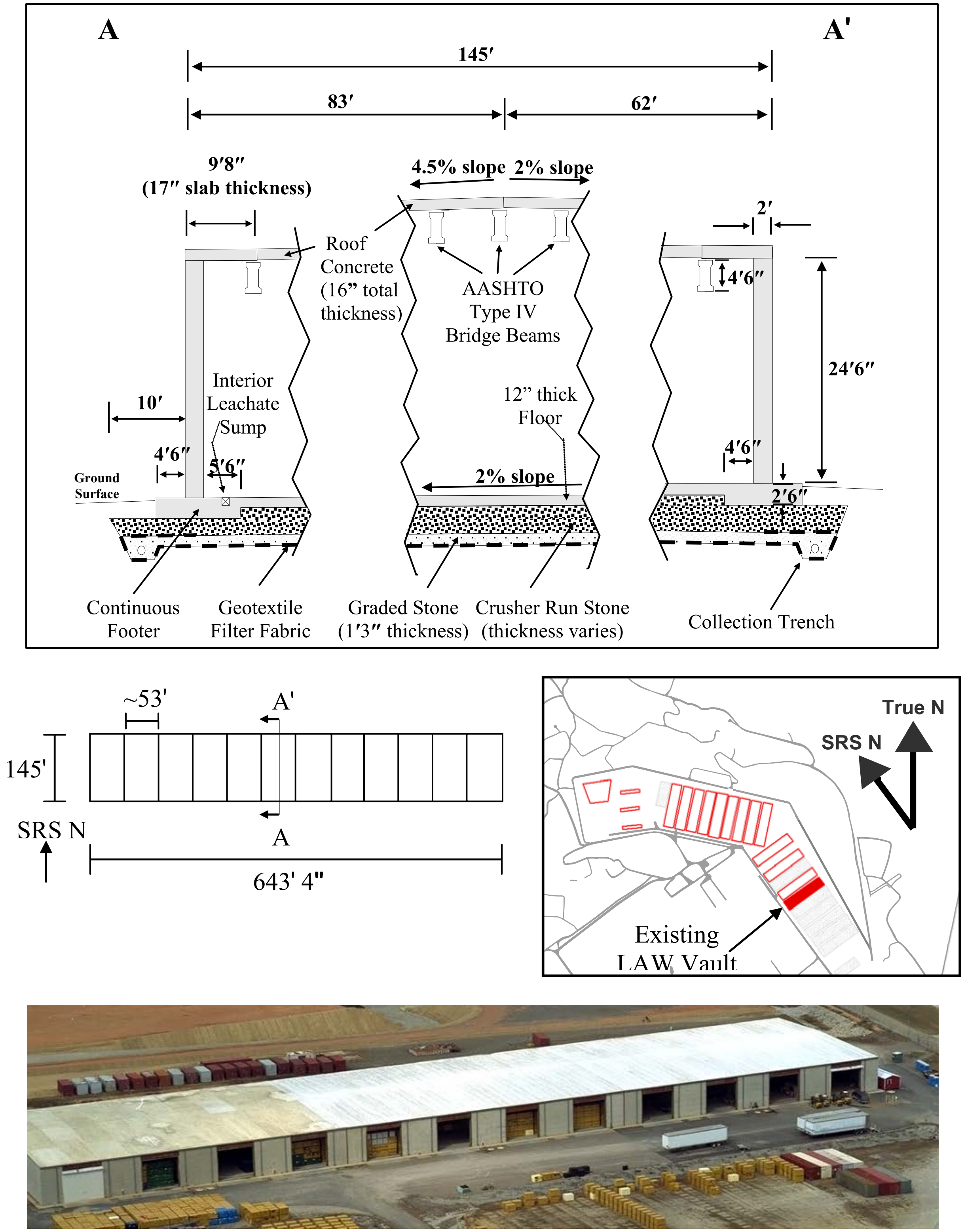


Figure 3-2. LAWV Cross-Sectional (A-A′) and Aerial Views.

refer to the areas adjacent to the vault sides which were modeled to determine whether subsurface drainage from the roof would sufficiently move through the lowermost backfill (Jones and Phifer, 2007). The infiltration profiles assume collapse of the LAWV roof 2,805 years after final closure and are based on the same degradation scenario for the final closure cap that was assumed for the Slit and Engineered Trenches. In contrast to the four-foot soil operational cover and HDPE interim cover for the Slit and Engineered Trenches, infiltration simulations for the operational and institutional control periods for the LAWV on-vault scenario are based on a 12.5-inch thick concrete roof of low permeability.

The simulation period for the LAWV was relative Year 100 to relative Year 10,100, where relative Year 100 is the installation date of the final closure cap. The actual period of performance for the PA is 1,000 years following final closure (i.e., relative Year 1,100); however, infiltration estimates were extended to relative Year 10,100 to capture roof collapse at relative Year 2,905 and to be consistent with the simulation period for Slit and Engineered Trenches. Dyer and Flach (2018) and Phifer et al. (2007) describe in greater detail the formulation and execution of the HELP model for the intact closure cap infiltration cases, including degradation assumptions for the barrier and lateral drainage layers.

During the operational and institutional control periods, water entrance into the LAWV is minimized through the vault subdrain system, the minimum 24-inch thick concrete walls, and the 16-inch thick concrete slab roof with bonded-in-place fiberboard insulation covered by a layer of waterproof membrane roofing (Jones and Phifer, 2007). Any water that enters the vault is intercepted by the individual cell floor collection systems. This results in essentially zero infiltration through the waste during the operational and institutional control periods. Infiltration through the permanent reinforced concrete roof slab was modeled in HELP assuming the waterproof membrane roofing was not in place.

Upon structural failure of the LAWV roof at relative Year 2,905, the conservative assumption is that the roof collapses into the vault and the overlying closure cap subsides. Closure cap subsidence results in the cap losing its runoff and drainage layer functionality together with a decrease in evapotranspiration in the subsided area. Increased infiltration will occur through the portion of the closure cap overlying the collapsed LAWV (Jones and Phifer, 2007). Jones and Phifer (2007) calculated the subsidence potential to be approximately 21 feet.

HELP v4.0 model files for the on-vault and off-vault infiltration cases were stored in the parent directory C:\Help4.0 in three separate subdirectories[e] (see Appendix D for a diagram of the file hierarchy):

- C:\Help4.0\Hweather stores input parameters for evapotranspiration calculations (ROOFEVAP.D11, FEVAP.D11, VCOLEVAP.D11) as well as HELP-model-generated weather input files containing 100 years of daily precipitation data (FPREC.D4), daily temperature data (FTEMP.D7), and daily solar radiation data (FSOLAR.D13). Appendix A provides additional background information on weather data input for the HELP model.
- C:\Help4.0\LAW contains the input and output files for each on-vault time step that are stored in separate subdirectories labeled C:\Help4.0\LAW\LAWRF (roof only), C:\Help4.0\LAW\LAW00

[e] The as-written batch execution files embedded in the HELP directories for this data package require the HELP model to be executed from the C: drive. If executed from another directory or drive, then the Python script and the .bat files in the parent directory and each of the subdirectories for each case will need to be edited for the new directory pathway.

(Year 100 cap) through C:\Help4.0\LAW\LAW11 (Year 2,905 cap), and C:\Help4.0\LAW\LAWCLPSE (roof collapse and beyond).

- C:\Help4.0\LAWOFF contains the input and output files for each off-vault time step that are stored in separate subdirectories labeled C:\Help4.0\LAWOFF\LAWOP (operational period, soil only), C:\Help4.0\LAWOFF\LAWIC (institutional control period, soil only), C:\Help4.0\LAWOFF\LAW00 (Year 100 cap) through C:\Help4.0\LAWOFF\LAW11 (Year 2,905 cap), and C:\Help4.0\LAWOFF\LAWCLPSE (roof collapse and beyond).
- C:\Help4.0\Source contains the executable Fortran files for the HELP model.

All infiltration timesteps were executed together by double-clicking the HELP.bat Windows batch file stored in the subdirectories C:\Help4.0\LAW and C:\Help4.0\LAWOFF. Overall summary files labeled LAW.OUT, LAW_DRAINAGE.OUT, LAW_PERC.OUT, and LAW_RUNOFF.OUT were created by double-clicking the Python-based model cat_FC.py stored in the subdirectories C:\Help4.0\LAW and C:\Help4.0\LAWOFF. Output files for each on-vault case were stored in C:\Help4.0\LAW\LAWxx\Output, where xx is RF, 00 through 11, or CLPSE. Output files for each individual off-vault case were stored in C:\Help4.0\LAWOFF\LAWxx\Output, where xx is OP, IC, 00 through 11, or CLPSE.

HELP model simulations for the on-vault scenario treat the 12-inch thick lower backfill layer just above the vault roof as a lateral drainage layer with a conservative two percent slope and 62-foot slope length (north side roof) based on analyses completed by Jones and Phifer (2007). Designating the lower backfill as a drainage layer with backfill hydraulic properties allows water to drain from the roof and avoids the buildup of hydraulic head. The concrete roof slab is treated in the HELP model as a barrier soil liner with an estimated saturated hydraulic conductivity equal to 1.0E-12 cm/sec.

Jones and Phifer (2007) describe in detail the conceptual model for the off-vault simulations of the LAWV using the HELP model. The off-vault simulation region of interest is the soil backfill adjacent to and within ten feet of the north and south sides (long axis) of the LAWV. The purpose of the off-vault simulations is to confirm that subsurface drainage (runoff) from the concrete vault roof will adequately drain through the lowermost backfill layers adjacent to the vault walls. An off-vault width of ten feet represents one half of the approximately 20-foot distance between the LAWV and the neighboring Slit Trenches. The differences in model setup between the on-vault and off-vault simulations (based on relative Year 100 nondegraded closure cap case) are:

- On-Vault Layers 8 and 9 (24-inch Foundation Layer (1E-03) and 12-inch Lower Drainage Layer) in the on-vault simulations are combined for the off-vault simulations into a single 36-inch vertical-percolation foundation layer (Off-Vault Layer 8) with identical material and hydraulic properties.
- On-Vault Layer 10 (Concrete Roof Slab) in the on-vault simulations is changed for the off-vault simulations to a 12.5-inch thick barrier soil liner (Off-Vault Layer 9) with the same material and hydraulic properties as the 36-inch thick Foundation Layer (1E-03) above.
- A 298-inch thick vertical percolation layer with same properties as Foundation Layer (1E-03) above is added to represent backfill material extending from the bottom of Off-Vault Layer 9 to

the vault's construction grade. The total thickness of the layer is the rounded sum of the vault's wall height to the bottom of the roof edge (24.5 feet, Figure 3-2 cross-section A-A') and the thickness of the roof's precast deck panels (3.5 inches = 16-inch total roof thickness less 12.5-inch concrete slab).

- Drainage off the concrete roof (On-Vault Layer 9) in the on-vault simulations is added as a subsurface inflow (run-on) to Layer 8 in the time-equivalent off-vault simulations. Due to the difference in surficial drainage area and to conserve mass, the subsurface drainage flux (inches per year) must be multiplied by the roof-to-off-vault width ratio (62 feet/10 feet = 6.2) to obtain the subsurface inflow flux for the off-vault simulations. Appendix D includes a tabular summary of the subsurface inflow inputs to Off-Vault Layer 8 for the off-vault simulations.

Table 3-1 lists technical reports relevant to the calculation of infiltration rates for the LAWV. Appendix D contains the HELP model input parameter data sheets for each time step for both the on-vault and off-vault cases. Table 3-2 and Table 3-3 summarize the infiltration rates for the LAWV on-vault and off-vault cases, respectively, from the operational period through roof collapse at relative Year 2,905 and beyond. Included in Table 3-2 and Table 3-3 are the HELP model input (xx.D10), output (xx.OUT), and weather input data (xx.D4, xx.D7, xx.D11, xx.D13) filenames corresponding to each time step. Reported infiltration rates from the HELP model are temporally (annually) and spatially (585-foot total slope length) averaged.

Table 3-1. Technical Reports Relevant to the Calculation of Infiltration Rates for the LAWV.

Report Number	Authors/Year	Title	Relevance
SRNL-STI-2017-00104, Rev. 0	Dixon, K. L. (2017)	HELP 4.0 Documentation Updates for Software and Data	HELP model adaptations to run on Windows 10
WSRC-TR-2005-00405, Rev. 0	Jones, W. E., and Phifer, M. A. (2007)	E-Area Low-Activity Waste Vault Subsidence Potential and Closure Cap Performance (U).	Conceptual approach for calculating infiltration rates for the LAWV
SRNL-STI-2010-00618, Rev. 0	McDowell-Boyer et al. (2011)	Data Package for HELP Models used in the E-Area Low-Level Waste Facility Performance Assessment	Infiltration rates used in 2008 E-Area PA for the LAWV
SRNL-RP-2009-00075, Rev. 0	Phifer, M. A. et al. (2009)	Closure Plan for the E-Area Low-Level Waste Facility	Operational and interim closure covers

Table 3-2. LAWV Infiltration Rates and Associated HELP Model Input and Output Files: On-Vault Case.

Relative Year [1]	Period	HELP Model Input, Output, and Weather Files [2]	PC Directory Location for Execution	Infiltration Rate Reported for Layer [3]	On-Vault Infiltration Rate (inches/year)
-40 to 0	Operational	LAWRF.D10 LAWRF.OUT ROOFEVAP.D11 [2]	C:\Help4.0\LAW\LAWRF	Concrete Roof	0.0
0 to 100	Institutional Control	LAWRF.D10 LAWRF.OUT ROOFEVAP.D11 [2]	C:\Help4.0\LAW\LAWRF	Concrete Roof	0.0
100	Closure Cap	LAW00.D10 LAW00.OUT	C:\Help4.0\LAW\LAW00	Geomembrane	0.00081
180	Closure Cap	LAW01.D10 LAW01.OUT	C:\Help4.0\LAW\LAW01	Geomembrane	0.007
290	Closure Cap	LAW02.D10 LAW02.OUT	C:\Help4.0\LAW\LAW02	Geomembrane	0.16
300	Closure Cap	LAW03.D10 LAW03.OUT	C:\Help4.0\LAW\LAW03	Geomembrane	0.18
340	Closure Cap	LAW04.D10 LAW04.OUT	C:\Help4.0\LAW\LAW04	Geomembrane	0.30
380	Closure Cap	LAW05.D10 LAW05.OUT	C:\Help4.0\LAW\LAW05	Geomembrane	0.38
480	Closure Cap	LAW06.D10 LAW06.OUT	C:\Help4.0\LAW\LAW06	Geomembrane	1.39
660	Closure Cap	LAW07.D10 LAW07.OUT	C:\Help4.0\LAW\LAW07	Geomembrane	3.23
1,100	Closure Cap	LAW08.D10 LAW08.OUT	C:\Help4.0\LAW\LAW08	Geomembrane	6.82

Table 3-2 (Cont'd). LAWV Infiltration Rates and Associated HELP Model Input and Output Files: On-Vault Case.

Relative Year [1]	Period	HELP Model Input, Output, and Weather Files [2]	PC Directory Location for Execution	Infiltration Rate Reported for Layer [3]	On-Vault Infiltration Rate (inches/year)
1,900	Closure Cap	LAW09.D10 LAW09.OUT	C:\Help4.0\LAW\LAW09	Geomembrane	10.24
2,723	Closure Cap	LAW10.D10 LAW10.OUT	C:\Help4.0\LAW\LAW10	Geomembrane	11.10
2,905	Closure Cap	LAW11.D10 LAW11.OUT	C:\Help4.0\LAW\LAW11	Geomembrane	11.13
2,905 and Beyond	Roof Collapse	LAWCLPSE.D10 LAWCLPSE.OUT VCOLEVAP.D11 [2]	C:\Help4.0\LAW\LAWCLPSE	Collapsed Cap	18.89

1 Year 0: Beginning of institutional control period. Year 100: End of institutional control period; installation date of final closure cap.

2 HELP Weather files are FPREC.D4, FTEMP.D7, FEVAP.D11, and FSOLAR.D13 except where noted in the table.

3 On-vault infiltration rates for the geomembrane layer represent the volumetric flux of water that will percolate vertically downward to the sloped concrete roof and drain horizontally to the roof edges. In HELP model simulations of the intact closure cap, the predicted percolation rate through the concrete slab roof is essentially zero. As a result, 100 percent of the water that percolates through the geomembrane layer above the LAWV will drain to the roof edges and becomes an inflow (subsurface run-on) for the off-vault infiltration simulations. When setting the upper boundary condition for the PORFLOW vadose-zone simulations, it is important to consider the conservation of mass because the "Soil Next to Vault Roof" off-vault infiltration rates reported in Table 3-3 include the on-vault geomembrane drainage flux.

Table 3-3. LAWV Infiltration Rates and Associated HELP Model Input and Output Files: Off-Vault Case.

Relative Year [1]	Period	HELP Model Input, Output, and Weather Files [2]	PC Directory Location for Execution	Infiltration Rate Reported for Layer [3]	Off-Vault Infiltration Rate (inches/year)
-40 to 0	Operational	LAWOP.D10 LAWOP.OUT VCOLEVAP.D11 [2]	C:\Help4.0\LAWOFF\LAWOP	Off-Vault Ground Surface	16.17
0 to 100	Institutional Control	LAWIC.D10 LAWIC.OUT VCOLEVAP.D11 [2]	C:\Help4.0\LAWOFF\LAWIC	Off-Vault Ground Surface	16.17
100	Closure Cap	LAW00.D10 LAW00.OUT	C:\Help4.0\LAWOFF\LAW00	Geomembrane	0.00081
				Soil Next to Vault Roof	0.00571
180	Closure Cap	LAW01.D10 LAW01.OUT	C:\Help4.0\LAWOFF\LAW01	Geomembrane	0.0070
				Soil Next to Vault Roof	0.047
290	Closure Cap	LAW02.D10 LAW02.OUT	C:\Help4.0\LAWOFF\LAW02	Geomembrane	0.16
				Soil Next to Vault Roof	1.12
300	Closure Cap	LAW03.D10 LAW03.OUT	C:\Help4.0\LAWOFF\LAW03	Geomembrane	0.18
				Soil Next to Vault Roof	1.21
340	Closure Cap	LAW04.D10 LAW04.OUT	C:\Help4.0\LAWOFF\LAW04	Geomembrane	0.30
				Soil Next to Vault Roof	2.09
380	Closure Cap	LAW05.D10 LAW05.OUT	C:\Help4.0\LAWOFF\LAW05	Geomembrane	0.38
				Soil Next to Vault Roof	2.65
480	Closure Cap	LAW06.D10 LAW06.OUT	C:\Help4.0\LAWOFF\LAW06	Geomembrane	1.39
				Soil Next to Vault Roof	9.87
660	Closure Cap	LAW07.D10 LAW07.OUT	C:\Help4.0\LAWOFF\LAW07	Geomembrane	3.23
				Soil Next to Vault Roof	23.09
1,100	Closure Cap	LAW08.D10 LAW08.OUT	C:\Help4.0\LAWOFF\LAW08	Geomembrane	6.82
				Soil Next to Vault Roof	48.80

Table 3-3 (Cont'd). LAWV Infiltration Rates and Associated HELP Model Input and Output Files: Off-Vault Case.

Relative Year [1]	Period	HELP Model Input, Output, and Weather Files [2]	PC Directory Location for Execution	Infiltration Rate Reported for Layer [3]	Off-Vault Infiltration Rate (inches/year)
1,900	Closure Cap	LAW09.D10 LAW09.OUT	C:\Help4.0\LAWOFF\LAW09	Geomembrane	10.24
				Soil Next to Vault Roof	73.37
2,723	Closure Cap	LAW10.D10 LAW10.OUT	C:\Help4.0\LAWOFF\LAW10	Geomembrane	11.10
				Soil Next to Vault Roof	79.49
2,905	Closure Cap	LAW11.D10 LAW11.OUT	C:\Help4.0\LAWOFF\LAW11	Geomembrane	11.13
				Soil Next to Vault Roof	79.72
2,905 and Beyond	Roof Collapse	LAWCLPSE.D10 LAWCLPSE.OUT	C:\Help4.0\LAWOFF\LAWCLPSE	Geomembrane	11.13
				Soil Next to Vault Roof	11.11 [4]

1 Year 0: Beginning of institutional control period. Year 100: End of institutional control period; installation date of final closure cap.

2 HELP Weather files are FPREC.D4, FTEMP.D7, FEVAP.D11, and FSOLAR.D13 except where noted in the table.

3 For the off-vault case, vertical infiltration rates are reported at two elevations: the cap geomembrane layer above and the soil backfill layer below at the same elevation as the outside edge of the sloped concrete roof. When setting the upper boundary condition for the PORFLOW vadose-zone simulations, it is important to consider the conservation of mass because the "Soil Next to Vault Roof" off-vault infiltration rates reported above include the on-vault "Geomembrane" drainage flux. In addition, HELP model simulations of the intact closure cap predict that the percolation rate through the concrete slab roof is essentially zero. If PORFLOW simulations of the LAWV assume nonzero leakage through cracks in the concrete roof, then the "Soil Next to Vault Roof" infiltration rates at each time step will need to be lowered by (62 feet/10 feet) x (concrete slab leakage flux in inches/year).

4 The off-vault infiltration rate through the backfill soil adjacent to the vault roof decreases significantly after roof collapse because there is no longer any on-vault lateral drainage (subsurface run-on) from the sloped concrete roof.

4.0 Intermediate-Level Vault (ILV)

4.1 Planned E-Area LLWF Closure

The ILV is a below-grade, reinforced concrete vault with two modules: Intermediate-Level Tritium (ILT) module containing two cells and Intermediate-Level Non-Tritium (ILNT) module containing seven cells. Together, the two modules comprise a footprint of 279 feet by 48 feet. The ILV is located to the south of Slit Trenches 08 and 09 as indicated in Figure 4-1.

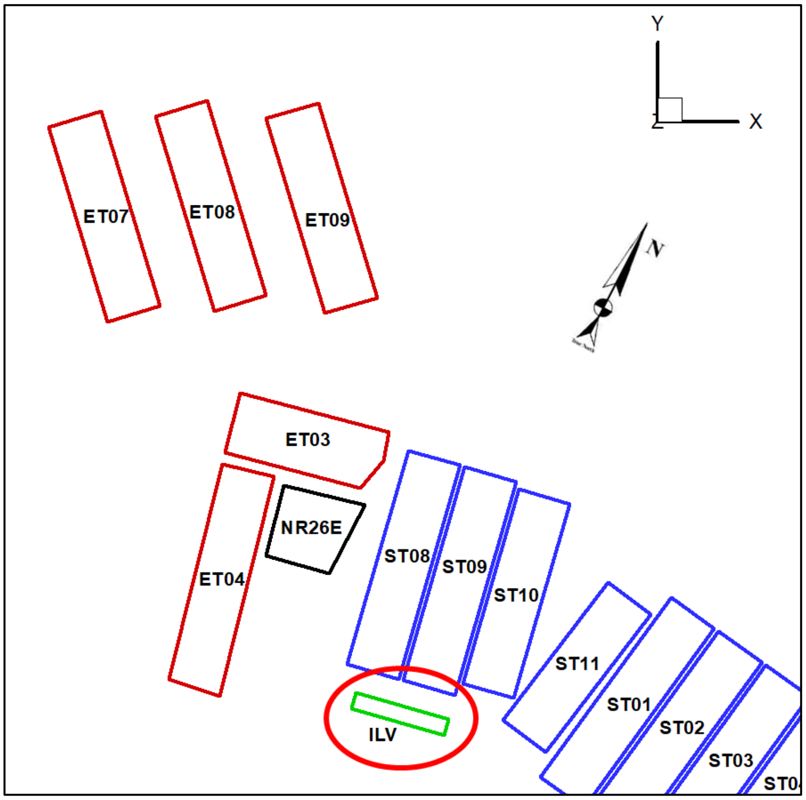


Figure 4-1. E-Area LLWF Layout showing location of the ILV (Hamm, 2019).

The ILV was constructed with 30-inch thick, reinforced concrete exterior end walls, 24-inch thick, reinforced concrete exterior side walls, and 18-inch thick, reinforced concrete interior walls as depicted in Figure 4-2. The walls have no horizontal joints and are structurally mated to a 30-inch thick, reinforced concrete base slab that extends two feet beyond the exterior walls. The floor of each cell slopes to a drain which runs to a sump in the base slab of each cell, and it is overlain by a minimum 14-inch graded stone drainage layer. Sloped rain covers, consisting of a roofing membrane on a metal deck on steel framing installed over each cell, are used to direct rainwater onto the ground for runoff as shown in Figure 4-3. The sloped rain covers are used during the operational period only and will be replaced with a permanent concrete roof after operations cease. The sloped rain covers and permanent concrete roof slope downward toward ST08 and ST09 from south to north.

Operational closure of the ILV will occur in stages. ILT Cell #1 will be operationally closed by placing a three-foot, one-inch thick final layer of grout level with the top of the interior ILV wall. The installed silo

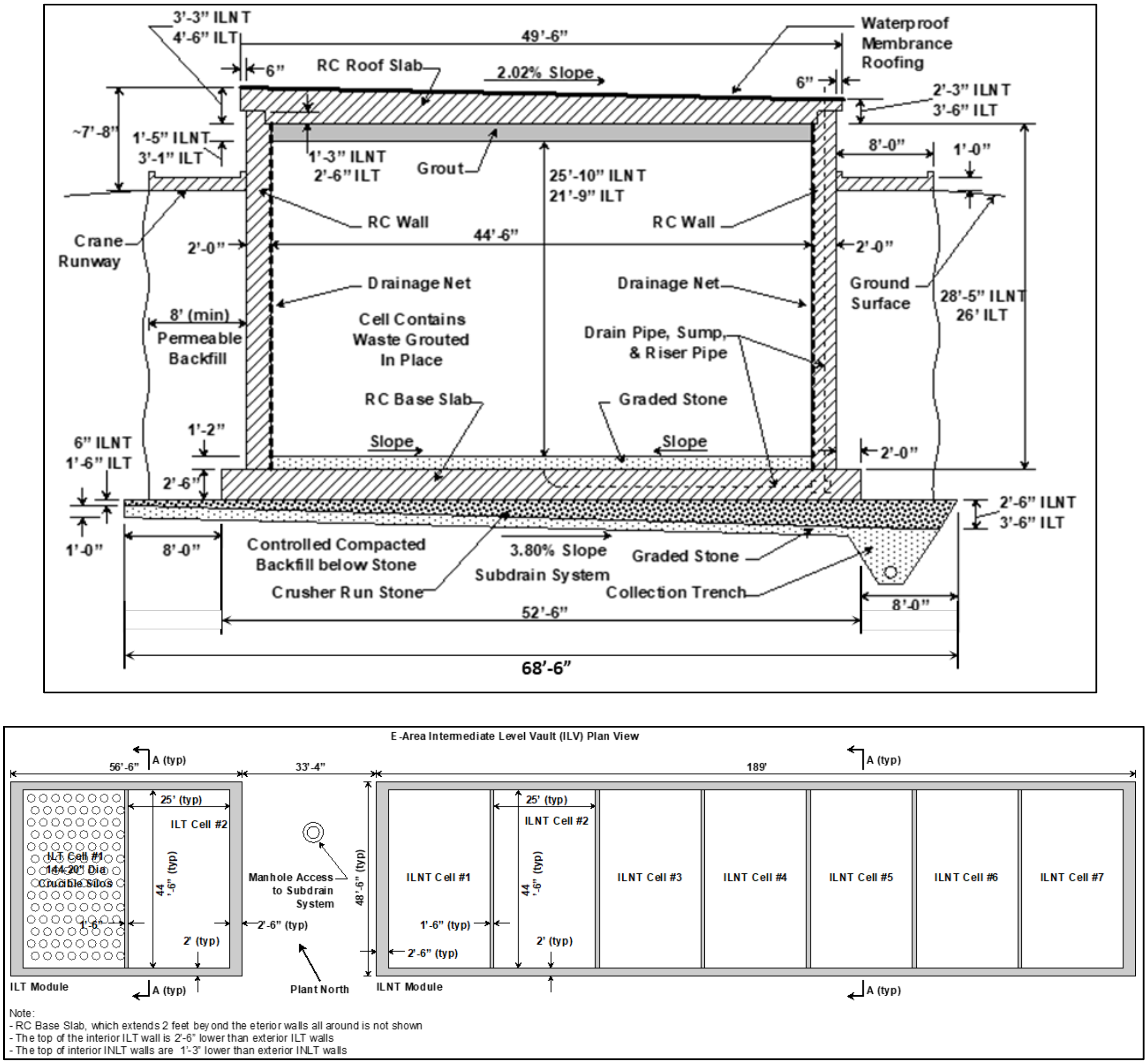


Figure 4-2. Plan, and Cross-Sectional (A-A) Views of the ILV.

shielding plugs will remain in place within the final grout layer. ILT Cell #2 and ILNT Cells #1 through #7 will be operationally closed as they are filled with waste by removing any shielding tees and placing a one-foot, five-inch thick final layer of grout level with the top of the interior ILV walls. After the entire ILT module has been filled, it will be operationally closed by installing a three-foot, six-inch to four-foot, six-inch permanent reinforced concrete roof slab and overlying bonded-in-place fiberboard insulation and waterproof membrane roofing over the entire module. After the entire ILNT module has been filled, it will be operationally closed by installing a two-foot, three-inch to three-foot, three-inch permanent reinforced concrete roof slab and overlying bonded-in-place fiberboard insulation and waterproof membrane roofing over the entire module. The rain covers, shielding tees, and unused shielding plugs will no longer be required after installation of the permanent roof slab. No additional closure actions beyond operational closure are anticipated for the ILV during the 100-year institutional control period (i.e., interim closure).

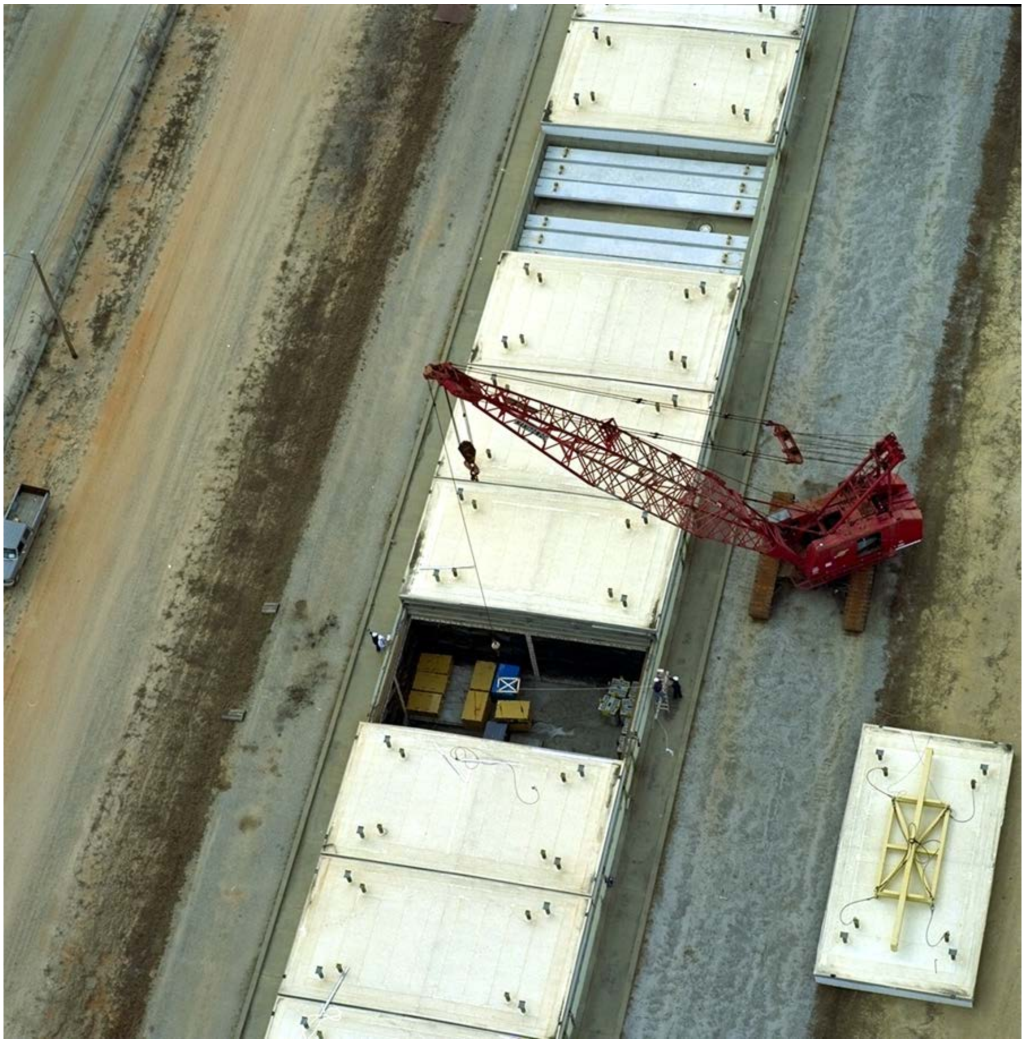


Figure 4-3. Aerial View of the ILV.

Final closure of the ILV will take place at final closure of the entire E-Area LLWF which will occur at the end of the 100-year institutional control period. Final closure will consist of installation of an integrated closure system designed to minimize moisture contact with the waste and to provide an intruder deterrent. The integrated closure system will consist of a multilayer soil-geomembrane closure cap installed over all the disposal units as described in more detail below as well as a run-off drainage system. The closure cap will have a two percent slope perpendicular to the long axis of the ILV to minimize the overburden loads on the vault and maximize runoff and lateral drainage from the overlying closure cap. In addition, the average closure cap thickness above the LAWV will be maintained at nine feet or less to satisfy differential settlement and maximum seismic load considerations.

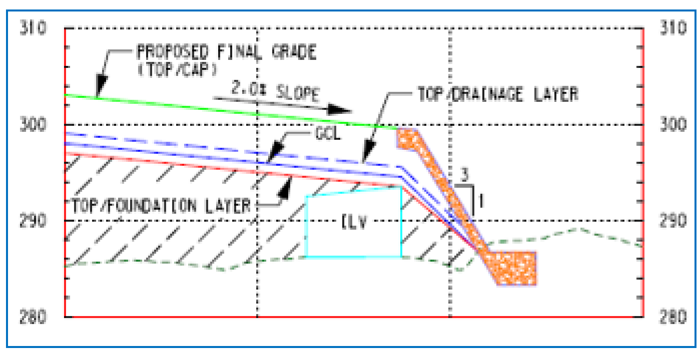
Following installation of the final closure cap but before vault structural failure, the final closure cap and the structurally intact concrete vault will minimize infiltration into the vault. During this period, the hydraulic properties of the closure cap are assumed to degrade, resulting in increased infiltration through the closure cap over time. In addition, cracks are assumed to develop in the roof slab upon placement of the closure cap load, resulting in increased infiltration through the vault roof (Jones and Phifer, 2007).

4.2 ILV Infiltration Scenario

Based on its size and location (Figure 4-4), the intact infiltration model of the proposed ILV final closure cap design assumed a Bahia grass vegetative cover, two percent slope, and 250-foot maximum slope length. The final cover will include the following layers from bottom to top:

- Foundation layer (minimal thickness)
- Blended soil-bentonite layer (12 inches)
- GCL (200 mil)
- HDPE geomembrane (60 mil)
- Geotextile filter fabric (100 mil)
- Lateral drainage layer (12 inches)
- Geotextile filter fabric (100 mil)
- Erosion barrier (12 inches)
- Upper backfill layer (30 inches)
- Topsoil (6 inches)

Cross-Section through Short Axis of the Vault



Final Closure Cap Detail

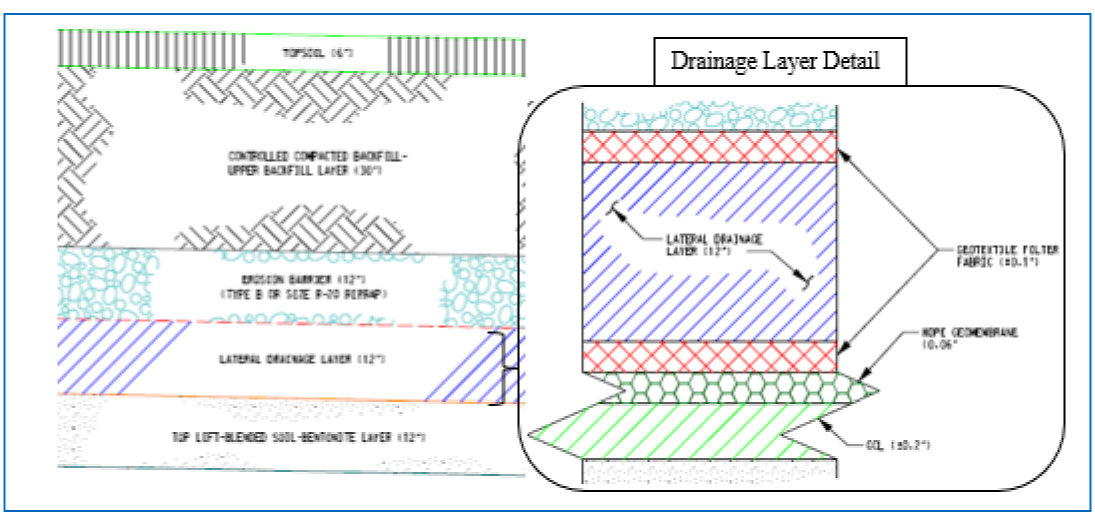


Figure 4-4. ILV Disposal Unit Final Closure Cap Configuration (C-CT-E-00084, 2016).

The earthen foundation layer thickness above the vault will be minimal as shown in Figure 4-4 because the waste below is encased in a concrete vault enclosure with a concrete slab roof. A thickness of 27 inches (minimum roof slab thickness shown in Figure 4-2) was assumed for the concrete slab roof layer in the HELP model simulations.

Version 4.0 of the HELP model (Dixon, 2017) was used to generate the desired infiltration rate time profiles for both on-vault and off-vault locations in a manner similar to what was reported by McDowell-Boyer et al. (2011) for the 2008 E-Area LLWF PA. On-vault locations refer to those areas overlying the vault roof; off-vault locations refer to the 10-foot wide area adjacent to the downslope (northern) side of the vault which was modeled to determine whether subsurface drainage from the roof would sufficiently move through the lowermost backfill (Jones and Phifer, 2007). The infiltration profiles assume collapse of the ILV roof 7,000 years after final closure and are based on the same degradation scenario for the final closure cap that was assumed for the Slit and Engineered Trenches. In contrast to the four-foot soil operational cover and HDPE interim cover for the Slit and Engineered Trenches, infiltration simulations for the operational and institutional control periods for the ILV on-vault scenario are based on a 27-inch thick concrete roof of low permeability.

The simulation period for the ILV was relative Year 100 to relative Year 10,100, where relative Year 100 is the installation date of the final closure cap. The actual period of performance for the PA is 1,000 years following final closure (i.e., relative Year 1,100); however, infiltration estimates were extended to relative Year 10,100 to capture roof collapse at relative Year 7,100 and to be consistent with the simulation period for Slit and Engineered Trenches. Dyer and Flach (2018) and Phifer et al. (2007) describe in greater detail the formulation and execution of the HELP model for the intact closure cap infiltration cases, including degradation assumptions for the barrier and lateral drainage layers.

During the operational and institutional control periods, water entrance into the ILV is minimized through the vault subdrain system, minimum 24-inch thick concrete walls, and sloped roof cover (i.e., temporary sloped metal rain cover with roofing membrane over each cell during the operational period or a minimum 27-inch thick concrete slab roof with bonded-in-place fiberboard insulation covered by a layer of waterproof membrane roofing during institutional control). Any water that enters the vault is intercepted by the individual cell floor collection systems. This results in essentially zero infiltration through the waste during the operational and institutional control periods. Infiltration through the permanent reinforced concrete roof slab was modeled in HELP assuming the waterproof membrane roofing was not in place.

McDowell-Boyer et al. (2011) conservatively assumed that upon structural failure at relative Year 7,100, the ILV roof will collapse into the interior of the vault followed by subsidence of the overlying final closure cover. Subsidence of the closure cover results in the loss of its runoff and drainage layer functionality together with a decrease in evapotranspiration in the subsided area. In addition, because of its positioning under the E-Area cap relative to other disposal units, surface run-off and lateral drainage from the upslope intact closure cap will drain into the subsided ILV area. A footnote associated with Table E-18 in Appendix E shows how this subsurface run-on flux was calculated. Increased infiltration will occur through the portion of the subsided closure cap overlying the collapsed ILV. WSRC (2008) reports a subsidence potential of 19 feet for the ILV.

HELP v4.0 model files for the on-vault and off-vault infiltration cases were stored in the parent directory C:\Help4.0 in three separate subdirectories[f] (see Appendix E for a diagram of the file hierarchy):

- C:\Help4.0\Hweather stores input parameters for evapotranspiration calculations (ROOFEVAP.D11, FEVAP.D11, VCOLEVAP.D11) as well as HELP-model-generated weather input files containing 100 years of daily precipitation data (FPREC.D4), daily temperature data (FTEMP.D7), and daily solar radiation data (FSOLAR.D13). Appendix A provides additional background information on weather data input for the HELP model.
- C:\Help4.0\ILV contains input and output files for each on-vault time step stored in separate subdirectories labeled C:\Help4.0\ILV\ILVRF (roof only), C:\Help4.0\ILV\ILV00 (Year 100 cap) through C:\Help4.0\ILV\ILV14 (Year 7,100 cap), and C:\Help4.0\ILV\ILVCLPSE (roof collapse and beyond).
- C:\Help4.0\ILVOFF contains the input and output files for each off-vault time step that are stored in separate subdirectories labeled C:\Help4.0\ILVOFF\ILVOP (operational period, soil only), C:\Help4.0\ILVOFF\ILVIC (institutional control period, soil only), C:\Help4.0\ILVOFF\ILV00 (Year 100 cap) through C:\Help4.0\ILVOFF\ILV14 (Year 7,100 cap), and C:\Help4.0\ILVOFF\ILVCLPSE (roof collapse and beyond).
- C:\Help4.0\Source contains the executable Fortran files for the HELP model.

All infiltration timesteps were executed together by double-clicking the HELP.bat Windows batch file stored in the subdirectories C:\Help4.0\ILV and C:\Help4.0\ILVOFF. Overall summary files labeled ILV.OUT, ILV_DRAINAGE.OUT, ILV_PERC.OUT, and ILV_RUNOFF.OUT were created by double-clicking the Python-based model cat_FC.py stored in the subdirectories C:\Help4.0\ILV and C:\Help4.0\ILVOFF. Output files for each on-vault case were stored in C:\Help4.0\ILV\ILVxx\Output, where xx is RF, 00 through 14, or CLPSE. Output files for each individual off-vault case were stored in C:\Help4.0\ ILVOFF\ILVxx\Output, where xx is OP, IC, 00 through 14, or CLPSE.

HELP simulations for the on-vault scenario treat the 12-inch thick lower backfill layer just above the vault roof as a lateral drainage layer with two percent slope and 49.5-foot slope length (Figure 4-2) as was similarly done for the LAWV by Jones and Phifer (2007). Designating the lower backfill as a drainage layer with backfill hydraulic properties allows water to drain from the roof and avoids the buildup of hydraulic head. The concrete roof slab is treated in the HELP model as a barrier soil liner with an estimated saturated hydraulic conductivity equal to 1.0E-12 cm/sec.

The off-vault simulations of the ILV using the HELP model were executed using the same conceptual model as described by Jones and Phifer (2007) for the LAWV. The off-vault simulation region of interest is the soil backfill adjacent to and within ten feet of the north side (long axis) of the ILV. The purpose of the off-vault simulations is to confirm that subsurface drainage (runoff) from the concrete vault roof will adequately drain through the lowermost backfill layers adjacent to the vault wall. The differences in

[f] The as-written batch execution files embedded in the HELP directories for this data package require the HELP model to be executed from the C: drive. If executed from another directory or drive, then the Python script and the .bat files in the parent directory and each of the subdirectories for each case will need to be edited for the new directory pathway.

model setup between the on-vault and off-vault simulations are (based on relative Year 100 nondegraded closure cap case):

- On-Vault Layer 8 (12-inch Lower Drainage Layer) in the on-vault simulations is treated in the off-vault simulations as a 12-inch vertical-percolation backfill foundation layer (Off-Vault Layer 8) with identical material and hydraulic properties.
- On-Vault Layer 9 (Concrete Roof Slab) in the on-vault simulations is changed for the off-vault simulations to a 27-inch thick barrier soil liner (Off-Vault Layer 9) with the same material and hydraulic properties as the 12-inch thick Foundation Layer (1E-03) above.
- A 312-inch thick vertical percolation layer with same properties as Foundation Layer (1E-03) above is added to represent backfill material extending from the bottom of Off-Vault Layer 9 to the vault's construction grade. The layer thickness (26 feet) equals the vault's northside wall height to the bottom of the roof edge for the ILT modules (Figure 4-2, cross-section A-A).
- Drainage off the concrete roof (On-Vault Layer 9) in the on-vault simulations is added as a subsurface inflow (run-on) to Layer 8 in the time-equivalent off-vault simulations. Due to the difference in surficial drainage area and to conserve mass, the subsurface drainage flux (inches per year) must be multiplied by the roof-to-off-vault width ratio (49.5 feet/10 feet = 4.95) to obtain the subsurface inflow flux for the off-vault simulations. Appendix E includes a tabular summary of the subsurface inflow inputs to Off-Vault Layer 8 for the off-vault simulations.

Table 4-1 lists technical reports relevant to the calculation of infiltration rates for the ILV. Appendix E contains the HELP model input parameter data sheets for each time step for both the on-vault and off-vault cases. Table 4-2 and Table 4-3 summarize the infiltration rates for the ILV on-vault and off-vault cases, respectively, from the operational period through roof collapse at relative Year 7,100 and beyond. Included in Table 4-2 and Table 4-3 are the HELP model input (xx.D10), output (xx.OUT), and weather input data (xx.D4, xx.D7, xx.D11, xx.D13) filenames corresponding to each time step. Reported infiltration rates from the HELP model are temporally (annually) and spatially (250-foot total slope length) averaged.

Table 4-1. Technical Reports Relevant to the Calculation of Infiltration Rates for the ILV.

Report Number	Authors/Year	Title	Relevance
SRNL-STI-2017-00104, Rev. 0	Dixon, K. L. (2017)	HELP 4.0 Documentation Updates for Software and Data	HELP model adaptations to run on Windows 10
WSRC-TR-2005-00405, Rev. 0	Jones, W. E., and Phifer, M. A. (2007)	E-Area Low-Activity Waste Vault Subsidence Potential and Closure Cap Performance (U).	Conceptual approach for calculating infiltration rates for the ILV
SRNL-STI-2010-00618, Rev. 0	McDowell-Boyer et al. (2011)	Data Package for HELP Models used in the E-Area Low-Level Waste Facility Performance Assessment	Infiltration rates used in 2008 E-Area PA for ILV
SRNL-RP-2009-00075, Rev. 0	Phifer, M. A. et al. (2009)	Closure Plan for the E-Area Low-Level Waste Facility	Operational and interim closure covers

Table 4-2. ILV Infiltration Rates and Associated HELP Model Input and Output Files: On-Vault Case.

Relative Year [1]	Period	HELP Model Input, Output, and Weather Files [2]	PC Directory Location for Execution	Infiltration Rate Reported for Layer [3]	On-Vault Infiltration Rate (inches/year)
-40 to 0	Operational	ILVRF.D10 ILVRF.OUT ROOFEVAP.D11 [2]	C:\Help4.0\ILV\ILVRF	Removable Metal Roof	0.0
0 to 100	Institutional Control	ILVRF.D10 ILVRF.OUT ROOFEVAP.D11 [2]	C:\Help4.0\ILV\ILVRF	Concrete Roof	0.0
100	Closure Cap	ILV00.D10 ILV00.OUT	C:\Help4.0\ILV\ILV00	Geomembrane	0.00015
180	Closure Cap	ILV01.D10 ILV01.OUT	C:\Help4.0\ILV\ILV01	Geomembrane	0.0009
290	Closure Cap	ILV02.D10 ILV02.OUT	C:\Help4.0\ILV\ILV02	Geomembrane	0.02
300	Closure Cap	ILV03.D10 ILV03.OUT	C:\Help4.0\ILV\ILV03	Geomembrane	0.022
340	Closure Cap	ILV04.D10 ILV04.OUT	C:\Help4.0\ILV\ILV04	Geomembrane	0.08
380	Closure Cap	ILV05.D10 ILV05.OUT	C:\Help4.0\ILV\ILV05	Geomembrane	0.10
480	Closure Cap	ILV06.D10 ILV06.OUT	C:\Help4.0\ILV\ILV06	Geomembrane	0.41
660	Closure Cap	ILV07.D10 ILV07.OUT	C:\Help4.0\ILV\ILV07	Geomembrane	1.18
1,100	Closure Cap	ILV08.D10 ILV08.OUT	C:\Help4.0\ILV\ILV08	Geomembrane	3.86

Table 4-2 (Cont'd). ILV Infiltration Rates and Associated HELP Model Input and Output Files: On-Vault Case.

Relative Year [1]	Period	HELP Model Input, Output, and Weather Files [2]	PC Directory Location for Execution	Infiltration Rate Reported for Layer [3]	On-Vault Infiltration Rate (inches/year)
1,900	Closure Cap	ILV09.D10 ILV09.OUT	C:\Help4.0\ILV\ILV09	Geomembrane	8.68
2,723	Closure Cap	ILV10.D10 ILV10.OUT	C:\Help4.0\ILV\ILV10	Geomembrane	10.60
2,905	Closure Cap	ILV11.D10 ILV11.OUT	C:\Help4.0\ILV\ILV11	Geomembrane	10.64
3,300	Closure Cap	ILV12.D10 ILV12.OUT	C:\Help4.0\ILV\ILV12	Geomembrane	10.71
5,700	Closure Cap	ILV13.D10 ILV13.OUT	C:\Help4.0\ILV\ILV13	Geomembrane	10.89
7,100	Closure Cap	ILV14.D10 ILV14.OUT	C:\Help4.0\ILV\ILV14	Geomembrane	10.94
7,100 and Beyond	Roof Collapse	ILVCLPSE.D10 ILVCLPSE.OUT VCOLEVAP.D11 [2]	C:\Help4.0\ILV\ILVCLPSE	Collapsed Cap	36.85

[1] Year 0: Beginning of institutional control period. Year 100: End of institutional control period; installation date of final closure cap.

[2] HELP Weather files are FPREC.D4, FTEMP.D7, FEVAP.D11, and FSOLAR.D13 except where noted in the table.

[3] On-vault infiltration rates for the geomembrane layer represent the volumetric flux of water that will percolate vertically downward to the sloped concrete roof and drain horizontally to the northern roof edge. In HELP model simulations of the intact closure cap, the predicted percolation rate through the concrete slab roof is essentially zero. As a result, 100 percent of the water that percolates through the geomembrane layer above the ILV will drain to the northern roof edge and becomes an inflow (subsurface run-on) for the off-vault infiltration simulations. When setting the upper boundary condition for the PORFLOW vadose-zone simulations, it is important to consider the conservation of mass because the "Soil Next to Vault Roof" off-vault infiltration rates reported in Table 4-3 include the on-vault geomembrane drainage flux.

Table 4-3. ILV Infiltration Rates and Associated HELP Model Input and Output Files: Off-Vault Case.

Relative Year [1]	Period	HELP Model Input, Output, and Weather Files [2]	PC Directory Location for Execution	Infiltration Rate Reported for Layer [3]	Off-Vault Infiltration Rate (inches/year)
-40 to 0	Operational	ILVOP.D10 ILVOP.OUT VCOLEVAP.D11 [2]	C:\Help4.0\ILVOFF\ILVOP	Off-Vault Ground Surface	16.17
0 to 100	Institutional Control	ILVIC.D10 ILVIC.OUT VCOLEVAP.D11 [2]	C:\Help4.0\ILVOFF\ILVIC	Off-Vault Ground Surface	16.17
100	Closure Cap	ILV00.D10 ILV00.OUT	C:\Help4.0\ILVOFF\ILV00	Geomembrane Soil Next to Vault Roof	0.00015 0.00085
180	Closure Cap	ILV01.D10 ILV01.OUT	C:\Help4.0\ILVOFF\ILV01	Geomembrane Soil Next to Vault Roof	0.0009 0.0053
290	Closure Cap	ILV02.D10 ILV02.OUT	C:\Help4.0\ILVOFF\ILV02	Geomembrane Soil Next to Vault Roof	0.02 0.11
300	Closure Cap	ILV03.D10 ILV03.OUT	C:\Help4.0\ILVOFF\ILV03	Geomembrane Soil Next to Vault Roof	0.02 0.12
340	Closure Cap	ILV04.D10 ILV04.OUT	C:\Help4.0\ILVOFF\ILV04	Geomembrane Soil Next to Vault Roof	0.08 0.48
380	Closure Cap	ILV05.D10 ILV05.OUT	C:\Help4.0\ILVOFF\ILV05	Geomembrane Soil Next to Vault Roof	0.10 0.59
480	Closure Cap	ILV06.D10 ILV06.OUT	C:\Help4.0\ILVOFF\ILV06	Geomembrane Soil Next to Vault Roof	0.41 2.38
660	Closure Cap	ILV07.D10 ILV07.OUT	C:\Help4.0\ILVOFF\ILV07	Geomembrane Soil Next to Vault Roof	1.18 6.96
1,100	Closure Cap	ILV08.D10 ILV08.OUT	C:\Help4.0\ILVOFF\ILV08	Geomembrane Soil Next to Vault Roof	3.86 22.86

Table 4-3 (Cont'd). ILV Infiltration Rates and Associated HELP Model Input and Output Files: Off-Vault Case.

Relative Year [1]	Period	HELP Model Input, Output, and Weather Files [2]	PC Directory Location for Execution	Infiltration Rate Reported for Layer [3]	Off-Vault Infiltration Rate (inches/year)
1,900	Closure Cap	ILV09.D10 ILV09.OUT	C:\Help4.0\ILVOFF\ILV09	Geomembrane	8.68
				Soil Next to Vault Roof	51.52
2,723	Closure Cap	ILV10.D10 ILV10.OUT	C:\Help4.0\ILVOFF\ILV10	Geomembrane	10.60
				Soil Next to Vault Roof	62.91
2,905	Closure Cap	ILV11.D10 ILV11.OUT	C:\Help4.0\ILVOFF\ILV11	Geomembrane	10.64
				Soil Next to Vault Roof	63.16
3,300	Closure Cap	ILV12.D10 ILV12.OUT	C:\Help4.0\ILVOFF\ILV12	Geomembrane	10.71
				Soil Next to Vault Roof	63.59
5,700	Closure Cap	ILV13.D10 ILV13.OUT	C:\Help4.0\ILVOFF\ILV13	Geomembrane	10.89
				Soil Next to Vault Roof	64.66
7,100	Closure Cap	ILV14.D10 ILV14.OUT	C:\Help4.0\ILVOFF\ILV14	Geomembrane	10.94
				Soil Next to Vault Roof	64.93
7,100 and Beyond	Roof Collapse	ILVCLPSE.D10 ILVCLPSE.OUT	C:\Help4.0\ILVOFF\ILVCLPSE	Geomembrane	10.94
				Soil Next to Vault Roof	10.93 [4]

[1] Year 0: Beginning of institutional control period. Year 100: End of institutional control period; installation date of final closure cap.

[2] HELP Weather files are FPREC.D4, FTEMP.D7, FEVAP.D11, and FSOLAR.D13 except where noted in the table.

[3] For the off-vault case, vertical infiltration rates are reported at two elevations: the cap geomembrane layer above and the soil backfill layer below at the same elevation as the outside edge of the sloped concrete roof. When setting the upper boundary condition for the PORFLOW vadose-zone simulations, it is important to consider the conservation of mass because the "Soil Next to Vault Roof" off-vault infiltration rates reported above include the on-vault "Geomembrane" drainage flux. In addition, HELP model simulations of the intact closure cap predict that the percolation rate through the concrete slab roof is essentially zero. If PORFLOW simulations of the ILV assume nonzero leakage through cracks in the concrete roof, then the "Soil Next to Vault Roof" infiltration rates at each time step will need to be lowered by (49.5 feet/10 feet) x (concrete slab leakage flux in inches/year).

[4] The off-vault infiltration rate through the backfill soil adjacent to the vault roof decreases significantly after roof collapse because there is no longer any on-vault lateral drainage (subsurface run-on) from the sloped concrete roof.

5.0 Component-in-Grout (CIG) Special Waste Form

5.1 Planned E-Area LLWF Closure

Two CIG trench disposal units (CIG01 and CIG02) were originally proposed for the E-Area LLWF (see Figure 5-1); however, the units have been underutilized and there are currently no forecasted needs for CIG waste disposal through the end of E-Area operations. Consequently, as shown in Figure 5-2, the remaining unused portion of CIG01 and the entire areal footprint for CIG02 will be repurposed as Slit Trenches and renamed ST23 and ST24, respectively (Hamm, 2019).

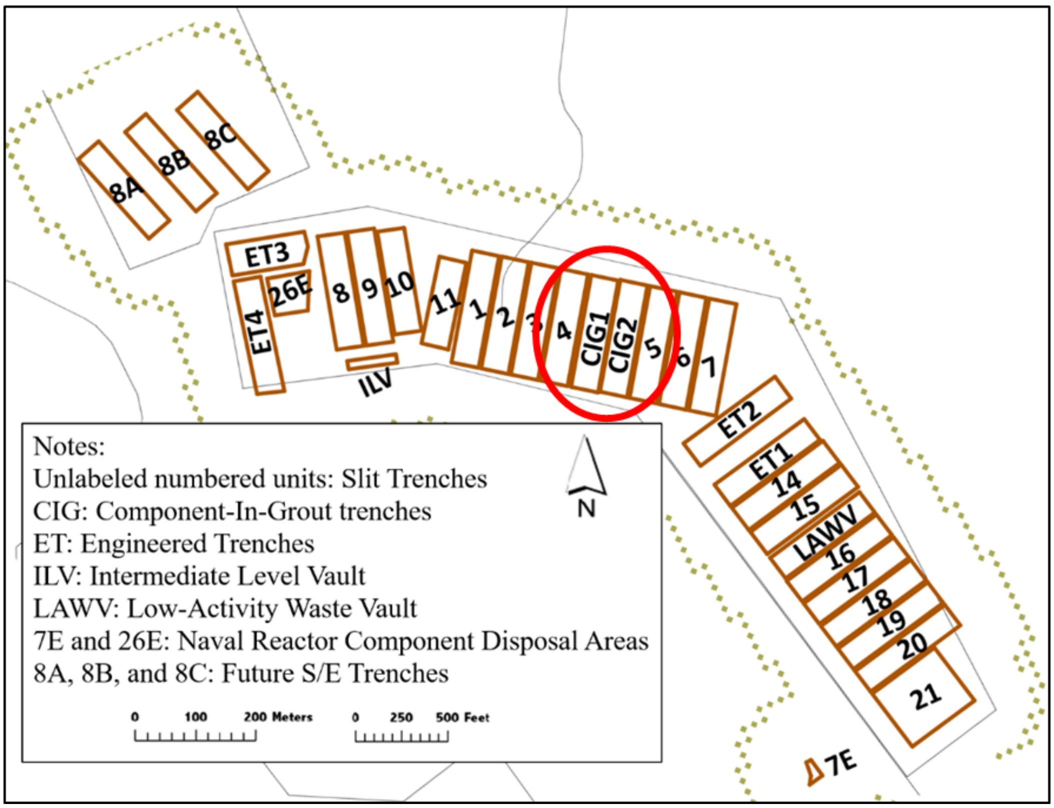


Figure 5-1. E-Area LLWF Layout circa 2008 showing the Location of the Original CIG Trench Units (Wohlwend and Butcher, 2018).

The eight-existing grouted CIG01 trench segments shown in Figure 5-3 will be treated in the upcoming PA revision as a CIG special waste form having unique subsidence assumptions within the overall ST23 footprint. The eight below-grade earthen trench segments contain grout-encapsulated waste components that provide greater waste isolation than Slit and Engineered Trenches. The grouting operation was conducted to achieve a minimum one-foot grout thickness below, between, and above components as well as the surrounding undisturbed soil and soil cover for complete encapsulation as shown in Figure 5-4. The unused trench segments in ST23 and all five slit trench segments in ST24 will be treated the same as other Slit Trenches from an infiltration perspective (2% slope, 585-foot slope length bounding intact case, and two percent subsidence based only on the area of the ST23 total footprint utilized as a Slit Trench).

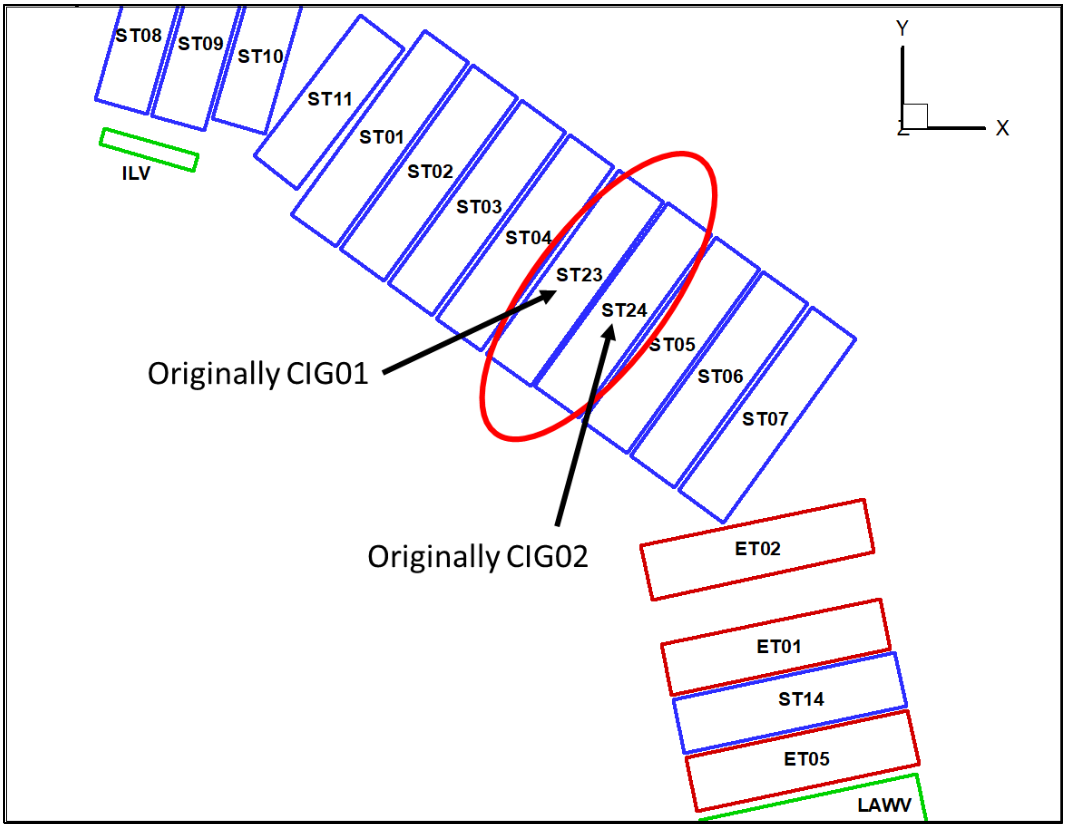


Figure 5-2. E-Area LLWF Footprints and Naming Convention for Upcoming PA (Hamm, 2019).

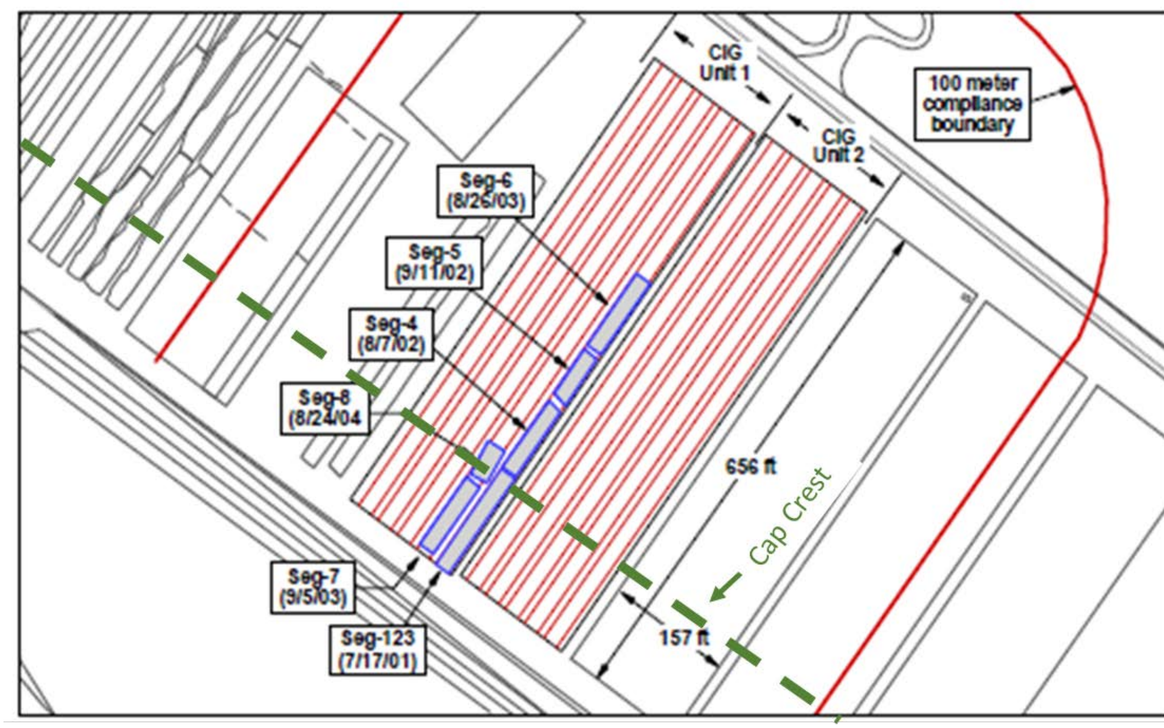


Figure 5-3. Location of CIG Trench Segments 1 through 8 together with their Burial Dates (WSRC, 2008).

Figure 5-4. CIG Trench Segment 6 Placement Sequence (Phifer et al., 2006).

After the top one-foot grout layer solidified, a minimum four-foot-thick clean layer of material (see below) was placed over the grout-encapsulated waste components. An overlying soil was then placed on top of the four-foot-thick clean layer and graded to provide positive drainage away from the CIG trenches. The four-foot-thick clean layer consists of one of the following materials:

- A minimum four-foot layer of clean soil from the excavation stockpile placed in a single lift with a bulldozer (i.e., an operational soil cover).

- A combination from bottom to top of a nominal 16-inch layer of controlled low-strength material (CLSM), a minimum 20-inch thick concrete mat, and a nominal 12-inch layer of clean soil from the excavation stockpile was placed over the grout-encapsulated waste components for a minimum four-foot thickness.

In addition, an HDPE operational stormwater runoff cover was installed within three months after each CIG trench segment had been emplaced in grout. The stormwater runoff cover is maintained during the operational period and will be incorporated into or replaced by the interim runoff cover for the entire ST23 footprint during the 100-year institutional control period. The interim runoff cover will consist of the surface application of an HDPE geomembrane that extends a minimum of ten feet beyond the edge of all sides of the unit.

Three hundred years of structural integrity will be ensured for the CIG special waste form in one of three ways:

1. Components were filled with grout or CLSM.
2. The components themselves were determined to be structurally sound for 300 years after burial through a structural-corrosion evaluation.
3. The grout-encapsulated CIG trench segment was or will be overlaid with a 20-inch steel-reinforced 3000-psi concrete mat with CLSM between the top of the grout and the bottom of the concrete slab.

A 20-inch thick concrete mat will support a 12.5-foot soil overburden from the final closure cap according to Peregoy (2006b). Employing one of the three stabilization measures above minimizes the subsidence potential of the CIG trench segments during the 300-year period following the end of operations (200 years after installation of the final closure cap). After 300 years, the subsidence potential will range from zero for segments containing component(s) filled with grout or CLSM to an estimated maximum of ten feet for segments containing predominately B-25 boxes with low-density waste or component(s) that are not filled with grout or CLSM (Jones et al., 2004; Peregoy 2006a; Phifer, 2004).

Final closure of the CIG trench segments and the entire E-Area LLWF will take place at the end of the 100-year institutional control period. Dynamic compaction of CIG trench segments will not be conducted. Final closure will consist of a multilayer soil-geomembrane closure cap installed over all the E-Area disposal units integrated with a drainage system to carry away runoff to nearby sediment basins. Figure 5-5 shows the planned final closure cap design for the CIG special waste form trench segments which is the same as the design for the Slit and Engineered Trenches.

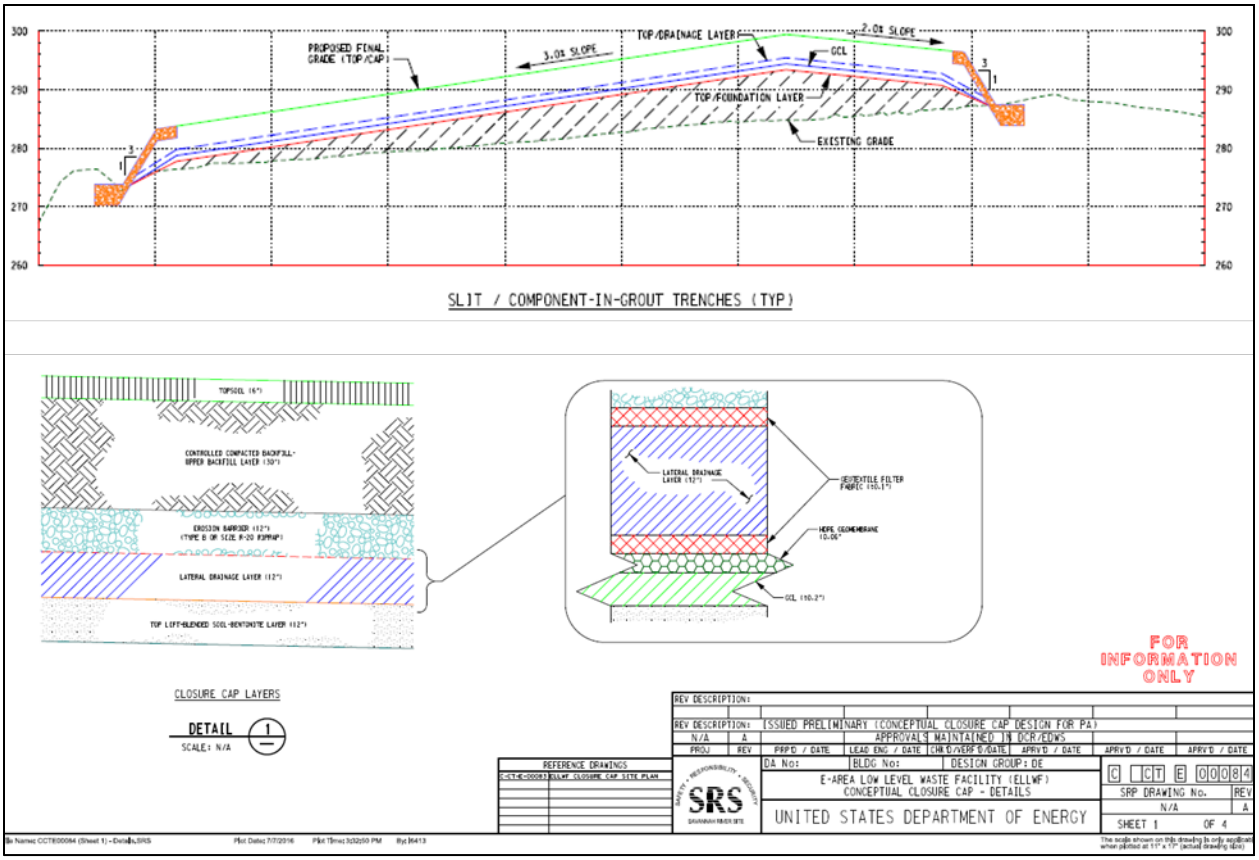


Figure 5-5. Planned Final Closure Cap Design for E-Area LLWF (C-CT-E-00084, 2016).

Waste was placed in ST23 (formerly CIG01) Trench Segments 1 through 8 as described below:

- The interiors of the components within Segments 1 through 3 were filled with grout or CLSM. As a result, there is no significant void space within these segments, and they will not subside. The three segments are covered with an operational stormwater runoff cover.
- Many of the components and other waste forms within Segments 4, 5, 6, and 7 consist of low-strength containers such as B-25 boxes, tankers, and SeaLand containers with significant interior void space. The four segments are covered with an operational stormwater runoff cover. Installation of a reinforced concrete mat over the segments is planned before installation of the E-Area LLWF final closure cap at the end of the 100-year institutional control period. The timing of the reinforced concrete mat installation has yet to be determined. The four segments are subject to subsidence.
- Segment 8 was overlaid with CLSM, an 18-inch thick reinforced concrete mat, and clean soil. The 18-inch thick concrete mat can support an 11.4-foot soil overburden from the final closure cap. The segment is covered with an operational stormwater runoff cover and is subject to subsidence.

5.2 CIG Special Waste Form Infiltration Scenario

ST23 and ST24 are positioned parallel to and in-between ST04 and ST05 as indicated in Figure 5-1. McDowell-Boyer et al. (2011) documents the bases for the HELP model infiltration calculations used in the 2008 E-Area LLWF PA for the original CIG01 and CIG02 trenches.

In the upcoming PA revision, the same Bahia grass case with two percent slope and 585-foot slope length assumed for the Slit and Engineered Trenches will also represent the upper bound on infiltration rates for intact portions of the closure cap over both ST23 and ST24. The section of the final closure cap above the CIG special waste form is assumed to remain intact for 200 years after the final cap is installed (relative Year 300 in HELP model simulations), while the sections of the final closure cap covering the slit-trench segments of ST23 and ST24 will be modeled in the same way as the other Slit and Engineered Trenches. The final closure cap will include the following layers from bottom to top as shown in Figure 5-5:

- Foundation layer (varying thickness)
- Blended soil-bentonite layer (12 inches)
- GCL (200 mil)
- HDPE geomembrane (60 mil)
- Geotextile filter fabric (100 mil)
- Lateral drainage layer (12 inches)
- Geotextile filter fabric (100 mil)
- Erosion barrier (12 inches)
- Upper backfill layer (30 inches)
- Topsoil (6 inches)

The minimum foundation layer thickness is one foot for the CIG trench segments (same as for Slit and Engineered Trenches) and assumes the presence of a pre-existing minimum four-foot thick clean layer of soil, CLSM, and/or concrete over the CIG waste. The middle backfill layer in the original FTF cap design is not included in the E-Area LLWF cap design so that the average cap thickness above the LAWV and ILV satisfies differential settlement and maximum seismic load considerations.

Version 4.0 of the HELP model (Dixon, 2017) was used to generate the desired infiltration rate time profile for the CIG trench segments. The simulation period of interest for the E-Area LLWF final closure cap is 100 to 10,100 years, where relative Year 100 is the installation date of the final closure cap and relative Year 300 is when CIG Segments 4, 5, 6, 7, and 8 are assumed to completely subside, resulting in a sudden increase in infiltration. The actual period of performance for the PA is 1,000 years following final closure (i.e., relative Year 1,100); however, infiltration estimates are extended to 10,000 years (i.e., relative Year 10,100) to ensure steady-state infiltration conditions are captured. Dyer and Flach (2018) and Phifer et al. (2007) describe in greater detail the formulation and execution of the HELP model for the intact infiltration case, including degradation assumptions for the barrier and lateral drainage layers.

Figure 5-3 shows that the crest of the proposed final closure cap will run perpendicular to the long axis of ST23, bisecting the two rows of grouted CIG trench segments of unequal length. Because both rows of grouted trench segments extend across the final closure cap crest, when the concrete covers fail catastrophically at relative Year 300, the subsided CIG special waste form area will behave like a basin with no surface or subsurface run-on from the surrounding intact portions of the closure cap (i.e., the upslope intact cap area is zero on both sides of the crest). As a result, the subsided grouted trench segments are treated in the HELP model as a 100% subsidence case with zero subsurface run-on.

HELP v4.0 model files for the CIG special waste form infiltration cases are stored in the parent directory C:\Help4.0 in three separate subdirectories[g] (see Appendix F for a diagram of the file hierarchy):

- C:\Help4.0\Hweather stores input parameters for evapotranspiration calculations (FEVAP.D11) as well as HELP-model-generated weather input files containing 100 years of daily precipitation data (FPREC.D4), daily temperature data (FTEMP.D7), and daily solar radiation data (FSOLAR.D13). Appendix A provides additional background information on weather data input for the HELP model.
- C:\Help4.0\CIG contains the input and output files for each infiltration time step (stored in separate subdirectories labeled C:\Help4.0\CIG\CIG00 for Year 100 through C:\Help4.0\CIG\CIG13 for Year 10,100).
- C:\Help4.0\Source contains the executable Fortran files for the HELP model.

All infiltration timesteps were executed at once by double-clicking the HELP.bat Windows batch file stored in the subdirectory C:\Help4.0\CIG. Overall summary files labeled CIG.OUT, CIG_DRAINAGE.OUT, CIG_PERC.OUT, and CIG_RUNOFF.OUT were created by double-clicking the Python-based model cat_FC.py stored in the subdirectory C:\Help4.0\CIG. Output files for each individual time-step case were stored in C:\Help4.0\CIG\CIGxx\Output, where xx ranges from 00 to 13.

Table 5-1 lists technical reports relevant to the calculation of infiltration rates for the CIG special waste form trench segments. Appendix F contains the HELP model input parameter data sheets for each time step in the infiltration degradation curve. Table 5-2 provides the infiltration rates for a 10,000-year period. Included in Table 5-2 are the HELP model input (xx.D10), output (xx.OUT), and weather input data (xx.D4, xx.D7, xx.D11, xx.D13) filenames corresponding to each time step. Reported infiltration rates from the HELP model are temporally (annually) and spatially (585-foot total slope length) averaged.

[g] The as-written batch execution files embedded in the HELP directories for this data package require the HELP model to be executed from the C: drive. If executed from another directory or drive, then the Python script and the .bat files in the parent directory and each of the subdirectories for each case will need to be edited for the new directory pathway.

Table 5-1. Technical Reports Relevant to the Calculation of Infiltration Rates for CIG Special Waste Form Trench Segments.

Report Number	Authors/Year	Title	Relevance
SRNL-STI-2017-00104, Rev. 0	Dixon, K. L. (2017)	HELP 4.0 Documentation Updates for Software and Data	HELP model adaptations to run on Windows 10
SRNL-STI-2010-00618, Rev. 0	McDowell-Boyer et al. (2011)	Data Package for HELP Models used in the E-Area Low-Level Waste Facility Performance Assessment	Infiltration rates used in 2008 E-Area PA for CIG trench segments
SRNL-RP-2009-00075, Rev. 0	Phifer, M. A. et al. (2009)	Closure Plan for the E-Area Low-Level Waste Facility	Facility description and closure plan for CIG trench segments

Table 5-2. CIG Special Waste Form Infiltration Rates and Associated HELP Model Input and Output Files.

Relative Year [1]	Period	HELP Model Input, Output, and Weather Files [2]	PC Directory Location for Execution	Infiltration Rate Reported for Layer	Infiltration Rate (inches/year)
-40 to 0	Operational (Four-foot Soil Cover)	CIGOP.D10 CIGOP.OUT	C:\Help4.0\CIG\CIGOP	Operational Soil Cover	15.78
-40 to 0	Operational (HDPE Runoff Cover)	CIGIC.D10 CIGIC.OUT ICEVAP.D11 [2]	C:\Help4.0\CIG\CIGIC	Operational HDPE Runoff Cover	0.1
0 to 100	Institutional Control (HDPE Runoff Cover)	CIGIC.D10 CIGIC.OUT ICEVAP.D11 [2]	C:\Help4.0\CIG\CIGIC	Interim HDPE Runoff Cover	0.1
100	Closure Cap	CIG00.D10 CIG00.OUT	C:\Help4.0\CIG\CIG00	Geomembrane	0.00081
180	Closure Cap	CIG01.D10 CIG01.OUT	C:\Help4.0\CIG\CIG01	Geomembrane	0.007
290	Closure Cap	CIG02.D10 CIG02.OUT	C:\Help4.0\CIG\CIG02	Geomembrane	0.16
300	Closure Cap	CIG03.D10 CIG03.OUT	C:\Help4.0\CIG\CIG03	Geomembrane	0.18
300	Subsidence (Segments 4, 5, 6 ,7, 8)	CIG04.D10 CIG04.OUT VCOLEVAP.D11 [2]	C:\Help4.0\CIG\CIG04	Geomembrane	19.0
400	Subsidence (Segments 4, 5, 6 ,7, 8)	CIG05.D10 CIG05.OUT VCOLEVAP.D11 [2]	C:\Help4.0\CIG\CIG05	Geomembrane	19.0
480	Subsidence (Segments 4, 5, 6 ,7, 8)	CIG06.D10 CIG06.OUT VCOLEVAP.D11 [2]	C:\Help4.0\CIG\CIG06	Geomembrane	19.0

Table 5-2 (Cont'd). CIG Special Waste Form Infiltration Rates and Associated HELP Model Input and Output Files.

Relative Year [1]	Period	HELP Model Input, Output, and Weather Files [2]	PC Directory Location for Execution	Infiltration Rate Reported for Layer	Infiltration Rate (inches/year)
660	Subsidence (Segments 4, 5, 6 ,7, 8)	CIG07.D10 CIG07.OUT VCOLEVAP.D11 [2]	C:\Help4.0\CIG\CIG07	Geomembrane	19.0
1,100	Subsidence (Segments 4, 5, 6 ,7, 8)	CIG08.D10 CIG08.OUT VCOLEVAP.D11 [2]	C:\Help4.0\CIG\CIG08	Geomembrane	19.0
1,900	Subsidence (Segments 4, 5, 6 ,7, 8)	CIG09.D10 CIG09.OUT VCOLEVAP.D11 [2]	C:\Help4.0\CIG\CIG09	Geomembrane	19.0
2,723	Subsidence (Segments 4, 5, 6 ,7, 8)	CIG10.D10 CIG10.OUT VCOLEVAP.D11 [2]	C:\Help4.0\CIG\CIG10	Geomembrane	19.0
3,300	Subsidence (Segments 4, 5, 6 ,7, 8)	CIG11.D10 CIG11.OUT VCOLEVAP.D11 [2]	C:\Help4.0\CIG\CIG11	Geomembrane	19.0
5,700	Subsidence (Segments 4, 5, 6 ,7, 8)	CIG12.D10 CIG12.OUT VCOLEVAP.D11 [2]	C:\Help4.0\CIG\CIG12	Geomembrane	19.0
10,100	Subsidence (Segments 4, 5, 6 ,7, 8)	CIG13.D10 CIG13.OUT VCOLEVAP.D11 [2]	C:\Help4.0\CIG\CIG13	Geomembrane	19.0

[1] Year 0: Beginning of institutional control period. Year 100: End of institutional control period; installation date of final closure cap.

[2] HELP Weather files are FPREC.D4, FTEMP.D7, FEVAP.D11, and FSOLAR.D13 except where noted in the table.

6.0 Naval Reactor Component Disposal Areas

Two areas within and adjacent to the E-Area LLWF at the SRS are used as disposal sites for reactor components from the U.S. Navy. As described in detail by Wohlwend and Butcher (2018), the reactor components arrive by rail and are moved by crane to the at-grade gravel disposal pads, currently 643-26E (NR26E) and formerly 643-7E (NR07E), as illustrated in Figure 6-1. Naval Reactor (NR) waste contains highly radioactive components consisting of activated corrosion-resistant metal alloy contained within thick steel casks, and auxiliary equipment primarily contaminated with activated corrosion products at low levels and contained within thinner-walled bolted containers. The NR07E disposal pad contains 41 casks up to 10.5 feet in diameter by 17.7 feet tall and is closed to future receipts. Structural fill has been placed around and over the NR07E disposal pad for radiation shielding as shown in Figure 6-2. The current NR waste projections for NR26E are for 33 heavily shielded, welded casks (31 are already in place on the NR26E pad) and 381 thinner-walled, bolted containers through the year 2040. At the assumed start of institutional control on September 28, 2040, structural fill will be placed around and over casks and containers on the NR26E pad as was done for NR07E. Unlike for Slit and Engineered Trenches, during institutional control, an HDPE interim cover will not be placed over the structural fill surrounding the NRCDAs. The conceptual model for degradation of the bolted containers assumes hydraulic, but not structural, failure immediately when the structural fill is placed. Because of the robust nature of the containers and waste forms, they are treated as non-crushable containers and zero subsidence of the final closure cap is assumed to occur. Similarly, the welded casks are assumed to fail hydraulically, but not structurally, after 750 years based on the estimated corrosion time for a minimum 1.25-inch weld. Dynamic compaction of the NRCDAs before installation of the final closure cap is prohibited to preserve the structural integrity (non-crushable) assumption.

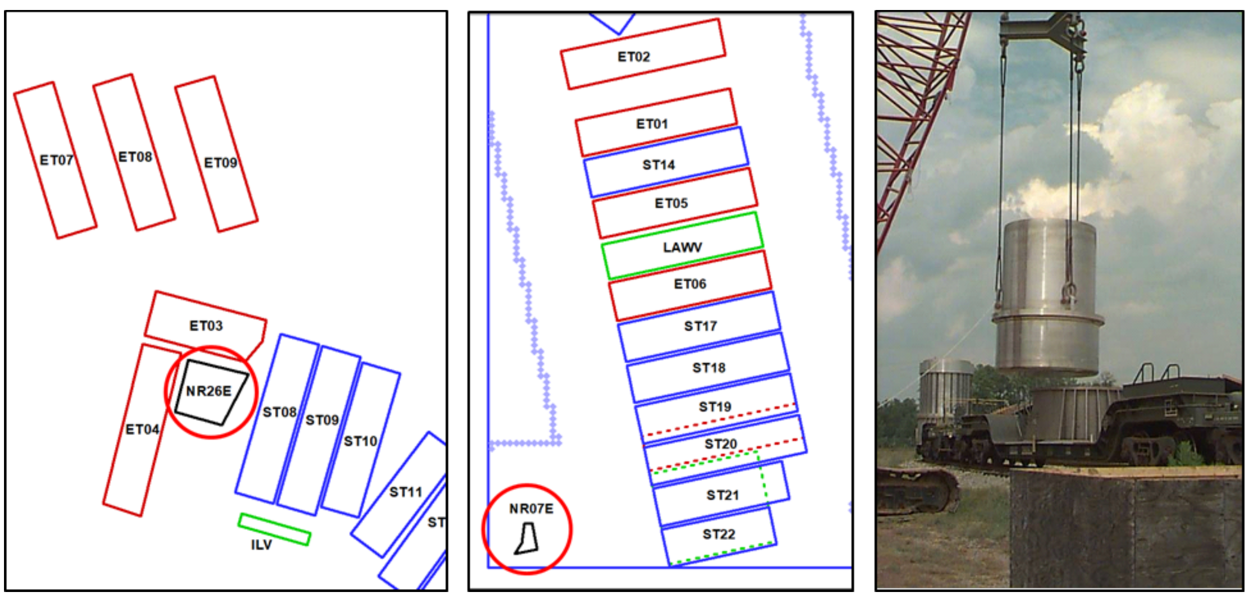


Figure 6-1. E-Area LLWF Layout showing location of 643-26E NRCDA (labeled NR26E), 643-7E NRCDA (labeled NR07E), and adjacent units (Wohlwend and Butcher, 2018; Hamm, 2019).

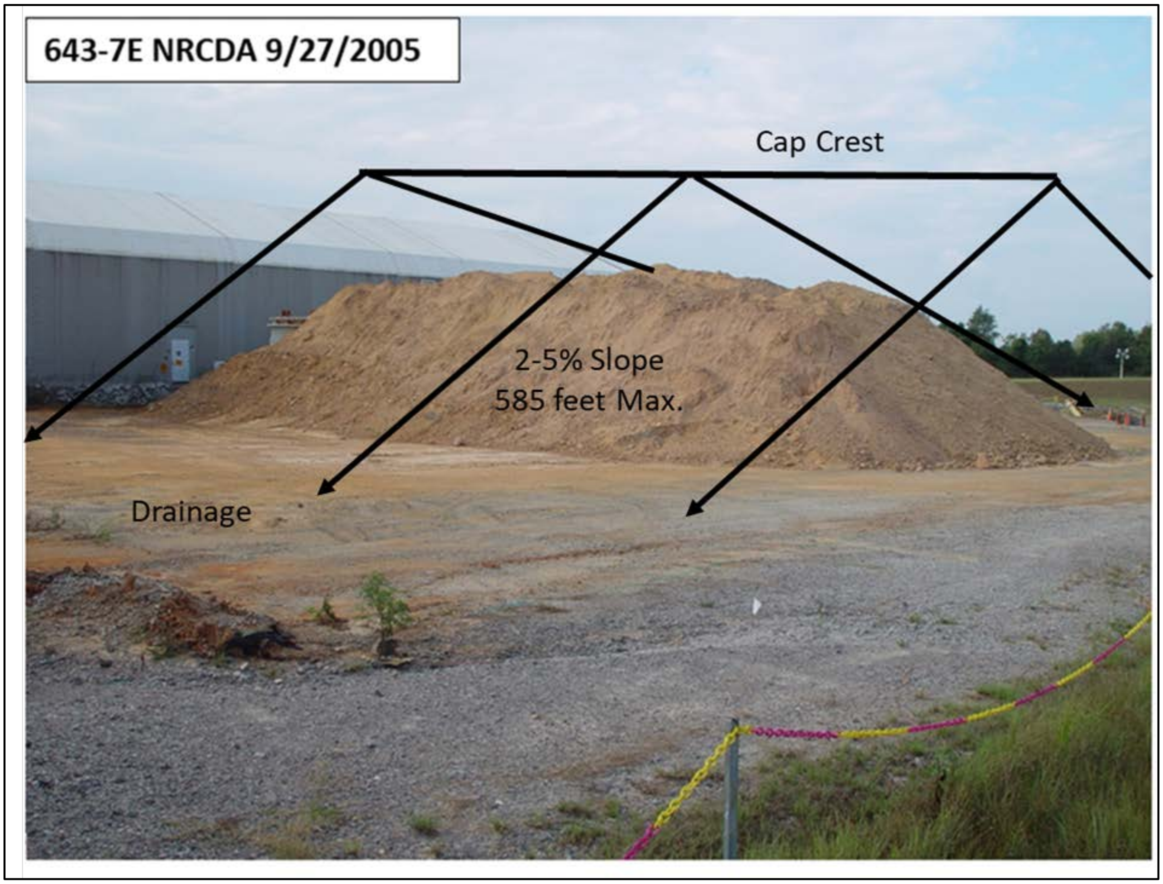


Figure 6-2. Final Closure Cap Crest and Slope Concept for 643-7E NRCDA.

Because the NRCDA casks and containers will be assumed to maintain their structural integrity throughout the operational, institutional control, and final closure cap periods, an intact infiltration scenario will apply for all time (i.e., no cap subsidence). The NR26E pad will be covered by the main E-Area LLWF closure cap. The slope and maximum slope length above the NR26E pad are two percent and approximately 200 feet, respectively. The NR07E pad will require an individual closure cap as shown schematically in Figure 6-2. Like the main closure cap design, the specifications for the NR07E closure cap will include a slope ranging from two to five percent and a maximum slope length of 585 feet. The actual slope length will be substantially shorter.

For simplicity and consistency, the upper bound intact infiltration scenario for Slit and Engineered Trenches will be used for the NRCDA pads as well. Table 6-1 identifies the relevant tables and figures from the Slit and Engineered Trench section. The only difference in infiltration rates for the NRCDAs versus Slit and Engineered Trenches occurs during the institutional control period because an HDPE interim cover will not be placed over the structural fill surrounding the NRCDAs. Table 6-2 summarizes the infiltration rates for the NRCDAs from the operational period through relative Year 10,100.

Table 6-1. Intact Infiltration Scenario for NRCDA Pads.

Description	Location
Relevant technical reports	Table 2-1
HELP model input parameter data sheets	Appendix B
HELP model data files and location	Table 2-2
Infiltration rates for the bounding intact case	Table 2-2, Figure 2-3, Figure 2-4

Table 6-2. NRCDA Intact Infiltration Rates and Associated HELP Model Input and Output Files.

Relative Year [1]	Cover Type	HELP Model Input, Output, and Weather Files [2]	PC Directory Location for Execution	Infiltration Rate (inches/year)
-30 to 0	Structural Soil Fill	ST_OpCover.D10 ST_OpCover.OUT	C:\Help4.0\SLIT_OpCover\ ST_OpCover	15.78
0 to 100	Structural Soil Fill	ST_OpCover.D10 ST_OpCover.OUT	C:\Help4.0\SLIT_OpCover\ ST_OpCover	15.78
100	Closure Cap	ST00.D10 ST00.OUT	C:\Help4.0\STET_INTACT\ST00	0.0008
180	Closure Cap	ST01.D10 ST01.OUT	C:\Help4.0\STET_INTACT\ST01	0.007
290	Closure Cap	ST02.D10 ST02.OUT	C:\Help4.0\STET_INTACT\ST02	0.16
300	Closure Cap	ST03.D10 ST03.OUT	C:\Help4.0\STET_INTACT\ST03	0.18
340	Closure Cap	ST04.D10 ST04.OUT	C:\Help4.0\STET_INTACT\ST04	0.30
380	Closure Cap	ST05.D10 ST05.OUT	C:\Help4.0\STET_INTACT\ST05	0.38
480	Closure Cap	ST06.D10 ST06.OUT	C:\Help4.0\STET_INTACT\ST06	1.39
660	Closure Cap	ST07.D10 ST07.OUT	C:\Help4.0\STET_INTACT\ST07	3.23
1,100	Closure Cap	ST08.D10 ST08.OUT	C:\Help4.0\STET_INTACT\ST08	6.82
1,900	Closure Cap	ST09.D10 ST09.OUT	C:\Help4.0\STET_INTACT\ST09	10.24
2,723	Closure Cap	ST10.D10 ST10.OUT	C:\Help4.0\STET_INTACT\ST10	11.10
3,300	Closure Cap	ST11.D10 ST11.OUT	C:\Help4.0\STET_INTACT\ST11	11.18
5,700	Closure Cap	ST12.D10 ST12.OUT	C:\Help4.0\STET_INTACT\ST12	11.30
10,100	Closure Cap	ST13.D10 ST13.OUT	C:\Help4.0\STET_INTACT\ST13	11.35

[1] Year 0: Beginning of institutional control period. Year 100: End of institutional control period; installation date of final closure cap. An HDPE cover is not used during the institutional control period for the NRCDAs. Instead, a soil structural fill is placed around and over the disposal pads for radiation shielding.

[2] HELP Weather files are FPREC.D4, FTEMP.D7, FEVAP.D11, and FSOLAR.D13 except where noted in the table.

7.0 Quality Assurance

The software quality assurance plan for the HELP v4.0 model was developed by Dixon (2017). Design checks were completed for HELP infiltration model simulations of the CIG trenches (Dyer, 2019a), LAW and IL vaults (Dyer, 2019b), Slit and Engineered Trenches (Dyer, 2019c; Dyer, 2018b), and NRCDAs (Dyer, 2019c). Design checks of the probabilistic subsidence model and intact and subsidence uncertainty cases for the Slit and Engineered Trenches are reported by Dyer (2019c) and Dyer (2018d). A technical review of this report was also done that is consistent with the E7 Manual, procedure 2.60 as outlined in SRNL Technical Report Design Checklist contained in WSRC-IM-2002-00011, Rev. 2.

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Appendix A. HELP Model Weather Input Data

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The HELP model requires the input of evapotranspiration, precipitation, temperature, and solar radiation data. Four input options are available for each type of weather data:

1. Historical records for specific cities (HELP model default)
2. Synthetic data generated using the statistical characteristics of historical data for specific cities
3. Synthetic data generated utilizing mean monthly precipitation and temperature data for the specific location of interest
4. Manual data entry (Schroeder et al. 1994a; Schroeder et al. 1994b)

The default historical weather databases included with HELP versions 3.07 and 4.0 are quite limited with respect to the period covered and the number of cities available. A complete set of historical weather data for either SRS or Augusta, GA (Option 1) is unavailable in the HELP model. Alternatively, the HELP model will generate up to 100 years of synthetic weather data for many more cities than are included in the default historical weather databases (Option 2). For example, synthetic weather data can be generated for Augusta, GA, but not SRS. A third option is to utilize actual monthly precipitation and temperature data from SRS to modify the synthetic data generated for Augusta, GA. Lastly, manual data entry (Option 4) is time consuming to implement because it requires the availability of daily precipitation, temperature, and solar radiation data as well as placement of the data in a fixed format acceptable to HELP. Option 3 was chosen as the best choice for SRS.

One hundred years of synthetic daily precipitation, temperature, and solar radiation data were generated using HELP's synthetic weather data generator for Augusta, GA as modified with SRS-specific mean monthly precipitation and temperature data. SRS collects meteorological data from a network of nine weather stations. SRS precipitation data has been collected primarily at the SRNL (773-A) weather station between 1952 and 1995 and at the Central Climatology site (CLM) since 1995. The closest weather station to the E-Area LLWF and FTF is the 200-F weather station, where precipitation data has been collected from a manual rain gauge daily (with some exceptions) since 1961. The primary source of SRS temperature data is the SRNL (773-A) weather station from 1968 to 1995 and the CLM from 1995 to present. Temperature data is not collected at the 200-F weather station.

SRS monthly precipitation and temperature data from the combined SRNL/CLM weather stations and precipitation data from the 200-F weather station were obtained from the SRNL Atmospheric Technologies Center website (https://weather.srs.gov/weather/). To be consistent with the HELP model simulations for the FTF design, mean monthly precipitation data from the 200-F weather station and mean monthly temperature data from the combined SRNL/CLM weather stations were used in the HELP model simulations for the E-Area LLWF. Phifer et al. (2007) describes in detail how missing precipitation data from the 200-F weather station was addressed.

Table A-1 provides monthly precipitation totals for the years 1961 to 2006 from the 200-F weather station as reported by Phifer et al. (2007). The mean monthly precipitation rate for this 46-year period is shown on the last line of the table.

Table A-1. Monthly Precipitation Data in Inches for 200-F Weather Station (by Phifer et al., 2007).

Year	Jan	Feb	March	April	May	June	July	August	Sept	October	Nov	Dec
1961	3.55	5.53	7.57	7.23	4.21	2.00	2.94	8.55	0.56	0.02	1.80	6.20
1962	4.35	5.28	6.46	3.85	2.61	1.97	1.74	4.36	4.03	1.87	3.31	2.40
1963	6.05	3.59	3.15	3.18	2.37	7.04	2.00	1.54	5.05	0.00	3.24	4.11
1964	7.67	5.69	5.40	5.81	3.56	5.18	10.99	10.87	5.19	6.44	0.77	4.17
1965	2.12	6.24	8.13	2.45	1.70	4.28	9.63	1.75	2.11	3.00	2.18	1.31
1966	6.82	5.42	4.39	3.26	4.87	3.82	3.88	5.17	4.68	1.37	1.18	3.21
1967	3.56	3.71	7.54	2.60	4.56	2.13	6.28	7.31	1.02	0.53	2.37	2.83
1968	3.92	0.97	1.92	1.83	2.91	4.32	4.93	3.14	1.88	3.03	4.14	2.84
1969	1.85	2.13	3.43	4.20	3.41	4.36	1.99	5.43	5.96	1.96	0.34	3.83
1970	2.78	2.62	7.65	1.33	4.99	3.09	2.87	3.20	0.69	4.29	1.83	5.06
1971	5.01	3.97	8.70	2.85	2.03	6.73	11.52	9.40	2.33	4.91	2.16	3.03
1972	7.93	3.66	2.78	0.47	3.75	5.84	2.68	6.88	1.28	0.76	3.62	4.73
1973	5.31	4.82	6.48	4.97	5.17	8.52	4.50	5.83	3.22	1.22	0.35	4.69
1974	2.68	6.60	2.91	2.63	3.86	4.97	4.00	6.98	3.24	0.01	2.05	4.12
1975	5.45	6.19	5.97	3.98	5.48	3.24	7.65	3.95	7.86	1.00	4.43	4.00
1976	4.22	1.50	3.95	2.22	10.86	6.40	3.28	2.41	5.40	5.54	3.89	4.82
1977	3.86	2.20	7.90	1.02	2.61	3.79	4.02	8.43	4.66	5.44	2.07	5.14
1978	8.44	1.45	3.07	4.85	3.33	1.94	4.13	2.72	3.74	0.20	3.54	2.17
1979	3.41	9.31	3.95	5.37	7.44	1.55	7.55	9.14	7.77	1.38	7.34	2.29
1980	4.29	2.33	11.44	2.31	3.57	3.30	0.99	2.86	7.38	1.95	2.21	1.96
1981	0.93	3.91	3.87	2.71	4.51	5.05	4.39	5.92	0.85	2.88	0.91	8.45
1982	4.73	3.86	1.95	4.90	2.37	4.07	10.53	6.45	5.02	3.61	2.06	4.58
1983	4.00	8.06	5.49	4.71	3.00	2.77	3.71	6.21	3.52	2.21	4.98	3.66
1984	3.53	5.34	6.05	7.11	10.73	1.82	6.46	3.52	1.06	0.40	0.97	1.16
1985	2.98	6.36	1.06	0.83	3.49	4.88	9.82	2.90	0.90	3.77	7.51	2.74
1986	1.18	3.05	2.75	0.96	3.47	2.60	2.61	8.59	0.80	3.05	5.76	4.94
1987	6.79	7.50	4.35	0.75	1.86	5.02	5.68	4.20	2.91	0.32	2.28	1.37
1988	3.74	1.03	2.48	4.88	0.97	6.67	2.24	2.98	4.79	3.50	1.92	1.66
1989	1.24	2.91	4.83	5.89	3.36	5.82	9.51	0.39	4.84	5.51	3.65	3.35
1990	2.91	1.84	1.88	0.94	2.16	3.87	7.65	10.65	0.50	17.84	1.25	2.55
1991	6.73	1.80	7.86	5.43	3.93	3.35	14.4	9.79	2.05	0.80	1.47	3.19
1992	3.63	5.32	2.93	2.74	1.54	8.28	5.18	8.70	2.42	6.21	8.57	2.96
1993	8.90	5.09	8.48	1.37	1.56	6.03	2.87	3.48	6.56	0.61	2.29	1.79
1994	4.81	3.38	6.68	0.98	1.20	4.80	5.54	5.29	1.48	10.5	2.56	4.91
1995	5.97	7.50	0.83	0.93	2.10	12.73	4.27	6.69	5.42	2.31	2.13	3.90
1996	3.08	2.08	6.81	1.69	2.40	4.59	5.55	10.58	3.14	2.09	1.46	2.97
1997	4.20	5.56	2.32	3.88	2.42	6.77	7.02	2.33	5.80	5.54	5.49	7.57
1998	8.42	6.59	6.48	5.97	3.63	3.74	4.79	3.63	8.30	0.78	0.76	1.90
1999	5.82	2.60	3.04	1.34	2.55	8.67	4.70	2.87	5.66	2.24	0.65	1.35
2000	5.80	1.06	3.06	2.08	2.27	6.02	2.90	5.84	6.47	0.02	3.86	2.02
2001	3.21	3.55	6.88	1.44	4.00	6.29	5.30	1.78	5.70	0.04	0.97	0.68
2002	2.07	2.13	3.50	2.19	1.54	2.75	4.76	6.02	3.87	3.34	5.64	4.20
2003	1.62	5.97	8.10	9.67	6.60	7.28	5.86	3.09	2.32	3.10	1.30	2.27
2004	4.63	6.81	0.99	1.69	2.47	8.49	3.01	4.21	10.54	3.32	4.11	3.81
2005	2.88	3.96	6.57	1.35	3.82	7.78	5.09	6.00	0.20	4.80	2.42	6.33
2006	3.47	3.37	2.45	3.22	1.53	7.73	5.88	1.49	2.34	2.53	3.25	5.12
Monthly Average Precip.	4.36	4.21	4.88	3.18	3.54	5.05	5.38	5.29	3.82	2.96	2.85	3.53

All precipitation data is from the 200-F Weather Station, except as noted below:

- 200-F Weather Station precipitation data is unavailable in the SRS ATG Climate Data database on the following days: 3/30/1967, 3/31/1967, 4/1/1967 through 4/18/1967, 11/4/1968, 10/31/1970, 1/24/1971, 11/27/1971, and 10/31/1998.

- The monthly data highlighted in grey represents months where some daily precipitation data is missing from the 200-F weather station database (i.e., possible underreporting). For these seven instances, if the monthly precipitation total for the combined SRNL/CLM weather stations exceeded the value reported by the 200-F weather station, the monthly total for the combined SRNL/CLM weather stations was used instead.
  - March 1967: Monthly 200-F precipitation total of 5.29 inches was replaced with the monthly combined SRNL/CLM total of 7.54 inches.
  - April 1967: Monthly 200-F precipitation total of 2.58 inches was replaced with the monthly combined SRNL/CLM total of 2.6 inches.
  - November 1968: Monthly 200-F precipitation total of 2.89 inches was replaced with the monthly combined SRNL/CLM total of 4.14 inches.
  - October 1970: Monthly 200-F precipitation total of 4.29 inches was retained.
  - January 1971: Monthly 200-F precipitation total of 4.47 inches was replaced with the monthly combined SRNL/CLM total of 5.01 inches.
  - November 1971: Monthly 200-F precipitation total of 1.75 inches was replaced with the monthly combined SRNL/CLM total of 2.16 inches.
  - October 1998: Monthly 200-F precipitation total of 0.78 inches was retained.

Table A-2 provides monthly temperature data for the years 1968 through 2006 obtained from the combined SRNL/CLM weather stations. The mean monthly temperature for this 39-year period is shown on the last line of the table.

Evapotranspiration data, which is considered constant from year to year, was based on HELP-model default data for Augusta, GA. The evaporative zone depth is the maximum depth to which the HELP model will allow evapotranspiration to occur. Except where noted, an evaporative zone "fair" depth of 22 inches was chosen based on guidance from the HELP manual (Schroeder et al., 1994b). Twenty-two inches is considered a conservative maximum evaporative-zone depth due to anticipated capillarity associated with the surficial soil types (i.e., topsoil and upper backfill) and the anticipated root depths. The maximum leaf area index (LAI) is a measure of the maximum active biomass that the HELP model allows to be present. The actual LAI utilized by the HELP model is modified from the maximum based upon daily temperature, daily solar radiation, and the beginning and ending dates of the growing season. Except where noted, a maximum LAI equal to 3.5 (good stand of grass) was chosen based on guidance from the HELP manual (Schroeder et al., 1994b).

The methodology used by the HELP model to calculate the evapotranspiration rate is described in detail by Schroeder et al. (1994b). The methodology takes into consideration daily solar radiation, daily temperature, humidity, wind speed, vegetation type, LAI, growing season, surface and soil water content, maximum evaporative depth, soil water transport, and soil capillarity. The vegetative cover for the E-Area LLWF closure cap is initially assumed to be Bahia grass before pine-tree intrusion 160 years after cap installation.

The following four weather data input files were generated using the HELP model's synthetic weather generator and were utilized in all HELP model runs, except where noted:

- Augusta, GA synthetic precipitation modified with SRS-specific average monthly precipitation data over 100 years (file name: FPREC.D4)
- Augusta, GA synthetic temperature modified with SRS-specific average monthly temperature data over 100 years (file name: FTEMP.D7)

- Augusta, GA synthetic solar radiation data over 100 years (file name: FSOLAR.D13)
- Augusta, GA evapotranspiration data (file name: FEVAP.D11)

Due to their size, the precipitation, temperature, and solar radiation data files are not reproduced in the appendix but are available electronically.

Figure A-1 displays the HELP model evapotranspiration input file FEVAP.D11 used in the E-Area LLWF infiltration simulations, except where noted. Figure A-2 shows the modified HELP model evapotranspiration input file ICEVAP.D11 used in the infiltration simulations for the institutional control (interim cover) case for Slit and Engineered Trenches. For the institutional control case, the LAI is assumed to equal zero (bare ground to represent HDPE geomembrane) and the evaporative zone depth is assumed to be 0.0001 inches (essentially zero; however, a small nonzero value must be assumed to enable model convergence). Figure A-3 displays the modified HELP model evapotranspiration input file VCOLEVAP.D11 used in the simulations of roof collapse for the LAWV, ILV and the CIG special waste form trench segments. An LAI equal to 1.0 for a poor stand of grass and an evaporative zone depth of 16 inches were assumed. Figure A-4 displays the modified HELP model evapotranspiration input file ROOFEVAP.D11 used in the simulations of the operational and institutional control periods for the on-vault intact concrete roof cases for the LAWV and ILV. An LAI equal to zero for bare ground and an evaporative zone depth of 10 inches were assumed.

FEVAP.D11
```
 1
AUGUSTA                     GEORGIA
33.22        68  323  3.5     22.     6.5   68.0  70.0  77.0  73.0

```

Figure A-1. FEVAP.D11 file used in E-Area LLWF HELP Model Simulations (except where noted).

ICEVAP.D11
```
 1
AUGUSTA                     GEORGIA
33.22        68  323  0.     .0001    6.5   68.0  70.0  77.0  73.0

```

Figure A-2. ICEVAP.D11 file used in HELP Model Simulations of the Institutional Control (Interim Cover) Period.

VCOLEVAP.d11
```
 1
AUGUSTA                     GEORGIA
33.22        68  323  1.      16.     6.5   68.0  70.0  77.0  73.0

```

Figure A-3. VCOLEVAP.D11 file used in HELP Model Simulations of Concrete Roof Collapse Cases for the LAWV, ILV, and CIG Special Waste Form Trench Segments.

```
ROOFEVAP.D11
 1
AUGUSTA                  GEORGIA
33.22         68 323 0.      10.     6.5   68.0 70.0 77.0 73.0

```

Figure A-4. ROOFEVAP.D11 file used in HELP Model Simulations of Intact Concrete Roof Cases for the LAWV and ILV.

Table A-2. Monthly Temperature Data in Degrees Fahrenheit for SRNL/CLM Weather Station.

Year	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
1968	43.5	43.4	57.1	66.5	71.3	80	83.1	82.8	77	67	55.4	45.9
1969	46.5	46.6	51.5	64.5	70.5	80.3	83.3	77.6	72.8	66.1	52.1	45.4
1970	39	47.2	55.9	66.8	74.2	79	81.1	80.8	78.6	67	51.6	49.3
1971	44.6	46.4	49.5	63.4	70.7	81.3	80.7	80.4	75.2	70.2	55.5	56.9
1972	51.7	45.6	57.6	67.4	72.4	75.3	79.7	80.6	77.2	64.8	54.4	53.2
1973	46.1	45.9	60.7	61.9	70.5	77.7	79.1	74.5	70.5	62.4	59	50.3
1974	59.6	50.8	62.2	66.2	75.3	77.5	81.5	80.9	75.3	64.5	56.6	49
1975	51.4	53.2	55.8	63.9	75.6	79.1	79.7	82.4	75.7	68.7	59.3	48.5
1976	44.2	55.7	61.5	64.8	68.9	75.6	80.4	78	73.1	60.1	48.7	44.8
1977	35.3	47.1	60	66.9	73.3	80.6	83.6	80.6	77.9	62.1	58.2	46.7
1978	39.3	41.3	54.2	65.7	70.9	79.7	82.1	81.2	77.1	65.6	60.7	49.6
1979	42.1	44.6	57.5	64.5	71.3	75.1	79.6	80.5	73.4	64.8	57.4	47.4
1980	45.9	44.3	52.6	63.5	71.2	78.3	83.8	82.5	79.2	62.7	52.8	46
1981	40.4	48.5	53	67	68.6	81.3	81.3	76.3	74	62.1	54.4	43.2
1982	43	50	58.9	62.4	75.7	78.8	80.9	80.1	75	66.2	58.7	54.8
1983	43.3	48	55.3	59.4	66.8	76.7	84.3	83.9	74.8	67.2	56.4	45.8
1984	45	51.7	56.5	62.6	71.9	80.1	80.1	80.8	74	73.4	53.4	56.9
1985	42.9	49.5	60.2	67.5	74.5	80.8	81.1	79.7	75.7	70.8	65.5	45.4
1986	45.4	54.6	57.9	66.4	74.4	82.7	86.9	80.1	78.4	67.1	61.3	49.3
1987	46.2	48.6	56.5	62.3	74.5	79.9	82.8	83.8	76.6	60.7	59.1	52.9
1988	42.3	47.8	56.8	64.2	70.4	76.8	81.6	81.4	75.4	61.2	58	49.1
1989	52.2	52	58.3	64.2	70.6	79.8	81.4	80.9	75.3	67.3	52.4	44.2
1990	54.9	57.5	60	64	72.9	80.5	83.7	83.8	79	69.4	59.9	54.6
1991	47.9	54.1	60.3	69.2	76.9	79.5	83.6	81.2	77.4	68.1	55.4	54
1992	49.5	54.1	57.2	65	71.2	78.9	83.7	80.7	76.9	65	57.1	48
1993	51.7	47.8	53.2	58.9	69.7	78.2	83.6	80	75.2	62.8	55.2	43.6
1994	41.5	50.1	60.2	68	71.2	82.3	81.8	81.2	77.4	67.2	62.3	53.3
1995	45.5	49.9	58.6	65.9	73.5	75	79.9	79	71.8	65.9	50.8	43.8
1996	44.6	50.1	50.6	61.6	72.9	76.5	79.3	76	72.7	62.1	51.6	48.8
1997	48.2	52.9	63.3	61.2	68.5	74	80.2	79	75	64.1	51.6	47
1998	49.7	51.1	53.6	62.7	74.6	82.1	82.6	80.3	75.8	66.9	60.5	53.6
1999	51.9	51.6	53.4	67.2	69.7	76.6	80.7	82.9	73.8	64.3	58.1	48.6
2000	44.4	50.2	58.5	60.7	75.1	78	79.9	77.6	71.7	62.5	53.1	38.2
2001	43.8	52.4	53	63.9	71.3	75.3	77.7	78.8	71.2	62.2	60	52.4
2002	47.3	48	57.6	68.1	70.2	77.5	80.5	78.4	75.4	66.7	51.7	44.5
2003	42	47.5	57.6	61.6	70.6	75.2	77.3	77.7	71.9	63.7	58.2	42.9
2004	43.7	45.2	58.5	63.4	74	77.7	80.1	77.3	73.2	66.2	56.1	45.8
2005	47.9	49	53.1	60.9	68	75.4	79.4	78.8	77	64.7	56.1	44.3
2006	50.8	47.3	55.3	66.3	70.1	76.2	80.3	80.5	72.9	62.4	53.6	50.6
Mean	**46.0**	**49.3**	**56.8**	**64.4**	**71.9**	**78.3**	**81.3**	**80.1**	**75.1**	**65.3**	**56.2**	**48.4**

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Appendix B. HELP v4.0 Input Parameters for Intact Cases – Slit and Engineered Trenches

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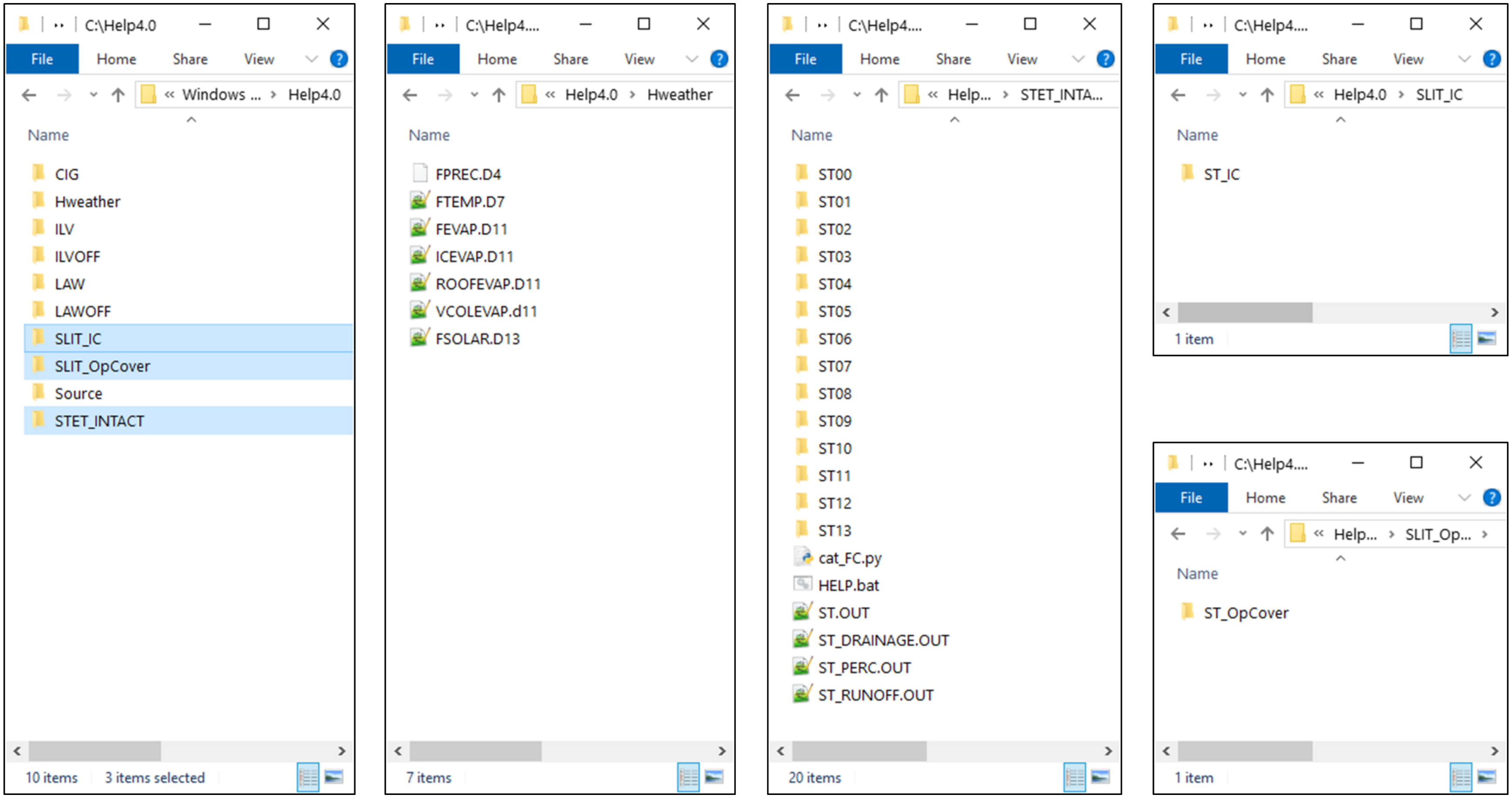

Figure B-1. HELP Model File Hierarchy for Slit and Engineered Trench Simulations.

Table B-1. HELP Model Input Data for Operational Soil Cover (ST_OpCover.D10).

Input Parameter (HELP Model Query)	Generic Input Parameter Value
Landfill area =	0.0689 acres
Percent of area where runoff is possible =	100%
Do you want to specify initial moisture storage? (Y/N)	Y
Amount of water or snow on surface =	0 inches
CN Input Parameter (HELP Model Query)	CN Input Parameter Value
Slope =	1 %
Slope length =	80 ft
Soil Texture =	4 (HELP model default soil texture)
Vegetation =	4 (i.e., a good stand of grass)
HELP Model Computed Curve Number = 53.06	

Layer	Layer Number	Layer Type
Topsoil	1	1 (vertical percolation layer)

Layer #	Layer Type	Layer Thickness (in)	Soil Texture No.	Total Porosity (Vol/Vol)	Field Capacity (Vol/Vol)	Wilting Point (Vol/Vol)	Initial Moisture [2] (Vol/Vol)
1	1	48		0.396	0.109	0.047	0.109

Layer #	Layer Type	Sat. Hyd. Conductivity (cm/sec)	Drainage Length (ft)	Drain Slope (%)	Leachate Recirc. (%)	Recirc. to Layer (#)	Subsurface Inflow (in/yr)
1	1	1.0E-03					

Layer #	Layer Type	Geomembrane Pinhole Density (#/acre)	Geomembrane Instal. Defects (#/acre)	Geomembrane Placement Quality	Geotextile Transmissivity (cm^2/sec)

Table B-2. HELP Model Input Data for Institutional Control (ST_IC.D10).

Input Parameter (HELP Model Query)	Generic Input Parameter Value
Landfill area =	0.0689 acres
Percent of area where runoff is possible =	100%
Do you want to specify initial moisture storage? (Y/N)	Y
Amount of water or snow on surface =	0 inches
CN Input Parameter (HELP Model Query)	**CN Input Parameter Value**
Slope =	2 %
Slope length =	585 ft
Soil Texture =	4 (HELP model default soil texture)
Vegetation =	4 (i.e., a good stand of grass)
HELP Model Computed Curve Number = 46.2	

Layer	Layer Number	Layer Type
Topsoil	1	1 (vertical percolation layer)
GCL	2	4 (geomembrane liner)
Topsoil	3	1 (vertical percolation layer)

Layer #	Layer Type	Layer Thickness (in)	Soil Texture No.	Total Porosity (Vol/Vol)	Field Capacity (Vol/Vol)	Wilting Point (Vol/Vol)	Initial Moisture [2] (Vol/Vol)
1	1	0.0001		0.396	0.109	0.047	0.109
2	4	0.06		0.75	0.747	0.4	0.75
3	1	48		0.396	0.109	0.047	0.109

Layer #	Layer Type	Sat. Hyd. Conductivity (cm/sec)	Drainage Length (ft)	Drain Slope (%)	Leachate Recirc. (%)	Recirc. to Layer (#)	Subsurface Inflow (in/yr)
1	1	1.0E-03					
2	4	5.0E-08					
3	1	1.0E-03					

Layer #	Layer Type	Geomembrane Pinhole Density (#/acre)	Geomembrane Instal. Defects (#/acre)	Geomembrane Placement Quality	Geotextile Transmissivity (cm^2/sec)
2	4	1	4	3	

Table B-3. HELP Model Input Data for Year 100 (ST00.D10).

Input Parameter (HELP Model Query)	Generic Input Parameter Value
Landfill area =	0.2686 acres
Percent of area where runoff is possible =	100%
Do you want to specify initial moisture storage? (Y/N)	Y
Amount of water or snow on surface =	0 inches
CN Input Parameter (HELP Model Query)	**CN Input Parameter Value**
Slope =	2 %
Slope length =	585 ft
Soil Texture =	4 (HELP model default soil texture)
Vegetation =	4 (i.e., a good stand of grass)
HELP Model Computed Curve Number = 46.2	

Layer	Layer Number	Layer Type
Topsoil	1	1 (vertical percolation layer)
Upper Backfill	2	1 (vertical percolation layer)
Erosion Barrier	3	1 (vertical percolation layer)
Lateral Drainage Layer	4	2 (lateral drainage layer)
HDPE Geomembrane	5	4 (geomembrane liner)
GCL	6	3 (barrier soil liner)
Foundation Layer (1E-06)	7	1 (vertical percolation layer)
Foundation Layer (1E-03)	8	1 (vertical percolation layer)

Layer #	Layer Type	Layer Thickness (in)	Soil Texture No.	Total Porosity (Vol/Vol)	Field Capacity (Vol/Vol)	Wilting Point (Vol/Vol)	Initial Moisture [2] (Vol/Vol)
1	1	6		0.396	0.109	0.047	0.109
2	1	30		0.35	0.252	0.181	0.252
3	1	12		0.15	0.1	0.07	0.1
4	2	12		0.417	0.045	0.018	0.045
5	4	0.06					
6	3	0.2		0.75	0.747	0.4	0.75
7	1	12		0.35	0.252	0.181	0.252
8	1	72		0.457	0.131	0.058	0.131

Layer #	Layer Type	Sat. Hyd. Conductivity (cm/sec)	Drainage Length (ft)	Drain Slope (%)	Leachate Recirc. (%)	Recirc. to Layer (#)	Subsurface Inflow (in/yr)
1	1	3.1E-03					
2	1	4.1E-05					
3	1	1.3E-04					
4	2	5.0E-02	585	2			
5	4	2.0E-13					
6	3	5.0E-09					
7	1	1.0E-06					
8	1	1.0E-03					

Layer #	Layer Type	Geomembrane Pinhole Density (#/acre)	Geomembrane Instal. Defects (#/acre)	Geomembrane Placement Quality	Geotextile Transmissivity (cm^2/sec)
5	4	1	4	2	

Table B-4. HELP Model Input Data for Year 180 (ST01.D10).

Input Parameter (HELP Model Query)	Generic Input Parameter Value
Landfill area =	0.2686 acres
Percent of area where runoff is possible =	100%
Do you want to specify initial moisture storage? (Y/N)	Y
Amount of water or snow on surface =	0 inches
CN Input Parameter (HELP Model Query)	CN Input Parameter Value
Slope =	2 %
Slope length =	585 ft
Soil Texture =	4 (HELP model default soil texture)
Vegetation =	4 (i.e., a good stand of grass)
HELP Model Computed Curve Number = 46.2	

Layer	Layer Number	Layer Type
Topsoil	1	1 (vertical percolation layer)
Upper Backfill	2	1 (vertical percolation layer)
Erosion Barrier	3	1 (vertical percolation layer)
Lateral Drainage Layer	4	2 (lateral drainage layer)
HDPE Geomembrane	5	4 (geomembrane liner)
GCL	6	3 (barrier soil liner)
Foundation Layer (1E-06)	7	1 (vertical percolation layer)
Foundation Layer (1E-03)	8	1 (vertical percolation layer)

Layer #	Layer Type	Layer Thickness (in)	Soil Texture No.	Total Porosity (Vol/Vol)	Field Capacity (Vol/Vol)	Wilting Point (Vol/Vol)	Initial Moisture [2] (Vol/Vol)
1	1	5.96		0.396	0.109	0.047	0.109
2	1	30		0.35	0.252	0.181	0.252
3	1	12		0.15	0.1	0.07	0.1
4	2	12		0.416	0.048	0.021	0.048
5	4	0.06					
6	3	0.2		0.75	0.747	0.4	0.75
7	1	12		0.35	0.252	0.181	0.252
8	1	72		0.457	0.131	0.058	0.131

Layer #	Layer Type	Sat. Hyd. Conductivity (cm/sec)	Drainage Length (ft)	Drain Slope (%)	Leachate Recirc. (%)	Recirc. to Layer (#)	Subsurface Inflow (in/yr)
1	1	3.1E-03					
2	1	4.1E-05					
3	1	1.3E-04					
4	2	4.48E-02	585	2			
5	4	2.0E-13					
6	3	5.0E-09					
7	1	1.0E-06					
8	1	1.0E-03					

Layer #	Layer Type	Geomembrane Pinhole Density (#/acre)	Geomembrane Instal. Defects (#/acre)	Geomembrane Placement Quality	Geotextile Transmissivity (cm^2/sec)
5	4	1	40	2	

Table B-5. HELP Model Input Data for Year 290 (ST02.D10).

Input Parameter (HELP Model Query)	Generic Input Parameter Value
Landfill area =	0.2686 acres
Percent of area where runoff is possible =	100%
Do you want to specify initial moisture storage? (Y/N)	Y
Amount of water or snow on surface =	0 inches
CN Input Parameter (HELP Model Query)	CN Input Parameter Value
Slope =	2 %
Slope length =	585 ft
Soil Texture =	4 (HELP model default soil texture)
Vegetation =	4 (i.e., a good stand of grass)
HELP Model Computed Curve Number = 46.2	

Layer	Layer Number	Layer Type
Topsoil	1	1 (vertical percolation layer)
Upper Backfill	2	1 (vertical percolation layer)
Erosion Barrier	3	1 (vertical percolation layer)
Lateral Drainage Layer	4	2 (lateral drainage layer)
HDPE Geomembrane	5	4 (geomembrane liner)
GCL	6	3 (barrier soil liner)
Foundation Layer (1E-06)	7	1 (vertical percolation layer)
Foundation Layer (1E-03)	8	1 (vertical percolation layer)

Layer #	Layer Type	Layer Thickness (in)	Soil Texture No.	Total Porosity (Vol/Vol)	Field Capacity (Vol/Vol)	Wilting Point (Vol/Vol)	Initial Moisture [2] (Vol/Vol)
1	1	5.90		0.396	0.109	0.047	0.109
2	1	30		0.35	0.252	0.181	0.252
3	1	12		0.15	0.1	0.07	0.1
4	2	12		0.414	0.052	0.024	0.052
5	4	0.06					
6	3	0.2		0.75	0.747	0.4	0.75
7	1	12		0.35	0.252	0.181	0.252
8	1	72		0.457	0.131	0.058	0.131

Layer #	Layer Type	Sat. Hyd. Conductivity (cm/sec)	Drainage Length (ft)	Drain Slope (%)	Leachate Recirc. (%)	Recirc. to Layer (#)	Subsurface Inflow (in/yr)
1	1	3.1E-03					
2	1	4.1E-05					
3	1	1.3E-04					
4	2	3.86E-02	585	2			
5	4	2.0E-13					
6	3	5.0E-08					
7	1	1.0E-06					
8	1	1.0E-03					

Layer #	Layer Type	Geomembrane Pinhole Density (#/acre)	Geomembrane Instal. Defects (#/acre)	Geomembrane Placement Quality	Geotextile Transmissivity (cm^2/sec)
5	4	1	96	2	

Table B-6. HELP Model Input Data for Year 300 (ST03.D10).

Input Parameter (HELP Model Query)	Generic Input Parameter Value
Landfill area =	0.2686 acres
Percent of area where runoff is possible =	100%
Do you want to specify initial moisture storage? (Y/N)	Y
Amount of water or snow on surface =	0 inches
CN Input Parameter (HELP Model Query)	CN Input Parameter Value
Slope =	2 %
Slope length =	585 ft
Soil Texture =	4 (HELP model default soil texture)
Vegetation =	4 (i.e., a good stand of grass)
HELP Model Computed Curve Number = 46.2	

Layer	Layer Number	Layer Type
Topsoil	1	1 (vertical percolation layer)
Upper Backfill	2	1 (vertical percolation layer)
Erosion Barrier	3	1 (vertical percolation layer)
Lateral Drainage Layer	4	2 (lateral drainage layer)
HDPE Geomembrane	5	4 (geomembrane liner)
GCL	6	3 (barrier soil liner)
Foundation Layer (1E-06)	7	1 (vertical percolation layer)
Foundation Layer (1E-03)	8	1 (vertical percolation layer)

Layer #	Layer Type	Layer Thickness (in)	Soil Texture No.	Total Porosity (Vol/Vol)	Field Capacity (Vol/Vol)	Wilting Point (Vol/Vol)	Initial Moisture [2] (Vol/Vol)
1	1	5.90		0.396	0.109	0.047	0.109
2	1	30		0.35	0.252	0.181	0.252
3	1	12		0.15	0.1	0.07	0.1
4	2	12		0.414	0.053	0.024	0.053
5	4	0.06					
6	3	0.2		0.75	0.747	0.4	0.75
7	1	12		0.35	0.252	0.181	0.252
8	1	72		0.457	0.131	0.058	0.131

Layer #	Layer Type	Sat. Hyd. Conductivity (cm/sec)	Drainage Length (ft)	Drain Slope (%)	Leachate Recirc. (%)	Recirc. to Layer (#)	Subsurface Inflow (in/yr)
1	1	3.1E-03					
2	1	4.1E-05					
3	1	1.3E-04					
4	2	3.81E-02	585	2			
5	4	2.0E-13					
6	3	5.0E-08					
7	1	1.0E-06					
8	1	1.0E-03					

Layer #	Layer Type	Geomembrane Pinhole Density (#/acre)	Geomembrane Instal. Defects (#/acre)	Geomembrane Placement Quality	Geotextile Transmissivity (cm^2/sec)
5	4	1	101	2	

Table B-7. HELP Model Input Data for Year 340 (ST04.D10).

Input Parameter (HELP Model Query)	Generic Input Parameter Value
Landfill area =	0.2686 acres
Percent of area where runoff is possible =	100%
Do you want to specify initial moisture storage? (Y/N)	Y
Amount of water or snow on surface =	0 inches
CN Input Parameter (HELP Model Query)	CN Input Parameter Value
Slope =	2 %
Slope length =	585 ft
Soil Texture =	4 (HELP model default soil texture)
Vegetation =	4 (i.e., a good stand of grass)
HELP Model Computed Curve Number = 46.2	

Layer	Layer Number	Layer Type
Topsoil	1	1 (vertical percolation layer)
Upper Backfill	2	1 (vertical percolation layer)
Erosion Barrier	3	1 (vertical percolation layer)
Lateral Drainage Layer	4	2 (lateral drainage layer)
HDPE Geomembrane & GCL	5	4 (geomembrane liner)
Foundation Layer (1E-06)	6	1 (vertical percolation layer)
Foundation Layer (1E-03)	7	1 (vertical percolation layer)

Layer #	Layer Type	Layer Thickness (in)	Soil Texture No.	Total Porosity (Vol/Vol)	Field Capacity (Vol/Vol)	Wilting Point (Vol/Vol)	Initial Moisture [2] (Vol/Vol)
1	1	5.88		0.396	0.109	0.047	0.109
2	1	30		0.35	0.252	0.181	0.252
3	1	12		0.15	0.1	0.07	0.1
4	2	12		0.414	0.054	0.026	0.054
5	4	0.26					
6	1	12		0.35	0.252	0.181	0.252
7	1	72		0.457	0.131	0.058	0.131

Layer #	Layer Type	Sat. Hyd. Conductivity (cm/sec)	Drainage Length (ft)	Drain Slope (%)	Leachate Recirc. (%)	Recirc. to Layer (#)	Subsurface Inflow (in/yr)
1	1	3.1E-03					
2	1	4.1E-05					
3	1	1.3E-04					
4	2	3.60E-02	585	2			
5	4	8.7E-13					
6	1	1.0E-06					
7	1	1.0E-03					

Layer #	Layer Type	Geomembrane Pinhole Density (#/acre)	Geomembrane Instal. Defects (#/acre)	Geomembrane Placement Quality	Geotextile Transmissivity (cm^2/sec)
5	4	1	121	2	

Table B-8. HELP Model Input Data for Year 380 (ST05.D10).

Input Parameter (HELP Model Query)	Generic Input Parameter Value
Landfill area =	0.2686 acres
Percent of area where runoff is possible =	100%
Do you want to specify initial moisture storage? (Y/N)	Y
Amount of water or snow on surface =	0 inches
CN Input Parameter (HELP Model Query)	CN Input Parameter Value
Slope =	2 %
Slope length =	585 ft
Soil Texture =	4 (HELP model default soil texture)
Vegetation =	4 (i.e., a good stand of grass)
HELP Model Computed Curve Number = 46.2	

Layer	Layer Number	Layer Type
Topsoil	1	1 (vertical percolation layer)
Upper Backfill	2	1 (vertical percolation layer)
Erosion Barrier	3	1 (vertical percolation layer)
Lateral Drainage Layer	4	2 (lateral drainage layer)
HDPE Geomembrane & GCL	5	4 (geomembrane liner)
Foundation Layer (1E-06)	6	1 (vertical percolation layer)
Foundation Layer (1E-03)	7	1 (vertical percolation layer)

Layer #	Layer Type	Layer Thickness (in)	Soil Texture No.	Total Porosity (Vol/Vol)	Field Capacity (Vol/Vol)	Wilting Point (Vol/Vol)	Initial Moisture [2] (Vol/Vol)
1	1	5.85		0.396	0.109	0.047	0.109
2	1	30		0.35	0.252	0.181	0.252
3	1	12		0.15	0.1	0.07	0.1
4	2	12		0.413	0.056	0.027	0.056
5	4	0.26					
6	1	12		0.35	0.252	0.181	0.252
7	1	72		0.457	0.131	0.058	0.131

Layer #	Layer Type	Sat. Hyd. Conductivity (cm/sec)	Drainage Length (ft)	Drain Slope (%)	Leachate Recirc. (%)	Recirc. to Layer (#)	Subsurface Inflow (in/yr)
1	1	3.1E-03					
2	1	4.1E-05					
3	1	1.3E-04					
4	2	3.41E-02	585	2			
5	4	8.7E-13					
6	1	1.0E-06					
7	1	1.0E-03					

Layer #	Layer Type	Geomembrane Pinhole Density (#/acre)	Geomembrane Instal. Defects (#/acre)	Geomembrane Placement Quality	Geotextile Transmissivity (cm^2/sec)
5	4	1	141	2	

Table B-9. HELP Model Input Data for Year 480 (ST06.D10).

Input Parameter (HELP Model Query)	Generic Input Parameter Value
Landfill area =	0.2686 acres
Percent of area where runoff is possible =	100%
Do you want to specify initial moisture storage? (Y/N)	Y
Amount of water or snow on surface =	0 inches
CN Input Parameter (HELP Model Query)	CN Input Parameter Value
Slope =	2 %
Slope length =	585 ft
Soil Texture =	4 (HELP model default soil texture)
Vegetation =	4 (i.e., a good stand of grass)
HELP Model Computed Curve Number = 46.2	

Layer	Layer Number	Layer Type
Topsoil	1	1 (vertical percolation layer)
Upper Backfill	2	1 (vertical percolation layer)
Erosion Barrier	3	1 (vertical percolation layer)
Lateral Drainage Layer	4	2 (lateral drainage layer)
HDPE Geomembrane & GCL	5	4 (geomembrane liner)
Foundation Layer (1E-06)	6	1 (vertical percolation layer)
Foundation Layer (1E-03)	7	1 (vertical percolation layer)

Layer #	Layer Type	Layer Thickness (in)	Soil Texture No.	Total Porosity (Vol/Vol)	Field Capacity (Vol/Vol)	Wilting Point (Vol/Vol)	Initial Moisture [2] (Vol/Vol)
1	1	5.84		0.396	0.109	0.047	0.109
2	1	30		0.35	0.252	0.181	0.252
3	1	12		0.15	0.1	0.07	0.1
4	2	12		0.412	0.06	0.03	0.06
5	4	0.26					
6	1	12		0.35	0.252	0.181	0.252
7	1	72		0.457	0.131	0.058	0.131

Layer #	Layer Type	Sat. Hyd. Conductivity (cm/sec)	Drainage Length (ft)	Drain Slope (%)	Leachate Recirc. (%)	Recirc. to Layer (#)	Subsurface Inflow (in/yr)
1	1	3.1E-03					
2	1	4.1E-05					
3	1	1.3E-04					
4	2	2.98E-02	585	2			
5	4	8.7E-13					
6	1	1.0E-06					
7	1	1.0E-03					

Layer #	Layer Type	Geomembrane Pinhole Density (#/acre)	Geomembrane Instal. Defects (#/acre)	Geomembrane Placement Quality	Geotextile Transmissivity (cm^2/sec)
5	4	1	479	2	

Table B-10. HELP Model Input Data for Year 660 (ST07.D10).

Input Parameter (HELP Model Query)	Generic Input Parameter Value
Landfill area =	0.2686 acres
Percent of area where runoff is possible =	100%
Do you want to specify initial moisture storage? (Y/N)	Y
Amount of water or snow on surface =	0 inches
CN Input Parameter (HELP Model Query)	CN Input Parameter Value
Slope =	2 %
Slope length =	585 ft
Soil Texture =	4 (HELP model default soil texture)
Vegetation =	4 (i.e., a good stand of grass)
HELP Model Computed Curve Number = 46.2	

Layer	Layer Number	Layer Type
Topsoil	1	1 (vertical percolation layer)
Upper Backfill	2	1 (vertical percolation layer)
Erosion Barrier	3	1 (vertical percolation layer)
Lateral Drainage Layer	4	2 (lateral drainage layer)
HDPE Geomembrane & GCL	5	4 (geomembrane liner)
Foundation Layer (1E-06)	6	1 (vertical percolation layer)
Foundation Layer (1E-03)	7	1 (vertical percolation layer)

Layer #	Layer Type	Layer Thickness (in)	Soil Texture No.	Total Porosity (Vol/Vol)	Field Capacity (Vol/Vol)	Wilting Point (Vol/Vol)	Initial Moisture [2] (Vol/Vol)
1	1	5.82		0.396	0.109	0.047	0.109
2	1	30		0.35	0.252	0.181	0.252
3	1	12		0.15	0.1	0.07	0.1
4	2	12		0.409	0.067	0.036	0.067
5	4	0.26					
6	1	12		0.35	0.252	0.181	0.252
7	1	72		0.457	0.131	0.058	0.131

Layer #	Layer Type	Sat. Hyd. Conductivity (cm/sec)	Drainage Length (ft)	Drain Slope (%)	Leachate Recirc. (%)	Recirc. to Layer (#)	Subsurface Inflow (in/yr)
1	1	3.1E-03					
2	1	4.1E-05					
3	1	1.3E-04					
4	2	2.33E-02	585	2			
5	4	8.7E-13					
6	1	1.0E-06					
7	1	1.0E-03					

Layer #	Layer Type	Geomembrane Pinhole Density (#/acre)	Geomembrane Instal. Defects (#/acre)	Geomembrane Placement Quality	Geotextile Transmissivity (cm^2/sec)
5	4	1	1115	2	

Table B-11. HELP Model Input Data for Year 1,100 (ST08.D10).

Input Parameter (HELP Model Query)	Generic Input Parameter Value
Landfill area =	0.2686 acres
Percent of area where runoff is possible =	100%
Do you want to specify initial moisture storage? (Y/N)	Y
Amount of water or snow on surface =	0 inches
CN Input Parameter (HELP Model Query)	CN Input Parameter Value
Slope =	2 %
Slope length =	585 ft
Soil Texture =	4 (HELP model default soil texture)
Vegetation =	4 (i.e., a good stand of grass)
HELP Model Computed Curve Number = 46.2	

Layer	Layer Number	Layer Type
Topsoil	1	1 (vertical percolation layer)
Upper Backfill	2	1 (vertical percolation layer)
Erosion Barrier	3	1 (vertical percolation layer)
Lateral Drainage Layer	4	2 (lateral drainage layer)
HDPE Geomembrane & GCL	5	4 (geomembrane liner)
Foundation Layer (1E-06)	6	1 (vertical percolation layer)
Foundation Layer (1E-03)	7	1 (vertical percolation layer)

Layer #	Layer Type	Layer Thickness (in)	Soil Texture No.	Total Porosity (Vol/Vol)	Field Capacity (Vol/Vol)	Wilting Point (Vol/Vol)	Initial Moisture [2] (Vol/Vol)
1	1	5.76		0.396	0.109	0.047	0.109
2	1	30		0.35	0.252	0.181	0.252
3	1	12		0.15	0.1	0.07	0.1
4	2	12		0.403	0.084	0.049	0.084
5	4	0.26					
6	1	12		0.35	0.252	0.181	0.252
7	1	72		0.457	0.131	0.058	0.131

Layer #	Layer Type	Sat. Hyd. Conductivity (cm/sec)	Drainage Length (ft)	Drain Slope (%)	Leachate Recirc. (%)	Recirc. to Layer (#)	Subsurface Inflow (in/yr)
1	1	3.1E-03					
2	1	4.1E-05					
3	1	1.3E-04					
4	2	1.28E-02	585	2			
5	4	8.7E-13					
6	1	1.0E-06					
7	1	1.0E-03					

Layer #	Layer Type	Geomembrane Pinhole Density (#/acre)	Geomembrane Instal. Defects (#/acre)	Geomembrane Placement Quality	Geotextile Transmissivity (cm^2/sec)
5	4	1	2669	2	

Table B-12. HELP Model Input Data for Year 1,900 (ST09.D10).

Input Parameter (HELP Model Query)	Generic Input Parameter Value
Landfill area =	0.2686 acres
Percent of area where runoff is possible =	100%
Do you want to specify initial moisture storage? (Y/N)	Y
Amount of water or snow on surface =	0 inches
CN Input Parameter (HELP Model Query)	CN Input Parameter Value
Slope =	2 %
Slope length =	585 ft
Soil Texture =	4 (HELP model default soil texture)
Vegetation =	4 (i.e., a good stand of grass)
HELP Model Computed Curve Number = 46.2	

Layer	Layer Number	Layer Type
Topsoil	1	1 (vertical percolation layer)
Upper Backfill	2	1 (vertical percolation layer)
Erosion Barrier	3	1 (vertical percolation layer)
Lateral Drainage Layer	4	2 (lateral drainage layer)
HDPE Geomembrane & GCL	5	4 (geomembrane liner)
Foundation Layer (1E-06)	6	1 (vertical percolation layer)
Foundation Layer (1E-03)	7	1 (vertical percolation layer)

Layer #	Layer Type	Layer Thickness (in)	Soil Texture No.	Total Porosity (Vol/Vol)	Field Capacity (Vol/Vol)	Wilting Point (Vol/Vol)	Initial Moisture [2] (Vol/Vol)
1	1	5.66		0.396	0.109	0.047	0.109
2	1	30		0.35	0.252	0.181	0.252
3	1	12		0.15	0.1	0.07	0.1
4	2	12		0.392	0.116	0.074	0.116
5	4	0.26					
6	1	12		0.35	0.252	0.181	0.252
7	1	72		0.457	0.131	0.058	0.131

Layer #	Layer Type	Sat. Hyd. Conductivity (cm/sec)	Drainage Length (ft)	Drain Slope (%)	Leachate Recirc. (%)	Recirc. to Layer (#)	Subsurface Inflow (in/yr)
1	1	3.1E-03					
2	1	4.1E-05					
3	1	1.3E-04					
4	2	4.3E-03	585	2			
5	4	8.7E-13					
6	1	1.0E-06					
7	1	1.0E-03					

Layer #	Layer Type	Geomembrane Pinhole Density (#/acre)	Geomembrane Instal. Defects (#/acre)	Geomembrane Placement Quality	Geotextile Transmissivity (cm^2/sec)
5	4	1	5496	2	

Table B-13. HELP Model Input Data for Year 2,723 (ST10.D10).

Input Parameter (HELP Model Query)	Generic Input Parameter Value
Landfill area =	0.2686 acres
Percent of area where runoff is possible =	100%
Do you want to specify initial moisture storage? (Y/N)	Y
Amount of water or snow on surface =	0 inches
CN Input Parameter (HELP Model Query)	CN Input Parameter Value
Slope =	2 %
Slope length =	585 ft
Soil Texture =	4 (HELP model default soil texture)
Vegetation =	4 (i.e., a good stand of grass)
HELP Model Computed Curve Number = 46.2	

Layer	Layer Number	Layer Type
Topsoil	1	1 (vertical percolation layer)
Upper Backfill	2	1 (vertical percolation layer)
Erosion Barrier	3	1 (vertical percolation layer)
Lateral Drainage Layer	4	2 (lateral drainage layer)
HDPE Geomembrane & GCL	5	4 (geomembrane liner)
Foundation Layer (1E-06)	6	1 (vertical percolation layer)
Foundation Layer (1E-03)	7	1 (vertical percolation layer)

Layer #	Layer Type	Layer Thickness (in)	Soil Texture No.	Total Porosity (Vol/Vol)	Field Capacity (Vol/Vol)	Wilting Point (Vol/Vol)	Initial Moisture [2] (Vol/Vol)
1	1	5.55		0.396	0.109	0.047	0.109
2	1	30		0.35	0.252	0.181	0.252
3	1	12		0.15	0.1	0.07	0.1
4	2	12		0.38	0.148	0.1	0.148
5	4	0.26					
6	1	12		0.35	0.252	0.181	0.252
7	1	72		0.457	0.131	0.058	0.131

Layer #	Layer Type	Sat. Hyd. Conductivity (cm/sec)	Drainage Length (ft)	Drain Slope (%)	Leachate Recirc. (%)	Recirc. to Layer (#)	Subsurface Inflow (in/yr)
1	1	3.1E-03					
2	1	4.1E-05					
3	1	1.3E-04					
4	2	1.4E-03	585	2			
5	4	8.7E-13					
6	1	1.0E-06					
7	1	1.0E-03					

Layer #	Layer Type	Geomembrane Pinhole Density (#/acre)	Geomembrane Instal. Defects (#/acre)	Geomembrane Placement Quality	Geotextile Transmissivity (cm^2/sec)
5	4	1	8403	2	

Table B-14. HELP Model Input Data for Year 3,300 (ST11.D10).

Input Parameter (HELP Model Query)	Generic Input Parameter Value
Landfill area =	0.2686 acres
Percent of area where runoff is possible =	100%
Do you want to specify initial moisture storage? (Y/N)	Y
Amount of water or snow on surface =	0 inches
CN Input Parameter (HELP Model Query)	CN Input Parameter Value
Slope =	2 %
Slope length =	585 ft
Soil Texture =	4 (HELP model default soil texture)
Vegetation =	4 (i.e., a good stand of grass)
HELP Model Computed Curve Number = 46.2	

Layer	Layer Number	Layer Type
Topsoil	1	1 (vertical percolation layer)
Upper Backfill	2	1 (vertical percolation layer)
Erosion Barrier	3	1 (vertical percolation layer)
Lateral Drainage Layer	4	2 (lateral drainage layer)
HDPE Geomembrane & GCL	5	4 (geomembrane liner)
Foundation Layer (1E-06)	6	1 (vertical percolation layer)
Foundation Layer (1E-03)	7	1 (vertical percolation layer)

Layer #	Layer Type	Layer Thickness (in)	Soil Texture No.	Total Porosity (Vol/Vol)	Field Capacity (Vol/Vol)	Wilting Point (Vol/Vol)	Initial Moisture [2] (Vol/Vol)
1	1	5.47		0.396	0.109	0.047	0.109
2	1	30		0.35	0.252	0.181	0.252
3	1	12		0.15	0.1	0.07	0.1
4	2	12		0.38	0.148	0.1	0.148
5	4	0.26					
6	1	12		0.35	0.252	0.181	0.252
7	1	72		0.457	0.131	0.058	0.131

Layer #	Layer Type	Sat. Hyd. Conductivity (cm/sec)	Drainage Length (ft)	Drain Slope (%)	Leachate Recirc. (%)	Recirc. to Layer (#)	Subsurface Inflow (in/yr)
1	1	3.1E-03					
2	1	4.1E-05					
3	1	1.3E-04					
4	2	1.4E-03	585	2			
5	4	8.7E-13					
6	1	1.0E-06					
7	1	1.0E-03					

Layer #	Layer Type	Geomembrane Pinhole Density (#/acre)	Geomembrane Instal. Defects (#/acre)	Geomembrane Placement Quality	Geotextile Transmissivity (cm^2/sec)
5	4	1	10442	2	

Table B-15. HELP Model Input Data for Year 5,700 (ST12.D10).

Input Parameter (HELP Model Query)	Generic Input Parameter Value
Landfill area =	0.2686 acres
Percent of area where runoff is possible =	100%
Do you want to specify initial moisture storage? (Y/N)	Y
Amount of water or snow on surface =	0 inches
CN Input Parameter (HELP Model Query)	CN Input Parameter Value
Slope =	2 %
Slope length =	585 ft
Soil Texture =	4 (HELP model default soil texture)
Vegetation =	4 (i.e., a good stand of grass)
HELP Model Computed Curve Number = 46.2	

Layer	Layer Number	Layer Type
Topsoil	1	1 (vertical percolation layer)
Upper Backfill	2	1 (vertical percolation layer)
Erosion Barrier	3	1 (vertical percolation layer)
Lateral Drainage Layer	4	2 (lateral drainage layer)
HDPE Geomembrane & GCL	5	4 (geomembrane liner)
Foundation Layer (1E-06)	6	1 (vertical percolation layer)
Foundation Layer (1E-03)	7	1 (vertical percolation layer)

Layer #	Layer Type	Layer Thickness (in)	Soil Texture No.	Total Porosity (Vol/Vol)	Field Capacity (Vol/Vol)	Wilting Point (Vol/Vol)	Initial Moisture [2] (Vol/Vol)
1	1	5.16		0.396	0.109	0.047	0.109
2	1	30		0.35	0.252	0.181	0.252
3	1	12		0.15	0.1	0.07	0.1
4	2	12		0.38	0.148	0.1	0.148
5	4	0.26					
6	1	12		0.35	0.252	0.181	0.252
7	1	72		0.457	0.131	0.058	0.131

Layer #	Layer Type	Sat. Hyd. Conductivity (cm/sec)	Drainage Length (ft)	Drain Slope (%)	Leachate Recirc. (%)	Recirc. to Layer (#)	Subsurface Inflow (in/yr)
1	1	3.1E-03					
2	1	4.1E-05					
3	1	1.3E-04					
4	2	1.4E-03	585	2			
5	4	8.7E-13					
6	1	1.0E-06					
7	1	1.0E-03					

Layer #	Layer Type	Geomembrane Pinhole Density (#/acre)	Geomembrane Instal. Defects (#/acre)	Geomembrane Placement Quality	Geotextile Transmissivity (cm^2/sec)
5	4	1	18921	2	

Table B-16. HELP Model Input Data for Year 10,100 (ST13.D10).

Input Parameter (HELP Model Query)	Generic Input Parameter Value
Landfill area =	0.2686 acres
Percent of area where runoff is possible =	100%
Do you want to specify initial moisture storage? (Y/N)	Y
Amount of water or snow on surface =	0 inches
CN Input Parameter (HELP Model Query)	CN Input Parameter Value
Slope =	2 %
Slope length =	585 ft
Soil Texture =	4 (HELP model default soil texture)
Vegetation =	4 (i.e., a good stand of grass)
HELP Model Computed Curve Number = 46.2	

Layer	Layer Number	Layer Type
Topsoil	1	1 (vertical percolation layer)
Upper Backfill	2	1 (vertical percolation layer)
Erosion Barrier	3	1 (vertical percolation layer)
Lateral Drainage Layer	4	2 (lateral drainage layer)
HDPE Geomembrane & GCL	5	4 (geomembrane liner)
Foundation Layer (1E-06)	6	1 (vertical percolation layer)
Foundation Layer (1E-03)	7	1 (vertical percolation layer)

Layer #	Layer Type	Layer Thickness (in)	Soil Texture No.	Total Porosity (Vol/Vol)	Field Capacity (Vol/Vol)	Wilting Point (Vol/Vol)	Initial Moisture [2] (Vol/Vol)
1	1	4.59		0.396	0.109	0.047	0.109
2	1	30		0.35	0.252	0.181	0.252
3	1	12		0.15	0.1	0.07	0.1
4	2	12		0.38	0.148	0.1	0.148
5	4	0.26					
6	1	12		0.35	0.252	0.181	0.252
7	1	72		0.457	0.131	0.058	0.131

Layer #	Layer Type	Sat. Hyd. Conductivity (cm/sec)	Drainage Length (ft)	Drain Slope (%)	Leachate Recirc. (%)	Recirc. to Layer (#)	Subsurface Inflow (in/yr)
1	1	3.1E-03					
2	1	4.1E-05					
3	1	1.3E-04					
4	2	1.4E-03	585	2			
5	4	8.7E-13					
6	1	1.0E-06					
7	1	1.0E-03					

Layer #	Layer Type	Geomembrane Pinhole Density (#/acre)	Geomembrane Instal. Defects (#/acre)	Geomembrane Placement Quality	Geotextile Transmissivity (cm^2/sec)
5	4	1	34466	2	

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Appendix C. Input and Results of Probabilistic Model Simulations for Slit and Engineered Trench Subsidence Cases

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Windows Batch File for Python Probabilistic Model (runPython_rev6D.bat)

Identification of Parameters on Each Input Line (*example parameter in parentheses*):

1. Python model (*SubsidedAverage_rev6.py*)
2. Prefix for output files (*Case_0.54_Per_110ft*)
3. Size of compartment in feet (*10.*)
4. Total number of compartments (*11*)
5. Percent subsidence (*0.54*)
6. Annual average rainfall minus evapotranspiration in inches (*16.5*)
7. Intact infiltration rate in inches/year (*0.00088*)
8. Number of Monte Carlo realizations (*100000*)
9. Debug flag (*True or False*)
10. Graphic flag >>>>>>O>>>>>> for output (.out) file (*True or False*)
11. Append flag for summary file (*w* for overwrite or *a* for append)

```
SubsidedAverage_rev6.py Case_0.54_Per_110ft 10. 11 0.54 16.5 0.00081 100000 False True w
SubsidedAverage_rev6.py Case_0.54_Per_110ft 10. 11 0.54 16.5 0.00695 100000 False True a
SubsidedAverage_rev6.py Case_0.54_Per_110ft 10. 11 0.54 16.5 0.16442 100000 False True a
SubsidedAverage_rev6.py Case_0.54_Per_110ft 10. 11 0.54 16.5 0.17746 100000 False True a
SubsidedAverage_rev6.py Case_0.54_Per_110ft 10. 11 0.54 16.5 0.30250 100000 False True a
SubsidedAverage_rev6.py Case_0.54_Per_110ft 10. 11 0.54 16.5 0.38002 100000 False True a
SubsidedAverage_rev6.py Case_0.54_Per_110ft 10. 11 0.54 16.5 1.38963 100000 False True a
SubsidedAverage_rev6.py Case_0.54_Per_110ft 10. 11 0.54 16.5 3.23304 100000 False True a
SubsidedAverage_rev6.py Case_0.54_Per_110ft 10. 11 0.54 16.5 6.81720 100000 False True a
SubsidedAverage_rev6.py Case_0.54_Per_110ft 10. 11 0.54 16.5 10.2419 100000 False True a
SubsidedAverage_rev6.py Case_0.54_Per_110ft 10. 11 0.54 16.5 11.0961 100000 False True a
SubsidedAverage_rev6.py Case_0.54_Per_110ft 10. 11 0.54 16.5 11.1791 100000 False True a
SubsidedAverage_rev6.py Case_0.54_Per_110ft 10. 11 0.54 16.5 11.3009 100000 False True a
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SubsidedAverage_rev6.py Case_4.9_Per_550ft 10. 55 4.9 16.5 11.3502 100000 False True a
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Probabilistic Model Results for Slit and Engineered Trench Subsidence Cases

Table C-1. Probabilistic Model Results for 0.54% Subsidence Case at 545 feet and 110 feet Slope Lengths.

Relative Year	Hole/ Compartment Size (ft)	Number of Compartments	Slope Length (ft)	Percent Subsidence	Infiltration Rate Less Evapotranspiration (in/yr)	Intact Infiltration Rate (in/yr)	Number of Realizations	Upslope-to-Subsided Area Ratio	Spatially Averaged Infiltration Rate (in/yr)
100	10	55	545	0.54	16.5	0.00081	100000	28.493906	2.288
180	10	55	545	0.54	16.5	0.00695	100000	28.345322	2.282
290	10	55	545	0.54	16.5	0.164	100000	28.287873	2.381
300	10	55	545	0.54	16.5	0.177	100000	28.276848	2.424
340	10	55	545	0.54	16.5	0.303	100000	28.487708	2.528
380	10	55	545	0.54	16.5	0.380	100000	28.272361	2.613
480	10	55	545	0.54	16.5	1.390	100000	28.503938	3.469
660	10	55	545	0.54	16.5	3.233	100000	28.378485	5.053
1100	10	55	545	0.54	16.5	6.817	100000	28.458253	8.140
1900	10	55	545	0.54	16.5	10.242	100000	28.473329	11.113
2723	10	55	545	0.54	16.5	11.096	100000	28.253152	11.839
3300	10	55	545	0.54	16.5	11.179	100000	28.403834	11.912
5700	10	55	545	0.54	16.5	11.301	100000	28.361949	12.014
10100	10	55	545	0.54	16.5	11.350	100000	28.392386	12.060
100	10	11	110	0.54	16.5	0.00081	100000	5.099608	0.538
180	10	11	110	0.54	16.5	0.00695	100000	5.028462	0.528
290	10	11	110	0.54	16.5	0.164	100000	5.1065	0.693
300	10	11	110	0.54	16.5	0.177	100000	5.04965	0.691
340	10	11	110	0.54	16.5	0.303	100000	5.09622	0.825
380	10	11	110	0.54	16.5	0.380	100000	5.035097	0.897
480	10	11	110	0.54	16.5	1.390	100000	5.071258	1.878
660	10	11	110	0.54	16.5	3.233	100000	5.014785	3.650
1100	10	11	110	0.54	16.5	6.817	100000	5.084847	7.121
1900	10	11	110	0.54	16.5	10.242	100000	5.052192	10.444
2723	10	11	110	0.54	16.5	11.096	100000	5.082361	11.270
3300	10	11	110	0.54	16.5	11.179	100000	5.040726	11.345
5700	10	11	110	0.54	16.5	11.301	100000	5.115773	11.467
10100	10	11	110	0.54	16.5	11.350	100000	5.062725	11.516

Upslope-to-Subsided Area Ratio: Ratio of intact area upslope of the subsided compartment to the area of the subsided compartment

Table C-2. Probabilistic Model Results for 2% Subsidence Case at 545 feet and 110 feet Slope Lengths.

Relative Year	Hole/ Compartment Size (ft)	Number of Compartments	Slope Length (ft)	Percent Subsidence	Infiltration Rate Less Evapotranspiration (in/yr)	Intact Infiltration Rate (in/yr)	Number of Realizations	Upslope-to-Subsided Area Ratio	Spatially Averaged Infiltration Rate (in/yr)
100	10	55	545	2.0	16.5	0.00081	100000	31.954807	6.625
180	10	55	545	2.0	16.5	0.00695	100000	31.879392	6.629
290	10	55	545	2.0	16.5	0.164	100000	31.967557	6.714
300	10	55	545	2.0	16.5	0.177	100000	31.921626	6.706
340	10	55	545	2.0	16.5	0.303	100000	32.029961	6.848
380	10	55	545	2.0	16.5	0.380	100000	32.022866	6.843
480	10	55	545	2.0	16.5	1.390	100000	32.078646	7.480
660	10	55	545	2.0	16.5	3.233	100000	32.068436	8.583
1100	10	55	545	2.0	16.5	6.817	100000	32.100546	10.721
1900	10	55	545	2.0	16.5	10.242	100000	31.93436	12.748
2723	10	55	545	2.0	16.5	11.096	100000	31.969013	13.273
3300	10	55	545	2.0	16.5	11.179	100000	32.041456	13.318
5700	10	55	545	2.0	16.5	11.301	100000	32.101484	13.403
10100	10	55	545	2.0	16.5	11.350	100000	31.996237	13.428
100	10	11	110	2.0	16.5	0.00081	100000	5.228292	1.855
180	10	11	110	2.0	16.5	0.00695	100000	5.192871	1.851
290	10	11	110	2.0	16.5	0.164	100000	5.170371	1.991
300	10	11	110	2.0	16.5	0.177	100000	5.211562	2.027
340	10	11	110	2.0	16.5	0.303	100000	5.219756	2.126
380	10	11	110	2.0	16.5	0.380	100000	5.196435	2.194
480	10	11	110	2.0	16.5	1.390	100000	5.175049	3.091
660	10	11	110	2.0	16.5	3.233	100000	5.226005	4.724
1100	10	11	110	2.0	16.5	6.817	100000	5.16215	7.896
1900	10	11	110	2.0	16.5	10.242	100000	5.206347	10.951
2723	10	11	110	2.0	16.5	11.096	100000	5.237388	11.707
3300	10	11	110	2.0	16.5	11.179	100000	5.153181	11.774
5700	10	11	110	2.0	16.5	11.301	100000	5.195871	11.888
10100	10	11	110	2.0	16.5	11.350	100000	5.236816	11.932

Upslope-to-Subsided Area Ratio: Ratio of intact area upslope of the subsided compartment to the area of the subsided compartment

Table C-3. Probabilistic Model Results for 3.6% Subsidence Case at 545 feet and 110 feet Slope Lengths.

Relative Year	Hole/ Compartment Size (ft)	Number of Compartments	Slope Length (ft)	Percent Subsidence	Infiltration Rate Less Evapotranspiration (in/yr)	Intact Infiltration Rate (in/yr)	Number of Realizations	Upslope-to-Subsided Area Ratio	Spatially Averaged Infiltration Rate (in/yr)
100	10	55	545	3.6	16.5	0.00081	100000	35.687131	9.543
180	10	55	545	3.6	16.5	0.00695	100000	35.708422	9.563
290	10	55	545	3.6	16.5	0.164	100000	35.714142	9.614
300	10	55	545	3.6	16.5	0.177	100000	35.606249	9.614
340	10	55	545	3.6	16.5	0.303	100000	35.695767	9.661
380	10	55	545	3.6	16.5	0.380	100000	35.620876	9.694
480	10	55	545	3.6	16.5	1.390	100000	35.711579	10.140
660	10	55	545	3.6	16.5	3.233	100000	35.639385	10.882
1100	10	55	545	3.6	16.5	6.817	100000	35.715294	12.422
1900	10	55	545	3.6	16.5	10.242	100000	35.679368	13.865
2723	10	55	545	3.6	16.5	11.096	100000	35.709564	14.216
3300	10	55	545	3.6	16.5	11.179	100000	35.633351	14.245
5700	10	55	545	3.6	16.5	11.301	100000	35.754846	14.312
10100	10	55	545	3.6	16.5	11.350	100000	35.668274	14.327
100	10	11	110	3.6	16.5	0.00081	100000	5.349224	3.167
180	10	11	110	3.6	16.5	0.00695	100000	5.356119	3.166
290	10	11	110	3.6	16.5	0.164	100000	5.386418	3.321
300	10	11	110	3.6	16.5	0.177	100000	5.347964	3.287
340	10	11	110	3.6	16.5	0.303	100000	5.337107	3.393
380	10	11	110	3.6	16.5	0.380	100000	5.376922	3.504
480	10	11	110	3.6	16.5	1.390	100000	5.371352	4.269
660	10	11	110	3.6	16.5	3.233	100000	5.340748	5.788
1100	10	11	110	3.6	16.5	6.817	100000	5.364733	8.680
1900	10	11	110	3.6	16.5	10.242	100000	5.355157	11.447
2723	10	11	110	3.6	16.5	11.096	100000	5.37028	12.135
3300	10	11	110	3.6	16.5	11.179	100000	5.345414	12.199
5700	10	11	110	3.6	16.5	11.301	100000	5.347902	12.294
10100	10	11	110	3.6	16.5	11.350	100000	5.346163	12.337

Upslope-to-Subsided Area Ratio: Ratio of intact area upslope of the subsided compartment to the area of the subsided compartment

Table C-4. Probabilistic Model Results for 4.9% Subsidence Case at 545 feet and 110 feet Slope Lengths.

Relative Year	Hole/ Compartment Size (ft)	Number of Compartments	Slope Length (ft)	Percent Subsidence	Infiltration Rate Less Evapotranspiration (in/yr)	Intact Infiltration Rate (in/yr)	Number of Realizations	Upslope-to-Subsided Area Ratio	Spatially Averaged Infiltration Rate (in/yr)
100	10	55	545	4.9	16.5	0.00081	100000	38.28579	11.063
180	10	55	545	4.9	16.5	0.00695	100000	38.236325	11.029
290	10	55	545	4.9	16.5	0.164	100000	38.310662	11.105
300	10	55	545	4.9	16.5	0.177	100000	38.320153	11.111
340	10	55	545	4.9	16.5	0.303	100000	38.265145	11.141
380	10	55	545	4.9	16.5	0.380	100000	38.263777	11.170
480	10	55	545	4.9	16.5	1.390	100000	38.303783	11.504
660	10	55	545	4.9	16.5	3.233	100000	38.29371	12.104
1100	10	55	545	4.9	16.5	6.817	100000	38.296554	13.292
1900	10	55	545	4.9	16.5	10.242	100000	38.242141	14.420
2723	10	55	545	4.9	16.5	11.096	100000	38.326212	14.715
3300	10	55	545	4.9	16.5	11.179	100000	38.315133	14.743
5700	10	55	545	4.9	16.5	11.301	100000	38.265023	14.779
10100	10	55	545	4.9	16.5	11.350	100000	38.246653	14.792
100	10	11	110	4.9	16.5	0.00081	100000	5.500656	4.160
180	10	11	110	4.9	16.5	0.00695	100000	5.486451	4.134
290	10	11	110	4.9	16.5	0.164	100000	5.503601	4.268
300	10	11	110	4.9	16.5	0.177	100000	5.50843	4.284
340	10	11	110	4.9	16.5	0.303	100000	5.508295	4.369
380	10	11	110	4.9	16.5	0.380	100000	5.525556	4.427
480	10	11	110	4.9	16.5	1.390	100000	5.520411	5.177
660	10	11	110	4.9	16.5	3.233	100000	5.500355	6.549
1100	10	11	110	4.9	16.5	6.817	100000	5.476237	9.249
1900	10	11	110	4.9	16.5	10.242	100000	5.507335	11.809
2723	10	11	110	4.9	16.5	11.096	100000	5.510756	12.458
3300	10	11	110	4.9	16.5	11.179	100000	5.514676	12.511
5700	10	11	110	4.9	16.5	11.301	100000	5.521022	12.607
10100	10	11	110	4.9	16.5	11.350	100000	5.520352	12.651

Upslope-to-Subsided Area Ratio: Ratio of intact area upslope of the subsided compartment to the area of the subsided compartment

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Appendix D. HELP Model Input Data Sheets for LAWVs

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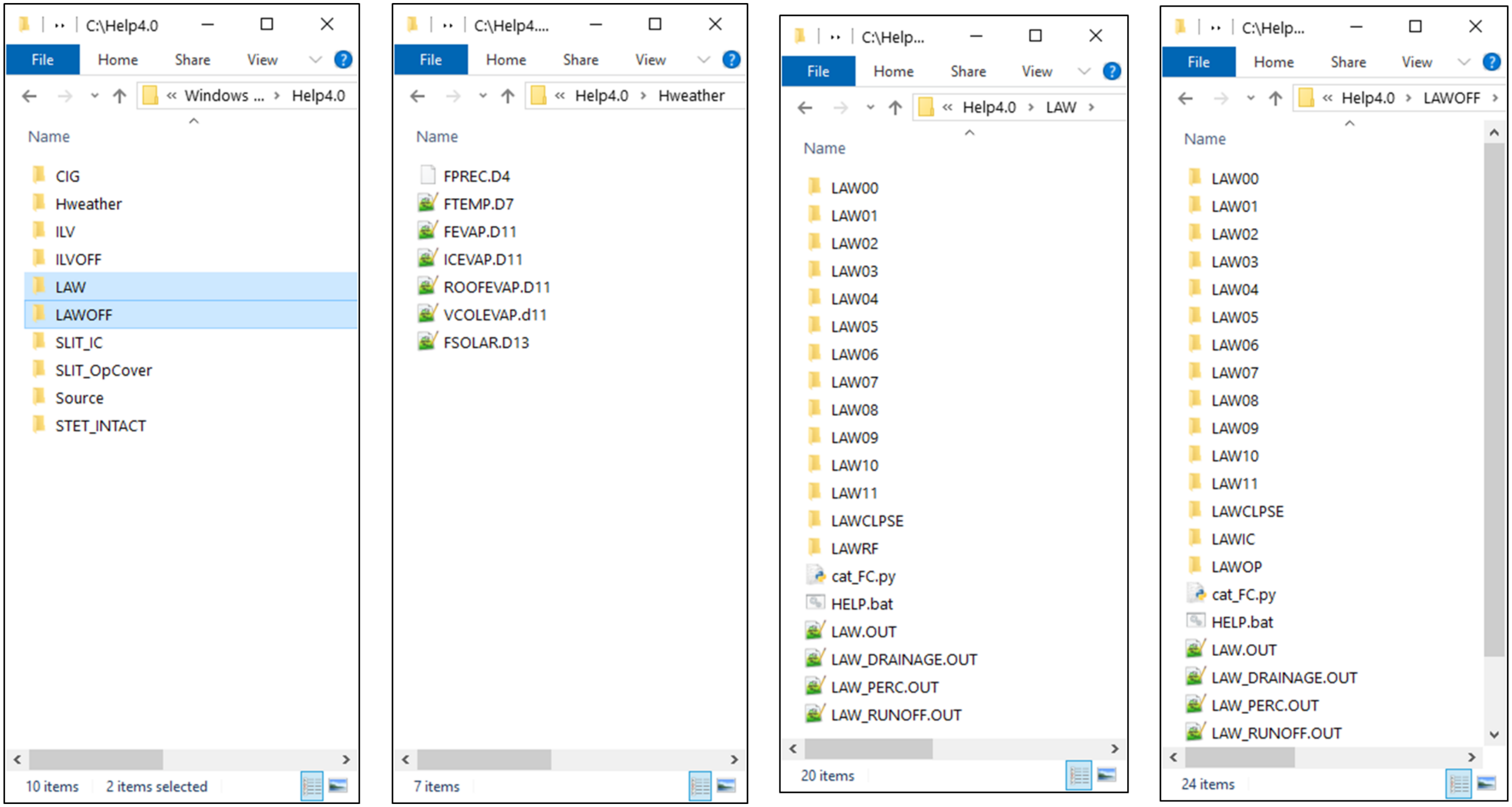

Figure D-1. HELP Model File Hierarchy for LAWV On-Vault and Off-Vault Simulations.

Table D-1. Subsurface Inflow Fluxes to Off-Vault Layer 8 for the Off-Vault LAWV HELP Model Simulations.

LAW Vault North Roof Length 62 feet			
Off-Vault Width 10 feet			
On-Vault LAW Vault Simulation Case	**HELP Model Layer**	**Drainage Rate (inches/year)**	**Subsurface Run-on to Off-Vault Area (inches/year)**
LAW00\OUTPUT\SUMMARY.TXT			
LATERAL DRAINAGE COLLECTED FROM LAYER	4	16.01044	
LATERAL DRAINAGE COLLECTED FROM LAYER	9	0.00079	0.004898
LAW01\OUTPUT\SUMMARY.TXT			
LATERAL DRAINAGE COLLECTED FROM LAYER	4	15.91031	
LATERAL DRAINAGE COLLECTED FROM LAYER	9	0.00656	0.040672
LAW02\OUTPUT\SUMMARY.TXT			
LATERAL DRAINAGE COLLECTED FROM LAYER	4	15.61436	
LATERAL DRAINAGE COLLECTED FROM LAYER	9	0.15471	0.959202
LAW03\OUTPUT\SUMMARY.TXT			
LATERAL DRAINAGE COLLECTED FROM LAYER	4	15.58604	
LATERAL DRAINAGE COLLECTED FROM LAYER	9	0.16754	1.038748
LAW04\OUTPUT\SUMMARY.TXT			
LATERAL DRAINAGE COLLECTED FROM LAYER	4	15.38997	
LATERAL DRAINAGE COLLECTED FROM LAYER	8	0.29009	1.798558
LAW05\OUTPUT\SUMMARY.TXT			
LATERAL DRAINAGE COLLECTED FROM LAYER	4	15.23168	
LATERAL DRAINAGE COLLECTED FROM LAYER	8	0.36689	2.274718
LAW06\OUTPUT\SUMMARY.TXT			
LATERAL DRAINAGE COLLECTED FROM LAYER	4	14.20780	
LATERAL DRAINAGE COLLECTED FROM LAYER	8	1.36955	8.49121
LAW07\OUTPUT\SUMMARY.TXT			
LATERAL DRAINAGE COLLECTED FROM LAYER	4	12.21902	
LATERAL DRAINAGE COLLECTED FROM LAYER	8	3.20344	19.861328
LAW08\OUTPUT\SUMMARY.TXT			
LATERAL DRAINAGE COLLECTED FROM LAYER	4	7.85859	
LATERAL DRAINAGE COLLECTED FROM LAYER	8	6.76999	41.973938
LAW09\OUTPUT\SUMMARY.TXT			
LATERAL DRAINAGE COLLECTED FROM LAYER	4	3.00765	
LATERAL DRAINAGE COLLECTED FROM LAYER	8	10.17890	63.10918
LAW10\OUTPUT\SUMMARY.TXT			
LATERAL DRAINAGE COLLECTED FROM LAYER	4	1.17939	
LATERAL DRAINAGE COLLECTED FROM LAYER	8	11.02765	68.37143
LAW11\OUTPUT\SUMMARY.TXT			
LATERAL DRAINAGE COLLECTED FROM LAYER	4	1.17259	
LATERAL DRAINAGE COLLECTED FROM LAYER	8	11.05931	68.567722

Table D-2. HELP Model Input Data for LAWV Concrete Roof Only (\LAW\LAWRF.D10).

Input Parameter (HELP Model Query)	Generic Input Parameter Value
Landfill area =	0.916 acres
Percent of area where runoff is possible =	100%
Do you want to specify initial moisture storage? (Y/N)	Y
Amount of water or snow on surface =	0 inches
User-Specified Curve Number = 97.0	

Layer	Layer Number	Layer Type
Gravel Drainage Layer	1	2 (lateral drainage layer)
Concrete Roof Slab	2	3 (barrier soil liner)
Gravel	3	1 (vertical percolation layer)

Layer #	Layer Type	Layer Thickness (in)	Soil Texture No.	Total Porosity (Vol/Vol)	Field Capacity (Vol/Vol)	Wilting Point (Vol/Vol)	Initial Moisture [2] (Vol/Vol)
1	2	0.1		0.38	0.08	0.013	0.08
2	3	16		0.19	0.18	0.17	0.19
3	1	101.64		0.38	0.08	0.013	0.08

Layer #	Layer Type	Sat. Hyd. Conductivity (cm/sec)	Drainage Length (ft)	Drain Slope (%)	Leachate Recirc. (%)	Recirc. to Layer (#)	Subsurface Inflow (in/yr)
1	2	1.0E-01	62	2			
2	3	1.0E-12					
3	1	1.0E-01					

Layer #	Layer Type	Geomembrane Pinhole Density (#/acre)	Geomembrane Instal. Defects (#/acre)	Geomembrane Placement Quality	Geotextile Transmissivity (cm^2/sec)

Table D-3. HELP Model Input Data for LAWV On-Vault Year 100 (\LAW\LAW00.D10).

Input Parameter (HELP Model Query)	Generic Input Parameter Value
Landfill area =	1.071 acres
Percent of area where runoff is possible =	100%
Do you want to specify initial moisture storage? (Y/N)	Y
Amount of water or snow on surface =	0 inches
CN Input Parameter (HELP Model Query)	CN Input Parameter Value
Slope =	2 %
Slope length =	585 ft
Soil Texture =	4 (HELP model default soil texture)
Vegetation =	4 (i.e., a good stand of grass)
HELP Model Computed Curve Number = 46.2	

Layer	Layer Number	Layer Type
Topsoil	1	1 (vertical percolation layer)
Upper Backfill	2	1 (vertical percolation layer)
Erosion Barrier	3	1 (vertical percolation layer)
Upper Drainage Layer	4	2 (lateral drainage layer)
HDPE Geomembrane	5	4 (geomembrane liner)
GCL	6	3 (barrier soil liner)
Foundation Layer (1E-06)	7	1 (vertical percolation layer)
Foundation Layer (1E-03)	8	1 (vertical percolation layer)
Lower Drainage Layer	9	2 (lateral drainage layer)
Concrete Roof Slab	10	3 (barrier soil liner)

Layer #	Layer Type	Layer Thickness (in)	Soil Texture No.	Total Porosity (Vol/Vol)	Field Capacity (Vol/Vol)	Wilting Point (Vol/Vol)	Initial Moisture [2] (Vol/Vol)
1	1	6		0.396	0.109	0.047	0.109
2	1	30		0.35	0.252	0.181	0.252
3	1	12		0.15	0.1	0.07	0.1
4	2	12		0.417	0.045	0.018	0.045
5	4	0.06					
6	3	0.2		0.75	0.747	0.4	0.75
7	1	12		0.35	0.252	0.181	0.252
8	1	24		0.457	0.131	0.058	0.131
9	2	12		0.457	0.131	0.058	0.131
10	3	12.5		0.19	0.18	0.17	0.19

Layer #	Layer Type	Sat. Hyd. Conductivity (cm/sec)	Drainage Length (ft)	Drain Slope (%)	Leachate Recirc. (%)	Recirc. to Layer (#)	Subsurface Inflow (in/yr)
1	1	3.1E-03					
2	1	4.1E-05					
3	1	1.3E-04					
4	2	5.0E-02	585	2			
5	4	2.0E-13					
6	3	5.0E-09					
7	1	1.0E-06					
8	1	1.0E-03					
9	2	1.0E-03	62	2			
10	3	1.0E-12					

Layer #	Layer Type	Geomembrane Pinhole Density (#/acre)	Geomembrane Instal. Defects (#/acre)	Geomembrane Placement Quality	Geotextile Transmissivity (cm^2/sec)
5	4	1	4	2	

Table D-4. HELP Model Input Data for LAWV On-Vault Year 180 (\LAW\LAW01.D10).

Input Parameter (HELP Model Query)	Generic Input Parameter Value
Landfill area =	1.071 acres
Percent of area where runoff is possible =	100%
Do you want to specify initial moisture storage? (Y/N)	Y
Amount of water or snow on surface =	0 inches
CN Input Parameter (HELP Model Query)	CN Input Parameter Value
Slope =	2 %
Slope length =	585 ft
Soil Texture =	4 (HELP model default soil texture)
Vegetation =	4 (i.e., a good stand of grass)
HELP Model Computed Curve Number = 46.2	

Layer	Layer Number	Layer Type
Topsoil	1	1 (vertical percolation layer)
Upper Backfill	2	1 (vertical percolation layer)
Erosion Barrier	3	1 (vertical percolation layer)
Upper Drainage Layer	4	2 (lateral drainage layer)
HDPE Geomembrane	5	4 (geomembrane liner)
GCL	6	3 (barrier soil liner)
Foundation Layer (1E-06)	7	1 (vertical percolation layer)
Foundation Layer (1E-03)	8	1 (vertical percolation layer)
Lower Drainage Layer	9	2 (lateral drainage layer)
Concrete Roof Slab	10	3 (barrier soil liner)

Layer #	Layer Type	Layer Thickness (in)	Soil Texture No.	Total Porosity (Vol/Vol)	Field Capacity (Vol/Vol)	Wilting Point (Vol/Vol)	Initial Moisture [2] (Vol/Vol)
1	1	5.96		0.396	0.109	0.047	0.109
2	1	30		0.35	0.252	0.181	0.252
3	1	12		0.15	0.1	0.07	0.1
4	2	12		0.416	0.048	0.021	0.048
5	4	0.06					
6	3	0.2		0.75	0.747	0.4	0.75
7	1	12		0.35	0.252	0.181	0.252
8	1	24		0.457	0.131	0.058	0.131
9	2	12		0.457	0.131	0.058	0.131
10	3	12.5		0.19	0.18	0.17	0.19

Layer #	Layer Type	Sat. Hyd. Conductivity (cm/sec)	Drainage Length (ft)	Drain Slope (%)	Leachate Recirc. (%)	Recirc. to Layer (#)	Subsurface Inflow (in/yr)
1	1	3.1E-03					
2	1	4.1E-05					
3	1	1.3E-04					
4	2	4.48E-02	585	2			
5	4	2.0E-13					
6	3	5.0E-09					
7	1	1.0E-06					
8	1	1.0E-03					
9	2	1.0E-03	62	2			
10	3	1.0E-12					

Layer #	Layer Type	Geomembrane Pinhole Density (#/acre)	Geomembrane Instal. Defects (#/acre)	Geomembrane Placement Quality	Geotextile Transmissivity (cm^2/sec)
5	4	1	40	2	

Table D-5. HELP Model Input Data for LAWV On-Vault Year 290 (\LAW\LAW02.D10).

Input Parameter (HELP Model Query)	Generic Input Parameter Value
Landfill area =	1.071 acres
Percent of area where runoff is possible =	100%
Do you want to specify initial moisture storage? (Y/N)	Y
Amount of water or snow on surface =	0 inches
CN Input Parameter (HELP Model Query)	CN Input Parameter Value
Slope =	2 %
Slope length =	585 ft
Soil Texture =	4 (HELP model default soil texture)
Vegetation =	4 (i.e., a good stand of grass)
HELP Model Computed Curve Number = 46.2	

Layer	Layer Number	Layer Type
Topsoil	1	1 (vertical percolation layer)
Upper Backfill	2	1 (vertical percolation layer)
Erosion Barrier	3	1 (vertical percolation layer)
Upper Drainage Layer	4	2 (lateral drainage layer)
HDPE Geomembrane	5	4 (geomembrane liner)
GCL	6	3 (barrier soil liner)
Foundation Layer (1E-06)	7	1 (vertical percolation layer)
Foundation Layer (1E-03)	8	1 (vertical percolation layer)
Lower Drainage Layer	9	2 (lateral drainage layer)
Concrete Roof Slab	10	3 (barrier soil liner)

Layer #	Layer Type	Layer Thickness (in)	Soil Texture No.	Total Porosity (Vol/Vol)	Field Capacity (Vol/Vol)	Wilting Point (Vol/Vol)	Initial Moisture [2] (Vol/Vol)
1	1	5.90		0.396	0.109	0.047	0.109
2	1	30		0.35	0.252	0.181	0.252
3	1	12		0.15	0.1	0.07	0.1
4	2	12		0.414	0.052	0.024	0.052
5	4	0.06					
6	3	0.2		0.75	0.747	0.4	0.75
7	1	12		0.35	0.252	0.181	0.252
8	1	24		0.457	0.131	0.058	0.131
9	2	12		0.457	0.131	0.058	0.131
10	3	12.5		0.19	0.18	0.17	0.19

Layer #	Layer Type	Sat. Hyd. Conductivity (cm/sec)	Drainage Length (ft)	Drain Slope (%)	Leachate Recirc. (%)	Recirc. to Layer (#)	Subsurface Inflow (in/yr)
1	1	3.1E-03					
2	1	4.1E-05					
3	1	1.3E-04					
4	2	3.86E-02	585	2			
5	4	2.0E-13					
6	3	5.0E-08					
7	1	1.0E-06					
8	1	1.0E-03					
9	2	1.0E-03	62	2			
10	3	1.0E-12					

Layer #	Layer Type	Geomembrane Pinhole Density (#/acre)	Geomembrane Instal. Defects (#/acre)	Geomembrane Placement Quality	Geotextile Transmissivity (cm^2/sec)
5	4	1	96	2	

Table D-6. HELP Model Input Data for LAWV On-Vault Year 300 (\LAW\LAW03.D10).

Input Parameter (HELP Model Query)	Generic Input Parameter Value
Landfill area =	1.071 acres
Percent of area where runoff is possible =	100%
Do you want to specify initial moisture storage? (Y/N)	Y
Amount of water or snow on surface =	0 inches
CN Input Parameter (HELP Model Query)	**CN Input Parameter Value**
Slope =	2 %
Slope length =	585 ft
Soil Texture =	4 (HELP model default soil texture)
Vegetation =	4 (i.e., a good stand of grass)
HELP Model Computed Curve Number = 46.2	

Layer	Layer Number	Layer Type
Topsoil	1	1 (vertical percolation layer)
Upper Backfill	2	1 (vertical percolation layer)
Erosion Barrier	3	1 (vertical percolation layer)
Upper Drainage Layer	4	2 (lateral drainage layer)
HDPE Geomembrane	5	4 (geomembrane liner)
GCL	6	3 (barrier soil liner)
Foundation Layer (1E-06)	7	1 (vertical percolation layer)
Foundation Layer (1E-03)	8	1 (vertical percolation layer)
Lower Drainage Layer	9	2 (lateral drainage layer)
Concrete Roof Slab	10	3 (barrier soil liner)

Layer #	Layer Type	Layer Thickness (in)	Soil Texture No.	Total Porosity (Vol/Vol)	Field Capacity (Vol/Vol)	Wilting Point (Vol/Vol)	Initial Moisture [2] (Vol/Vol)
1	1	5.90		0.396	0.109	0.047	0.109
2	1	30		0.35	0.252	0.181	0.252
3	1	12		0.15	0.1	0.07	0.1
4	2	12		0.414	0.053	0.024	0.053
5	4	0.06					
6	3	0.2		0.75	0.747	0.4	0.75
7	1	12		0.35	0.252	0.181	0.252
8	1	24		0.457	0.131	0.058	0.131
9	2	12		0.457	0.131	0.058	0.131
10	3	12.5		0.19	0.18	0.17	0.19

Layer #	Layer Type	Sat. Hyd. Conductivity (cm/sec)	Drainage Length (ft)	Drain Slope (%)	Leachate Recirc. (%)	Recirc. to Layer (#)	Subsurface Inflow (in/yr)
1	1	3.1E-03					
2	1	4.1E-05					
3	1	1.3E-04					
4	2	3.81E-02	585	2			
5	4	2.0E-13					
6	3	5.0E-08					
7	1	1.0E-06					
8	1	1.0E-03					
9	2	1.0E-03	62	2			
10	3	1.0E-12					

Layer #	Layer Type	Geomembrane Pinhole Density (#/acre)	Geomembrane Instal. Defects (#/acre)	Geomembrane Placement Quality	Geotextile Transmissivity (cm^2/sec)
5	4	1	101	2	

Table D-7. HELP Model Input Data for LAWV On-Vault Year 340 (\LAW\LAW04.D10).

Input Parameter (HELP Model Query)	Generic Input Parameter Value
Landfill area =	1.071 acres
Percent of area where runoff is possible =	100%
Do you want to specify initial moisture storage? (Y/N)	Y
Amount of water or snow on surface =	0 inches
CN Input Parameter (HELP Model Query)	CN Input Parameter Value
Slope =	2 %
Slope length =	585 ft
Soil Texture =	4 (HELP model default soil texture)
Vegetation =	4 (i.e., a good stand of grass)
HELP Model Computed Curve Number = 46.2	

Layer	Layer Number	Layer Type
Topsoil	1	1 (vertical percolation layer)
Upper Backfill	2	1 (vertical percolation layer)
Erosion Barrier	3	1 (vertical percolation layer)
Upper Drainage Layer	4	2 (lateral drainage layer)
HDPE Geomembrane & GCL	5	4 (geomembrane liner)
Foundation Layer (1E-06)	6	1 (vertical percolation layer)
Foundation Layer (1E-03)	7	1 (vertical percolation layer)
Lower Drainage Layer	8	2 (lateral drainage layer)
Concrete Roof Slab	9	3 (barrier soil liner)

Layer #	Layer Type	Layer Thickness (in)	Soil Texture No.	Total Porosity (Vol/Vol)	Field Capacity (Vol/Vol)	Wilting Point (Vol/Vol)	Initial Moisture [2] (Vol/Vol)
1	1	5.88		0.396	0.109	0.047	0.109
2	1	30		0.35	0.252	0.181	0.252
3	1	12		0.15	0.1	0.07	0.1
4	2	12		0.414	0.054	0.026	0.054
5	4	0.26					
6	1	12		0.35	0.252	0.181	0.252
7	1	24		0.457	0.131	0.058	0.131
8	2	12		0.457	0.131	0.058	0.131
9	3	12.5		0.19	0.18	0.17	0.19

Layer #	Layer Type	Sat. Hyd. Conductivity (cm/sec)	Drainage Length (ft)	Drain Slope (%)	Leachate Recirc. (%)	Recirc. to Layer (#)	Subsurface Inflow (in/yr)
1	1	3.1E-03					
2	1	4.1E-05					
3	1	1.3E-04					
4	2	3.60E-02	585	2			
5	4	8.7E-13					
6	1	1.0E-06					
7	1	1.0E-03					
8	2	1.0E-03	62	2			
9	3	1.0E-12					

Layer #	Layer Type	Geomembrane Pinhole Density (#/acre)	Geomembrane Instal. Defects (#/acre)	Geomembrane Placement Quality	Geotextile Transmissivity (cm^2/sec)
5	4	1	121	2	

Table D-8. HELP Model Input Data for LAWV On-Vault Year 380 (\LAW\LAW05.D10).

Input Parameter (HELP Model Query)	Generic Input Parameter Value
Landfill area =	1.071 acres
Percent of area where runoff is possible =	100%
Do you want to specify initial moisture storage? (Y/N)	Y
Amount of water or snow on surface =	0 inches
CN Input Parameter (HELP Model Query)	CN Input Parameter Value
Slope =	2 %
Slope length =	585 ft
Soil Texture =	4 (HELP model default soil texture)
Vegetation =	4 (i.e., a good stand of grass)
HELP Model Computed Curve Number = 46.2	

Layer	Layer Number	Layer Type
Topsoil	1	1 (vertical percolation layer)
Upper Backfill	2	1 (vertical percolation layer)
Erosion Barrier	3	1 (vertical percolation layer)
Upper Drainage Layer	4	2 (lateral drainage layer)
HDPE Geomembrane & GCL	5	4 (geomembrane liner)
Foundation Layer (1E-06)	6	1 (vertical percolation layer)
Foundation Layer (1E-03)	7	1 (vertical percolation layer)
Lower Drainage Layer	8	2 (lateral drainage layer)
Concrete Roof Slab	9	3 (barrier soil liner)

Layer #	Layer Type	Layer Thickness (in)	Soil Texture No.	Total Porosity (Vol/Vol)	Field Capacity (Vol/Vol)	Wilting Point (Vol/Vol)	Initial Moisture [2] (Vol/Vol)
1	1	5.85		0.396	0.109	0.047	0.109
2	1	30		0.35	0.252	0.181	0.252
3	1	12		0.15	0.1	0.07	0.1
4	2	12		0.413	0.056	0.027	0.056
5	4	0.26					
6	1	12		0.35	0.252	0.181	0.252
7	1	24		0.457	0.131	0.058	0.131
8	2	12		0.457	0.131	0.058	0.131
9	3	12.5		0.19	0.18	0.17	0.19

Layer #	Layer Type	Sat. Hyd. Conductivity (cm/sec)	Drainage Length (ft)	Drain Slope (%)	Leachate Recirc. (%)	Recirc. to Layer (#)	Subsurface Inflow (in/yr)
1	1	3.1E-03					
2	1	4.1E-05					
3	1	1.3E-04					
4	2	3.41E-02	585	2			
5	4	8.7E-13					
6	1	1.0E-06					
7	1	1.0E-03					
8	2	1.0E-03	62	2			
9	3	1.0E-12					

Layer #	Layer Type	Geomembrane Pinhole Density (#/acre)	Geomembrane Instal. Defects (#/acre)	Geomembrane Placement Quality	Geotextile Transmissivity (cm^2/sec)
5	4	1	141	2	

Table D-9. HELP Model Input Data for LAWV On-Vault Year 480 (\LAW\LAW06.D10).

Input Parameter (HELP Model Query)	Generic Input Parameter Value
Landfill area =	1.071 acres
Percent of area where runoff is possible =	100%
Do you want to specify initial moisture storage? (Y/N)	Y
Amount of water or snow on surface =	0 inches
CN Input Parameter (HELP Model Query)	CN Input Parameter Value
Slope =	2 %
Slope length =	585 ft
Soil Texture =	4 (HELP model default soil texture)
Vegetation =	4 (i.e., a good stand of grass)
HELP Model Computed Curve Number = 46.2	

Layer	Layer Number	Layer Type
Topsoil	1	1 (vertical percolation layer)
Upper Backfill	2	1 (vertical percolation layer)
Erosion Barrier	3	1 (vertical percolation layer)
Upper Drainage Layer	4	2 (lateral drainage layer)
HDPE Geomembrane & GCL	5	4 (geomembrane liner)
Foundation Layer (1E-06)	6	1 (vertical percolation layer)
Foundation Layer (1E-03)	7	1 (vertical percolation layer)
Lower Drainage Layer	8	2 (lateral drainage layer)
Concrete Roof Slab	9	3 (barrier soil liner)

Layer #	Layer Type	Layer Thickness (in)	Soil Texture No.	Total Porosity (Vol/Vol)	Field Capacity (Vol/Vol)	Wilting Point (Vol/Vol)	Initial Moisture [2] (Vol/Vol)
1	1	5.84		0.396	0.109	0.047	0.109
2	1	30		0.35	0.252	0.181	0.252
3	1	12		0.15	0.1	0.07	0.1
4	2	12		0.412	0.06	0.03	0.06
5	4	0.26					
6	1	12		0.35	0.252	0.181	0.252
7	1	24		0.457	0.131	0.058	0.131
8	2	12		0.457	0.131	0.058	0.131
9	3	12.5		0.19	0.18	0.17	0.19

Layer #	Layer Type	Sat. Hyd. Conductivity (cm/sec)	Drainage Length (ft)	Drain Slope (%)	Leachate Recirc. (%)	Recirc. to Layer (#)	Subsurface Inflow (in/yr)
1	1	3.1E-03					
2	1	4.1E-05					
3	1	1.3E-04					
4	2	2.98E-02	585	2			
5	4	8.7E-13					
6	1	1.0E-06					
7	1	1.0E-03					
8	2	1.0E-03	62	2			
9	3	1.0E-12					

Layer #	Layer Type	Geomembrane Pinhole Density (#/acre)	Geomembrane Instal. Defects (#/acre)	Geomembrane Placement Quality	Geotextile Transmissivity (cm^2/sec)
5	4	1	479	2	

Table D-10. HELP Model Input Data for LAWV On-Vault Year 660 (\LAW\LAW07.D10).

Input Parameter (HELP Model Query)	Generic Input Parameter Value
Landfill area =	1.071 acres
Percent of area where runoff is possible =	100%
Do you want to specify initial moisture storage? (Y/N)	Y
Amount of water or snow on surface =	0 inches
CN Input Parameter (HELP Model Query)	CN Input Parameter Value
Slope =	2 %
Slope length =	585 ft
Soil Texture =	4 (HELP model default soil texture)
Vegetation =	4 (i.e., a good stand of grass)
HELP Model Computed Curve Number = 46.2	

Layer	Layer Number	Layer Type
Topsoil	1	1 (vertical percolation layer)
Upper Backfill	2	1 (vertical percolation layer)
Erosion Barrier	3	1 (vertical percolation layer)
Upper Drainage Layer	4	2 (lateral drainage layer)
HDPE Geomembrane & GCL	5	4 (geomembrane liner)
Foundation Layer (1E-06)	6	1 (vertical percolation layer)
Foundation Layer (1E-03)	7	1 (vertical percolation layer)
Lower Drainage Layer	8	2 (lateral drainage layer)
Concrete Roof Slab	9	3 (barrier soil liner)

Layer #	Layer Type	Layer Thickness (in)	Soil Texture No.	Total Porosity (Vol/Vol)	Field Capacity (Vol/Vol)	Wilting Point (Vol/Vol)	Initial Moisture [2] (Vol/Vol)
1	1	5.82		0.396	0.109	0.047	0.109
2	1	30		0.35	0.252	0.181	0.252
3	1	12		0.15	0.1	0.07	0.1
4	2	12		0.409	0.067	0.036	0.067
5	4	0.26					
6	1	12		0.35	0.252	0.181	0.252
7	1	24		0.457	0.131	0.058	0.131
8	2	12		0.457	0.131	0.058	0.131
9	3	12.5		0.19	0.18	0.17	0.19

Layer #	Layer Type	Sat. Hyd. Conductivity (cm/sec)	Drainage Length (ft)	Drain Slope (%)	Leachate Recirc. (%)	Recirc. to Layer (#)	Subsurface Inflow (in/yr)
1	1	3.1E-03					
2	1	4.1E-05					
3	1	1.3E-04					
4	2	2.33E-02	585	2			
5	4	8.7E-13					
6	1	1.0E-06					
7	1	1.0E-03					
8	2	1.0E-03	62	2			
9	3	1.0E-12					

Layer #	Layer Type	Geomembrane Pinhole Density (#/acre)	Geomembrane Instal. Defects (#/acre)	Geomembrane Placement Quality	Geotextile Transmissivity (cm^2/sec)
5	4	1	1115	2	

Table D-11. HELP Model Input Data for LAWV On-Vault Year 1,100 (\LAW\LAW08.D10).

Input Parameter (HELP Model Query)	Generic Input Parameter Value
Landfill area =	1.071 acres
Percent of area where runoff is possible =	100%
Do you want to specify initial moisture storage? (Y/N)	Y
Amount of water or snow on surface =	0 inches
CN Input Parameter (HELP Model Query)	CN Input Parameter Value
Slope =	2 %
Slope length =	585 ft
Soil Texture =	4 (HELP model default soil texture)
Vegetation =	4 (i.e., a good stand of grass)
HELP Model Computed Curve Number = 46.2	

Layer	Layer Number	Layer Type
Topsoil	1	1 (vertical percolation layer)
Upper Backfill	2	1 (vertical percolation layer)
Erosion Barrier	3	1 (vertical percolation layer)
Upper Drainage Layer	4	2 (lateral drainage layer)
HDPE Geomembrane & GCL	5	4 (geomembrane liner)
Foundation Layer (1E-06)	6	1 (vertical percolation layer)
Foundation Layer (1E-03)	7	1 (vertical percolation layer)
Lower Drainage Layer	8	2 (lateral drainage layer)
Concrete Roof Slab	9	3 (barrier soil liner)

Layer #	Layer Type	Layer Thickness (in)	Soil Texture No.	Total Porosity (Vol/Vol)	Field Capacity (Vol/Vol)	Wilting Point (Vol/Vol)	Initial Moisture [2] (Vol/Vol)
1	1	5.76		0.396	0.109	0.047	0.109
2	1	30		0.35	0.252	0.181	0.252
3	1	12		0.15	0.1	0.07	0.1
4	2	12		0.403	0.084	0.049	0.084
5	4	0.26					
6	1	12		0.35	0.252	0.181	0.252
7	1	24		0.457	0.131	0.058	0.131
8	2	12		0.457	0.131	0.058	0.131
9	3	12.5		0.19	0.18	0.17	0.19

Layer #	Layer Type	Sat. Hyd. Conductivity (cm/sec)	Drainage Length (ft)	Drain Slope (%)	Leachate Recirc. (%)	Recirc. to Layer (#)	Subsurface Inflow (in/yr)
1	1	3.1E-03					
2	1	4.1E-05					
3	1	1.3E-04					
4	2	1.28E-02	585	2			
5	4	8.7E-13					
6	1	1.0E-06					
7	1	1.0E-03					
8	2	1.0E-03	62	2			
9	3	1.0E-12					

Layer #	Layer Type	Geomembrane Pinhole Density (#/acre)	Geomembrane Instal. Defects (#/acre)	Geomembrane Placement Quality	Geotextile Transmissivity (cm^2/sec)
5	4	1	2669	2	

Table D-12. HELP Model Input Data for LAWV On-Vault Year 1,900 (\LAW\LAW09.D10).

Input Parameter (HELP Model Query)	Generic Input Parameter Value
Landfill area =	1.071 acres
Percent of area where runoff is possible =	100%
Do you want to specify initial moisture storage? (Y/N)	Y
Amount of water or snow on surface =	0 inches
CN Input Parameter (HELP Model Query)	CN Input Parameter Value
Slope =	2 %
Slope length =	585 ft
Soil Texture =	4 (HELP model default soil texture)
Vegetation =	4 (i.e., a good stand of grass)
HELP Model Computed Curve Number = 46.2	

Layer	Layer Number	Layer Type
Topsoil	1	1 (vertical percolation layer)
Upper Backfill	2	1 (vertical percolation layer)
Erosion Barrier	3	1 (vertical percolation layer)
Upper Drainage Layer	4	2 (lateral drainage layer)
HDPE Geomembrane & GCL	5	4 (geomembrane liner)
Foundation Layer (1E-06)	6	1 (vertical percolation layer)
Foundation Layer (1E-03)	7	1 (vertical percolation layer)
Lower Drainage Layer	8	2 (lateral drainage layer)
Concrete Roof Slab	9	3 (barrier soil liner)

Layer #	Layer Type	Layer Thickness (in)	Soil Texture No.	Total Porosity (Vol/Vol)	Field Capacity (Vol/Vol)	Wilting Point (Vol/Vol)	Initial Moisture [2] (Vol/Vol)
1	1	5.66		0.396	0.109	0.047	0.109
2	1	30		0.35	0.252	0.181	0.252
3	1	12		0.15	0.1	0.07	0.1
4	2	12		0.392	0.116	0.074	0.116
5	4	0.26					
6	1	12		0.35	0.252	0.181	0.252
7	1	24		0.457	0.131	0.058	0.131
8	2	12		0.457	0.131	0.058	0.131
9	3	12.5		0.19	0.18	0.17	0.19

Layer #	Layer Type	Sat. Hyd. Conductivity (cm/sec)	Drainage Length (ft)	Drain Slope (%)	Leachate Recirc. (%)	Recirc. to Layer (#)	Subsurface Inflow (in/yr)
1	1	3.1E-03					
2	1	4.1E-05					
3	1	1.3E-04					
4	2	4.3E-03	585	2			
5	4	8.7E-13					
6	1	1.0E-06					
7	1	1.0E-03					
8	2	1.0E-03	62	2			
9	3	1.0E-12					

Layer #	Layer Type	Geomembrane Pinhole Density (#/acre)	Geomembrane Instal. Defects (#/acre)	Geomembrane Placement Quality	Geotextile Transmissivity (cm^2/sec)
5	4	1	5496	2	

Table D-13. HELP Model Input Data for LAWV On-Vault Year 2,723 (\LAW\LAW10.D10).

Input Parameter (HELP Model Query)	Generic Input Parameter Value
Landfill area =	1.071 acres
Percent of area where runoff is possible =	100%
Do you want to specify initial moisture storage? (Y/N)	Y
Amount of water or snow on surface =	0 inches
CN Input Parameter (HELP Model Query)	CN Input Parameter Value
Slope =	2 %
Slope length =	585 ft
Soil Texture =	4 (HELP model default soil texture)
Vegetation =	4 (i.e., a good stand of grass)
HELP Model Computed Curve Number = 46.2	

Layer	Layer Number	Layer Type
Topsoil	1	1 (vertical percolation layer)
Upper Backfill	2	1 (vertical percolation layer)
Erosion Barrier	3	1 (vertical percolation layer)
Upper Drainage Layer	4	2 (lateral drainage layer)
HDPE Geomembrane & GCL	5	4 (geomembrane liner)
Foundation Layer (1E-06)	6	1 (vertical percolation layer)
Foundation Layer (1E-03)	7	1 (vertical percolation layer)
Lower Drainage Layer	8	2 (lateral drainage layer)
Concrete Roof Slab	9	3 (barrier soil liner)

Layer #	Layer Type	Layer Thickness (in)	Soil Texture No.	Total Porosity (Vol/Vol)	Field Capacity (Vol/Vol)	Wilting Point (Vol/Vol)	Initial Moisture [2] (Vol/Vol)
1	1	5.55		0.396	0.109	0.047	0.109
2	1	30		0.35	0.252	0.181	0.252
3	1	12		0.15	0.1	0.07	0.1
4	2	12		0.38	0.148	0.1	0.148
5	4	0.26					
6	1	12		0.35	0.252	0.181	0.252
7	1	24		0.457	0.131	0.058	0.131
8	2	12		0.457	0.131	0.058	0.131
9	3	12.5		0.19	0.18	0.17	0.19

Layer #	Layer Type	Sat. Hyd. Conductivity (cm/sec)	Drainage Length (ft)	Drain Slope (%)	Leachate Recirc. (%)	Recirc. to Layer (#)	Subsurface Inflow (in/yr)
1	1	3.1E-03					
2	1	4.1E-05					
3	1	1.3E-04					
4	2	1.4E-03	585	2			
5	4	8.7E-13					
6	1	1.0E-06					
7	1	1.0E-03					
8	2	1.0E-03	62	2			
9	3	1.0E-12					

Layer #	Layer Type	Geomembrane Pinhole Density (#/acre)	Geomembrane Instal. Defects (#/acre)	Geomembrane Placement Quality	Geotextile Transmissivity (cm^2/sec)
5	4	1	8403	2	

Table D-14. HELP Model Input Data for LAWV On-Vault Year 2,905 (\LAW\LAW11.D10).

Input Parameter (HELP Model Query)	Generic Input Parameter Value
Landfill area =	1.071 acres
Percent of area where runoff is possible =	100%
Do you want to specify initial moisture storage? (Y/N)	Y
Amount of water or snow on surface =	0 inches
CN Input Parameter (HELP Model Query)	CN Input Parameter Value
Slope =	2 %
Slope length =	585 ft
Soil Texture =	4 (HELP model default soil texture)
Vegetation =	4 (i.e., a good stand of grass)
HELP Model Computed Curve Number = 46.2	

Layer	Layer Number	Layer Type
Topsoil	1	1 (vertical percolation layer)
Upper Backfill	2	1 (vertical percolation layer)
Erosion Barrier	3	1 (vertical percolation layer)
Upper Drainage Layer	4	2 (lateral drainage layer)
HDPE Geomembrane & GCL	5	4 (geomembrane liner)
Foundation Layer (1E-06)	6	1 (vertical percolation layer)
Foundation Layer (1E-03)	7	1 (vertical percolation layer)
Lower Drainage Layer	8	2 (lateral drainage layer)
Concrete Roof Slab	9	3 (barrier soil liner)

Layer #	Layer Type	Layer Thickness (in)	Soil Texture No.	Total Porosity (Vol/Vol)	Field Capacity (Vol/Vol)	Wilting Point (Vol/Vol)	Initial Moisture [2] (Vol/Vol)
1	1	5.53		0.396	0.109	0.047	0.109
2	1	30		0.35	0.252	0.181	0.252
3	1	12		0.15	0.1	0.07	0.1
4	2	12		0.38	0.148	0.1	0.148
5	4	0.26					
6	1	12		0.35	0.252	0.181	0.252
7	1	24		0.457	0.131	0.058	0.131
8	2	12		0.457	0.131	0.058	0.131
9	3	12.5		0.19	0.18	0.17	0.19

Layer #	Layer Type	Sat. Hyd. Conductivity (cm/sec)	Drainage Length (ft)	Drain Slope (%)	Leachate Recirc. (%)	Recirc. to Layer (#)	Subsurface Inflow (in/yr)
1	1	3.1E-03					
2	1	4.1E-05					
3	1	1.3E-04					
4	2	1.4E-03	585	2			
5	4	8.7E-13					
6	1	1.0E-06					
7	1	1.0E-03					
8	2	1.0E-03	62	2			
9	3	1.0E-12					

Layer #	Layer Type	Geomembrane Pinhole Density (#/acre)	Geomembrane Instal. Defects (#/acre)	Geomembrane Placement Quality	Geotextile Transmissivity (cm^2/sec)
5	4	1	9046	2	

Table D-15. HELP Model Input Data for LAWV On-Vault After Roof Collapse Year 2,905+ (\LAW\LAWCLPSE.D10).

Input Parameter (HELP Model Query)	Generic Input Parameter Value
Landfill area =	1.071 acres
Percent of area where runoff is possible =	0%
Do you want to specify initial moisture storage? (Y/N)	Y
Amount of water or snow on surface =	0 inches
User-Specified Curve Number = 0	

Layer	Layer Number	Layer Type
Topsoil	1	1 (vertical percolation layer)
Upper Backfill	2	1 (vertical percolation layer)
Erosion Barrier	3	1 (vertical percolation layer)
Upper Drainage Layer	4	1 (vertical percolation layer)
Foundation Layer (1E-06)	5	1 (vertical percolation layer)
Foundation Layer (1E-06)	6	1 (vertical percolation layer)
Foundation Layer (1E-03)	7	1 (vertical percolation layer)
Foundation Layer (1E-03)	8	1 (vertical percolation layer)

Layer #	Layer Type	Layer Thickness (in)	Soil Texture No.	Total Porosity (Vol/Vol)	Field Capacity (Vol/Vol)	Wilting Point (Vol/Vol)	Initial Moisture [2] (Vol/Vol)
1	1	5.53		0.396	0.109	0.047	0.109
2	1	30		0.35	0.252	0.181	0.252
3	1	12		0.15	0.1	0.07	0.1
4	1	12		0.38	0.148	0.1	0.148
5	1	0.26		0.35	0.252	0.181	0.252
6	1	12		0.35	0.252	0.181	0.252
7	1	24		0.457	0.131	0.058	0.131
8	1	12		0.457	0.131	0.058	0.131

Layer #	Layer Type	Sat. Hyd. Conductivity (cm/sec)	Drainage Length (ft)	Drain Slope (%)	Leachate Recirc. (%)	Recirc. to Layer (#)	Subsurface Inflow (in/yr)
1	1	3.1E-03					
2	1	4.1E-05					
3	1	1.3E-04					
4	1	1.4E-03					
5	1	1.0E-06					
6	1	1.0E-06					
7	1	1.0E-03					
8	1	1.0E-03					

Layer #	Layer Type	Geomembrane Pinhole Density (#/acre)	Geomembrane Instal. Defects (#/acre)	Geomembrane Placement Quality	Geotextile Transmissivity (cm^2/sec)

Table D-16. HELP Model Input Data for LAWV Off-Vault Operational Period (\LAWOFF\LAWOP.D10).

Input Parameter (HELP Model Query)	Generic Input Parameter Value
Landfill area =	0.1477 acres
Percent of area where runoff is possible =	100%
Do you want to specify initial moisture storage? (Y/N)	Y
Amount of water or snow on surface =	0 inches
CN Input Parameter (HELP Model Query)	CN Input Parameter Value
Slope =	1 %
Slope length =	15 ft
Soil Texture =	4 (HELP model default soil texture)
Vegetation =	1 (i.e., bare ground)
HELP Model Computed Curve Number = 83.64	

Layer	Layer Number	Layer Type
Upper Backfill	1	1 (vertical percolation layer)

Layer #	Layer Type	Layer Thickness (in)	Soil Texture No.	Total Porosity (Vol/Vol)	Field Capacity (Vol/Vol)	Wilting Point (Vol/Vol)	Initial Moisture [2] (Vol/Vol)
1	1	96		0.35	0.252	0.181	0.252

Layer #	Layer Type	Sat. Hyd. Conductivity (cm/sec)	Drainage Length (ft)	Drain Slope (%)	Leachate Recirc. (%)	Recirc. to Layer (#)	Subsurface Inflow (in/yr)
1	1	4.1E-05					

Layer #	Layer Type	Geomembrane Pinhole Density (#/acre)	Geomembrane Instal. Defects (#/acre)	Geomembrane Placement Quality	Geotextile Transmissivity (cm^2/sec)

Table D-17. HELP Model Input Data for LAWV Off-Vault Institutional Control Period (\LAWOFF\LAWIC.D10).

Input Parameter (HELP Model Query)	Generic Input Parameter Value
Landfill area =	0.1477 acres
Percent of area where runoff is possible =	100%
Do you want to specify initial moisture storage? (Y/N)	Y
Amount of water or snow on surface =	0 inches
CN Input Parameter (HELP Model Query)	**CN Input Parameter Value**
Slope =	1 %
Slope length =	15 ft
Soil Texture =	4 (HELP model default soil texture)
Vegetation =	1 (i.e., bare ground)
HELP Model Computed Curve Number = 83.64	

Layer	Layer Number	Layer Type
Upper Backfill	1	1 (vertical percolation layer)

Layer #	Layer Type	Layer Thickness (in)	Soil Texture No.	Total Porosity (Vol/Vol)	Field Capacity (Vol/Vol)	Wilting Point (Vol/Vol)	Initial Moisture [2] (Vol/Vol)
1	1	96		0.35	0.252	0.181	0.252

Layer #	Layer Type	Sat. Hyd. Conductivity (cm/sec)	Drainage Length (ft)	Drain Slope (%)	Leachate Recirc. (%)	Recirc. to Layer (#)	Subsurface Inflow (in/yr)
1	1	4.1E-05					

Layer #	Layer Type	Geomembrane Pinhole Density (#/acre)	Geomembrane Instal. Defects (#/acre)	Geomembrane Placement Quality	Geotextile Transmissivity (cm^2/sec)

Table D-18. HELP Model Input Data for LAWV Off-Vault Year 100 (\LAWOFF\LAW00.D10).

Input Parameter (HELP Model Query)	Generic Input Parameter Value
Landfill area =	0.148 acres
Percent of area where runoff is possible =	100%
Do you want to specify initial moisture storage? (Y/N)	Y
Amount of water or snow on surface =	0 inches
CN Input Parameter (HELP Model Query)	**CN Input Parameter Value**
Slope =	2 %
Slope length =	585 ft
Soil Texture =	4 (HELP model default soil texture)
Vegetation =	4 (i.e., a good stand of grass)
HELP Model Computed Curve Number = 46.2	

Layer	Layer Number	Layer Type
Topsoil	1	1 (vertical percolation layer)
Upper Backfill	2	1 (vertical percolation layer)
Erosion Barrier	3	1 (vertical percolation layer)
Upper Drainage Layer	4	2 (lateral drainage layer)
HDPE Geomembrane	5	4 (geomembrane liner)
GCL	6	3 (barrier soil liner)
Foundation Layer (1E-06)	7	1 (vertical percolation layer)
Foundation Layer (1E-03)	8	1 (vertical percolation layer)
Soil Fill Adjacent to Vault	9	3 (barrier soil liner)
Soil Fill Adjacent to Vault	10	1 (vertical percolation layer)

Layer #	Layer Type	Layer Thickness (in)	Soil Texture No.	Total Porosity (Vol/Vol)	Field Capacity (Vol/Vol)	Wilting Point (Vol/Vol)	Initial Moisture [2] (Vol/Vol)
1	1	6		0.396	0.109	0.047	0.109
2	1	30		0.35	0.252	0.181	0.252
3	1	12		0.15	0.1	0.07	0.1
4	2	12		0.417	0.045	0.018	0.045
5	4	0.06					
6	3	0.2		0.75	0.747	0.4	0.75
7	1	12		0.35	0.252	0.181	0.252
8	1	36		0.457	0.131	0.058	0.131
9	3	12.5		0.457	0.131	0.058	0.131
10	1	298		0.457	0.131	0.058	0.131

Layer #	Layer Type	Sat. Hyd. Conductivity (cm/sec)	Drainage Length (ft)	Drain Slope (%)	Leachate Recirc. (%)	Recirc. to Layer (#)	Subsurface Inflow (in/yr)
1	1	3.1E-03					
2	1	4.1E-05					
3	1	1.3E-04					
4	2	5.0E-02	585	2			
5	4	2.0E-13					
6	3	5.0E-09					
7	1	1.0E-06					
8	1	1.0E-03					0.004898
9	3	1.0E-03					
10	1	1.0E-03					

Layer #	Layer Type	Geomembrane Pinhole Density (#/acre)	Geomembrane Instal. Defects (#/acre)	Geomembrane Placement Quality	Geotextile Transmissivity (cm^2/sec)
5	4	1	4	2	

Table D-19. HELP Model Input Data for LAWV Off-Vault Year 180 (\LAWOFF\LAW01.D10).

Input Parameter (HELP Model Query)	Generic Input Parameter Value
Landfill area =	0.148 acres
Percent of area where runoff is possible =	100%
Do you want to specify initial moisture storage? (Y/N)	Y
Amount of water or snow on surface =	0 inches
CN Input Parameter (HELP Model Query)	CN Input Parameter Value
Slope =	2 %
Slope length =	585 ft
Soil Texture =	4 (HELP model default soil texture)
Vegetation =	4 (i.e., a good stand of grass)
HELP Model Computed Curve Number = 46.2	

Layer	Layer Number	Layer Type
Topsoil	1	1 (vertical percolation layer)
Upper Backfill	2	1 (vertical percolation layer)
Erosion Barrier	3	1 (vertical percolation layer)
Upper Drainage Layer	4	2 (lateral drainage layer)
HDPE Geomembrane	5	4 (geomembrane liner)
GCL	6	3 (barrier soil liner)
Foundation Layer (1E-06)	7	1 (vertical percolation layer)
Foundation Layer (1E-03)	8	1 (vertical percolation layer)
Soil Fill Adjacent to Vault	9	3 (barrier soil liner)
Soil Fill Adjacent to Vault	10	1 (vertical percolation layer)

Layer #	Layer Type	Layer Thickness (in)	Soil Texture No.	Total Porosity (Vol/Vol)	Field Capacity (Vol/Vol)	Wilting Point (Vol/Vol)	Initial Moisture [2] (Vol/Vol)
1	1	5.96		0.396	0.109	0.047	0.109
2	1	30		0.35	0.252	0.181	0.252
3	1	12		0.15	0.1	0.07	0.1
4	2	12		0.416	0.048	0.021	0.048
5	4	0.06					
6	3	0.2		0.75	0.747	0.4	0.75
7	1	12		0.35	0.252	0.181	0.252
8	1	36		0.457	0.131	0.058	0.131
9	3	12.5		0.457	0.131	0.058	0.131
10	1	298		0.457	0.131	0.058	0.131

Layer #	Layer Type	Sat. Hyd. Conductivity (cm/sec)	Drainage Length (ft)	Drain Slope (%)	Leachate Recirc. (%)	Recirc. to Layer (#)	Subsurface Inflow (in/yr)
1	1	3.1E-03					
2	1	4.1E-05					
3	1	1.3E-04					
4	2	4.48E-02	585	2			
5	4	2.0E-13					
6	3	5.0E-09					
7	1	1.0E-06					
8	1	1.0E-03					0.04067
9	3	1.0E-03					
10	1	1.0E-03					

Layer #	Layer Type	Geomembrane Pinhole Density (#/acre)	Geomembrane Instal. Defects (#/acre)	Geomembrane Placement Quality	Geotextile Transmissivity (cm^2/sec)
5	4	1	40	2	

Table D-20. HELP Model Input Data for LAWV Off-Vault Year 290 (\LAWOFF\LAW02.D10).

Input Parameter (HELP Model Query)	Generic Input Parameter Value
Landfill area =	0.148 acres
Percent of area where runoff is possible =	100%
Do you want to specify initial moisture storage? (Y/N)	Y
Amount of water or snow on surface =	0 inches
CN Input Parameter (HELP Model Query)	CN Input Parameter Value
Slope =	2 %
Slope length =	585 ft
Soil Texture =	4 (HELP model default soil texture)
Vegetation =	4 (i.e., a good stand of grass)
HELP Model Computed Curve Number = 46.2	

Layer	Layer Number	Layer Type
Topsoil	1	1 (vertical percolation layer)
Upper Backfill	2	1 (vertical percolation layer)
Erosion Barrier	3	1 (vertical percolation layer)
Upper Drainage Layer	4	2 (lateral drainage layer)
HDPE Geomembrane	5	4 (geomembrane liner)
GCL	6	3 (barrier soil liner)
Foundation Layer (1E-06)	7	1 (vertical percolation layer)
Foundation Layer (1E-03)	8	1 (vertical percolation layer)
Soil Fill Adjacent to Vault	9	3 (barrier soil liner)
Soil Fill Adjacent to Vault	10	1 (vertical percolation layer)

Layer #	Layer Type	Layer Thickness (in)	Soil Texture No.	Total Porosity (Vol/Vol)	Field Capacity (Vol/Vol)	Wilting Point (Vol/Vol)	Initial Moisture [2] (Vol/Vol)
1	1	5.90		0.396	0.109	0.047	0.109
2	1	30		0.35	0.252	0.181	0.252
3	1	12		0.15	0.1	0.07	0.1
4	2	12		0.414	0.052	0.024	0.052
5	4	0.06					
6	3	0.2		0.75	0.747	0.4	0.75
7	1	12		0.35	0.252	0.181	0.252
8	1	36		0.457	0.131	0.058	0.131
9	3	12.5		0.457	0.131	0.058	0.131
10	1	298		0.457	0.131	0.058	0.131

Layer #	Layer Type	Sat. Hyd. Conductivity (cm/sec)	Drainage Length (ft)	Drain Slope (%)	Leachate Recirc. (%)	Recirc. to Layer (#)	Subsurface Inflow (in/yr)
1	1	3.1E-03					
2	1	4.1E-05					
3	1	1.3E-04					
4	2	3.86E-02	585	2			
5	4	2.0E-13					
6	3	5.0E-08					
7	1	1.0E-06					
8	1	1.0E-03					0.95920
9	3	1.0E-03					
10	1	1.0E-03					

Layer #	Layer Type	Geomembrane Pinhole Density (#/acre)	Geomembrane Instal. Defects (#/acre)	Geomembrane Placement Quality	Geotextile Transmissivity (cm^2/sec)
5	4	1	96	2	

Table D-21. HELP Model Input Data for LAWV Off-Vault Year 300 (\LAWOFF\LAW03.D10).

Input Parameter (HELP Model Query)	Generic Input Parameter Value
Landfill area =	0.148 acres
Percent of area where runoff is possible =	100%
Do you want to specify initial moisture storage? (Y/N)	Y
Amount of water or snow on surface =	0 inches
CN Input Parameter (HELP Model Query)	CN Input Parameter Value
Slope =	2 %
Slope length =	585 ft
Soil Texture =	4 (HELP model default soil texture)
Vegetation =	4 (i.e., a good stand of grass)
HELP Model Computed Curve Number = 46.2	

Layer	Layer Number	Layer Type
Topsoil	1	1 (vertical percolation layer)
Upper Backfill	2	1 (vertical percolation layer)
Erosion Barrier	3	1 (vertical percolation layer)
Upper Drainage Layer	4	2 (lateral drainage layer)
HDPE Geomembrane	5	4 (geomembrane liner)
GCL	6	3 (barrier soil liner)
Foundation Layer (1E-06)	7	1 (vertical percolation layer)
Foundation Layer (1E-03)	8	1 (vertical percolation layer)
Soil Fill Adjacent to Vault	9	3 (barrier soil liner)
Soil Fill Adjacent to Vault	10	1 (vertical percolation layer)

Layer #	Layer Type	Layer Thickness (in)	Soil Texture No.	Total Porosity (Vol/Vol)	Field Capacity (Vol/Vol)	Wilting Point (Vol/Vol)	Initial Moisture [2] (Vol/Vol)
1	1	5.90		0.396	0.109	0.047	0.109
2	1	30		0.35	0.252	0.181	0.252
3	1	12		0.15	0.1	0.07	0.1
4	2	12		0.414	0.053	0.024	0.053
5	4	0.06					
6	3	0.2		0.75	0.747	0.4	0.75
7	1	12		0.35	0.252	0.181	0.252
8	1	36		0.457	0.131	0.058	0.131
9	3	12.5		0.457	0.131	0.058	0.131
10	1	298		0.457	0.131	0.058	0.131

Layer #	Layer Type	Sat. Hyd. Conductivity (cm/sec)	Drainage Length (ft)	Drain Slope (%)	Leachate Recirc. (%)	Recirc. to Layer (#)	Subsurface Inflow (in/yr)
1	1	3.1E-03					
2	1	4.1E-05					
3	1	1.3E-04					
4	2	3.81E-02	585	2			
5	4	2.0E-13					
6	3	5.0E-08					
7	1	1.0E-06					
8	1	1.0E-03					1.03875
9	3	1.0E-03					
10	1	1.0E-03					

Layer #	Layer Type	Geomembrane Pinhole Density (#/acre)	Geomembrane Instal. Defects (#/acre)	Geomembrane Placement Quality	Geotextile Transmissivity (cm^2/sec)
5	4	1	101	2	

Table D-22. HELP Model Input Data for LAWV Off-Vault Year 340 (\LAWOFF\LAW04.D10).

Input Parameter (HELP Model Query)	Generic Input Parameter Value
Landfill area =	0.148 acres
Percent of area where runoff is possible =	100%
Do you want to specify initial moisture storage? (Y/N)	Y
Amount of water or snow on surface =	0 inches
CN Input Parameter (HELP Model Query)	CN Input Parameter Value
Slope =	2 %
Slope length =	585 ft
Soil Texture =	4 (HELP model default soil texture)
Vegetation =	4 (i.e., a good stand of grass)
HELP Model Computed Curve Number = 46.2	

Layer	Layer Number	Layer Type
Topsoil	1	1 (vertical percolation layer)
Upper Backfill	2	1 (vertical percolation layer)
Erosion Barrier	3	1 (vertical percolation layer)
Upper Drainage Layer	4	2 (lateral drainage layer)
HDPE Geomembrane & GCL	5	4 (geomembrane liner)
Foundation Layer (1E-06)	6	1 (vertical percolation layer)
Foundation Layer (1E-03)	7	1 (vertical percolation layer)
Soil Fill Adjacent to Vault	8	3 (barrier soil liner)
Soil Fill Adjacent to Vault	9	1 (vertical percolation layer)

Layer #	Layer Type	Layer Thickness (in)	Soil Texture No.	Total Porosity (Vol/Vol)	Field Capacity (Vol/Vol)	Wilting Point (Vol/Vol)	Initial Moisture [2] (Vol/Vol)
1	1	5.88		0.396	0.109	0.047	0.109
2	1	30		0.35	0.252	0.181	0.252
3	1	12		0.15	0.1	0.07	0.1
4	2	12		0.414	0.054	0.026	0.054
5	4	0.26					
6	1	12		0.35	0.252	0.181	0.252
7	1	36		0.457	0.131	0.058	0.131
8	3	12.5		0.457	0.131	0.058	0.131
9	1	298		0.457	0.131	0.058	0.131

Layer #	Layer Type	Sat. Hyd. Conductivity (cm/sec)	Drainage Length (ft)	Drain Slope (%)	Leachate Recirc. (%)	Recirc. to Layer (#)	Subsurface Inflow (in/yr)
1	1	3.1E-03					
2	1	4.1E-05					
3	1	1.3E-04					
4	2	3.60E-02	585	2			
5	4	8.7E-13					
6	1	1.0E-06					
7	1	1.0E-03					1.79856
8	3	1.0E-03					
9	1	1.0E-03					

Layer #	Layer Type	Geomembrane Pinhole Density (#/acre)	Geomembrane Instal. Defects (#/acre)	Geomembrane Placement Quality	Geotextile Transmissivity (cm^2/sec)
5	4	1	121	2	

Table D-23. HELP Model Input Data for LAWV Off-Vault Year 380 (\LAWOFF\LAW05.D10).

Input Parameter (HELP Model Query)	Generic Input Parameter Value
Landfill area =	0.148 acres
Percent of area where runoff is possible =	100%
Do you want to specify initial moisture storage? (Y/N)	Y
Amount of water or snow on surface =	0 inches
CN Input Parameter (HELP Model Query)	CN Input Parameter Value
Slope =	2 %
Slope length =	585 ft
Soil Texture =	4 (HELP model default soil texture)
Vegetation =	4 (i.e., a good stand of grass)
HELP Model Computed Curve Number = 46.2	

Layer	Layer Number	Layer Type
Topsoil	1	1 (vertical percolation layer)
Upper Backfill	2	1 (vertical percolation layer)
Erosion Barrier	3	1 (vertical percolation layer)
Upper Drainage Layer	4	2 (lateral drainage layer)
HDPE Geomembrane & GCL	5	4 (geomembrane liner)
Foundation Layer (1E-06)	6	1 (vertical percolation layer)
Foundation Layer (1E-03)	7	1 (vertical percolation layer)
Soil Fill Adjacent to Vault	8	3 (barrier soil liner)
Soil Fill Adjacent to Vault	9	1 (vertical percolation layer)

Layer #	Layer Type	Layer Thickness (in)	Soil Texture No.	Total Porosity (Vol/Vol)	Field Capacity (Vol/Vol)	Wilting Point (Vol/Vol)	Initial Moisture [2] (Vol/Vol)
1	1	5.85		0.396	0.109	0.047	0.109
2	1	30		0.35	0.252	0.181	0.252
3	1	12		0.15	0.1	0.07	0.1
4	2	12		0.413	0.056	0.027	0.056
5	4	0.26					
6	1	12		0.35	0.252	0.181	0.252
7	1	36		0.457	0.131	0.058	0.131
8	3	12.5		0.457	0.131	0.058	0.131
9	1	298		0.457	0.131	0.058	0.131

Layer #	Layer Type	Sat. Hyd. Conductivity (cm/sec)	Drainage Length (ft)	Drain Slope (%)	Leachate Recirc. (%)	Recirc. to Layer (#)	Subsurface Inflow (in/yr)
1	1	3.1E-03					
2	1	4.1E-05					
3	1	1.3E-04					
4	2	3.41E-02	585	2			
5	4	8.7E-13					
6	1	1.0E-06					
7	1	1.0E-03					2.27472
8	3	1.0E-03					
9	1	1.0E-03					

Layer #	Layer Type	Geomembrane Pinhole Density (#/acre)	Geomembrane Instal. Defects (#/acre)	Geomembrane Placement Quality	Geotextile Transmissivity (cm^2/sec)
5	4	1	141	2	

Table D-24. HELP Model Input Data for LAWV Off-Vault Year 480 (\LAWOFF\LAW06.D10).

Input Parameter (HELP Model Query)	Generic Input Parameter Value
Landfill area =	0.148 acres
Percent of area where runoff is possible =	100%
Do you want to specify initial moisture storage? (Y/N)	Y
Amount of water or snow on surface =	0 inches
CN Input Parameter (HELP Model Query)	CN Input Parameter Value
Slope =	2 %
Slope length =	585 ft
Soil Texture =	4 (HELP model default soil texture)
Vegetation =	4 (i.e., a good stand of grass)
HELP Model Computed Curve Number = 46.2	

Layer	Layer Number	Layer Type
Topsoil	1	1 (vertical percolation layer)
Upper Backfill	2	1 (vertical percolation layer)
Erosion Barrier	3	1 (vertical percolation layer)
Upper Drainage Layer	4	2 (lateral drainage layer)
HDPE Geomembrane & GCL	5	4 (geomembrane liner)
Foundation Layer (1E-06)	6	1 (vertical percolation layer)
Foundation Layer (1E-03)	7	1 (vertical percolation layer)
Soil Fill Adjacent to Vault	8	3 (barrier soil liner)
Soil Fill Adjacent to Vault	9	1 (vertical percolation layer)

Layer #	Layer Type	Layer Thickness (in)	Soil Texture No.	Total Porosity (Vol/Vol)	Field Capacity (Vol/Vol)	Wilting Point (Vol/Vol)	Initial Moisture [2] (Vol/Vol)
1	1	5.84		0.396	0.109	0.047	0.109
2	1	30		0.35	0.252	0.181	0.252
3	1	12		0.15	0.1	0.07	0.1
4	2	12		0.412	0.06	0.03	0.06
5	4	0.26					
6	1	12		0.35	0.252	0.181	0.252
7	1	36		0.457	0.131	0.058	0.131
8	3	12.5		0.457	0.131	0.058	0.131
9	1	298		0.457	0.131	0.058	0.131

Layer #	Layer Type	Sat. Hyd. Conductivity (cm/sec)	Drainage Length (ft)	Drain Slope (%)	Leachate Recirc. (%)	Recirc. to Layer (#)	Subsurface Inflow (in/yr)
1	1	3.1E-03					
2	1	4.1E-05					
3	1	1.3E-04					
4	2	2.98E-02	585	2			
5	4	8.7E-13					
6	1	1.0E-06					
7	1	1.0E-03					8.49121
8	3	1.0E-03					
9	1	1.0E-03					

Layer #	Layer Type	Geomembrane Pinhole Density (#/acre)	Geomembrane Instal. Defects (#/acre)	Geomembrane Placement Quality	Geotextile Transmissivity (cm^2/sec)
5	4	1	479	2	

Table D-25. HELP Model Input Data for LAWV Off-Vault Year 660 (\LAWOFF\LAW07.D10).

Input Parameter (HELP Model Query)	Generic Input Parameter Value
Landfill area =	0.148 acres
Percent of area where runoff is possible =	100%
Do you want to specify initial moisture storage? (Y/N)	Y
Amount of water or snow on surface =	0 inches
CN Input Parameter (HELP Model Query)	CN Input Parameter Value
Slope =	2 %
Slope length =	585 ft
Soil Texture =	4 (HELP model default soil texture)
Vegetation =	4 (i.e., a good stand of grass)
HELP Model Computed Curve Number = 46.2	

Layer	Layer Number	Layer Type
Topsoil	1	1 (vertical percolation layer)
Upper Backfill	2	1 (vertical percolation layer)
Erosion Barrier	3	1 (vertical percolation layer)
Upper Drainage Layer	4	2 (lateral drainage layer)
HDPE Geomembrane & GCL	5	4 (geomembrane liner)
Foundation Layer (1E-06)	6	1 (vertical percolation layer)
Foundation Layer (1E-03)	7	1 (vertical percolation layer)
Soil Fill Adjacent to Vault	8	3 (barrier soil liner)
Soil Fill Adjacent to Vault	9	1 (vertical percolation layer)

Layer #	Layer Type	Layer Thickness (in)	Soil Texture No.	Total Porosity (Vol/Vol)	Field Capacity (Vol/Vol)	Wilting Point (Vol/Vol)	Initial Moisture [2] (Vol/Vol)
1	1	5.82		0.396	0.109	0.047	0.109
2	1	30		0.35	0.252	0.181	0.252
3	1	12		0.15	0.1	0.07	0.1
4	2	12		0.409	0.067	0.036	0.067
5	4	0.26					
6	1	12		0.35	0.252	0.181	0.252
7	1	36		0.457	0.131	0.058	0.131
8	3	12.5		0.457	0.131	0.058	0.131
9	1	298		0.457	0.131	0.058	0.131

Layer #	Layer Type	Sat. Hyd. Conductivity (cm/sec)	Drainage Length (ft)	Drain Slope (%)	Leachate Recirc. (%)	Recirc. to Layer (#)	Subsurface Inflow (in/yr)
1	1	3.1E-03					
2	1	4.1E-05					
3	1	1.3E-04					
4	2	2.33E-02	585	2			
5	4	8.7E-13					
6	1	1.0E-06					
7	1	1.0E-03					19.86133
8	3	1.0E-03					
9	1	1.0E-03					

Layer #	Layer Type	Geomembrane Pinhole Density (#/acre)	Geomembrane Instal. Defects (#/acre)	Geomembrane Placement Quality	Geotextile Transmissivity (cm^2/sec)
5	4	1	1115	2	

Table D-26. HELP Model Input Data for LAWV Off-Vault Year 1,100 (\LAWOFF\LAW08.D10).

Input Parameter (HELP Model Query)	Generic Input Parameter Value
Landfill area =	0.148 acres
Percent of area where runoff is possible =	100%
Do you want to specify initial moisture storage? (Y/N)	Y
Amount of water or snow on surface =	0 inches
CN Input Parameter (HELP Model Query)	CN Input Parameter Value
Slope =	2 %
Slope length =	585 ft
Soil Texture =	4 (HELP model default soil texture)
Vegetation =	4 (i.e., a good stand of grass)
HELP Model Computed Curve Number = 46.2	

Layer	Layer Number	Layer Type
Topsoil	1	1 (vertical percolation layer)
Upper Backfill	2	1 (vertical percolation layer)
Erosion Barrier	3	1 (vertical percolation layer)
Upper Drainage Layer	4	2 (lateral drainage layer)
HDPE Geomembrane & GCL	5	4 (geomembrane liner)
Foundation Layer (1E-06)	6	1 (vertical percolation layer)
Foundation Layer (1E-03)	7	1 (vertical percolation layer)
Soil Fill Adjacent to Vault	8	3 (barrier soil liner)
Soil Fill Adjacent to Vault	9	1 (vertical percolation layer)

Layer #	Layer Type	Layer Thickness (in)	Soil Texture No.	Total Porosity (Vol/Vol)	Field Capacity (Vol/Vol)	Wilting Point (Vol/Vol)	Initial Moisture [2] (Vol/Vol)
1	1	5.76		0.396	0.109	0.047	0.109
2	1	30		0.35	0.252	0.181	0.252
3	1	12		0.15	0.1	0.07	0.1
4	2	12		0.403	0.084	0.049	0.084
5	4	0.26					
6	1	12		0.35	0.252	0.181	0.252
7	1	36		0.457	0.131	0.058	0.131
8	3	12.5		0.457	0.131	0.058	0.131
9	1	298		0.457	0.131	0.058	0.131

Layer #	Layer Type	Sat. Hyd. Conductivity (cm/sec)	Drainage Length (ft)	Drain Slope (%)	Leachate Recirc. (%)	Recirc. to Layer (#)	Subsurface Inflow (in/yr)
1	1	3.1E-03					
2	1	4.1E-05					
3	1	1.3E-04					
4	2	1.28E-02	585	2			
5	4	8.7E-13					
6	1	1.0E-06					
7	1	1.0E-03					41.9739
8	3	1.0E-03					
9	1	1.0E-03					

Layer #	Layer Type	Geomembrane Pinhole Density (#/acre)	Geomembrane Instal. Defects (#/acre)	Geomembrane Placement Quality	Geotextile Transmissivity (cm^2/sec)
5	4	1	2669	2	

Table D-27. HELP Model Input Data for LAWV Off-Vault Year 1,900 (\LAWOFF\LAW09.D10).

Input Parameter (HELP Model Query)	Generic Input Parameter Value
Landfill area =	0.148 acres
Percent of area where runoff is possible =	100%
Do you want to specify initial moisture storage? (Y/N)	Y
Amount of water or snow on surface =	0 inches
CN Input Parameter (HELP Model Query)	CN Input Parameter Value
Slope =	2 %
Slope length =	585 ft
Soil Texture =	4 (HELP model default soil texture)
Vegetation =	4 (i.e., a good stand of grass)
HELP Model Computed Curve Number = 46.2	

Layer	Layer Number	Layer Type
Topsoil	1	1 (vertical percolation layer)
Upper Backfill	2	1 (vertical percolation layer)
Erosion Barrier	3	1 (vertical percolation layer)
Upper Drainage Layer	4	2 (lateral drainage layer)
HDPE Geomembrane & GCL	5	4 (geomembrane liner)
Foundation Layer (1E-06)	6	1 (vertical percolation layer)
Foundation Layer (1E-03)	7	1 (vertical percolation layer)
Soil Fill Adjacent to Vault	8	3 (barrier soil liner)
Soil Fill Adjacent to Vault	9	1 (vertical percolation layer)

Layer #	Layer Type	Layer Thickness (in)	Soil Texture No.	Total Porosity (Vol/Vol)	Field Capacity (Vol/Vol)	Wilting Point (Vol/Vol)	Initial Moisture [2] (Vol/Vol)
1	1	5.66		0.396	0.109	0.047	0.109
2	1	30		0.35	0.252	0.181	0.252
3	1	12		0.15	0.1	0.07	0.1
4	2	12		0.392	0.116	0.074	0.116
5	4	0.26					
6	1	12		0.35	0.252	0.181	0.252
7	1	36		0.457	0.131	0.058	0.131
8	3	12.5		0.457	0.131	0.058	0.131
9	1	298		0.457	0.131	0.058	0.131

Layer #	Layer Type	Sat. Hyd. Conductivity (cm/sec)	Drainage Length (ft)	Drain Slope (%)	Leachate Recirc. (%)	Recirc. to Layer (#)	Subsurface Inflow (in/yr)
1	1	3.1E-03					
2	1	4.1E-05					
3	1	1.3E-04					
4	2	4.3E-03	585	2			
5	4	8.7E-13					
6	1	1.0E-06					
7	1	1.0E-03					63.1092
8	3	1.0E-03					
9	1	1.0E-03					

Layer #	Layer Type	Geomembrane Pinhole Density (#/acre)	Geomembrane Instal. Defects (#/acre)	Geomembrane Placement Quality	Geotextile Transmissivity (cm^2/sec)
5	4	1	5496	2	

Table D-28. HELP Model Input Data for LAWV Off-Vault Year 2,723 (\LAWOFF\LAW10.D10).

Input Parameter (HELP Model Query)	Generic Input Parameter Value
Landfill area =	0.148 acres
Percent of area where runoff is possible =	100%
Do you want to specify initial moisture storage? (Y/N)	Y
Amount of water or snow on surface =	0 inches
CN Input Parameter (HELP Model Query)	CN Input Parameter Value
Slope =	2 %
Slope length =	585 ft
Soil Texture =	4 (HELP model default soil texture)
Vegetation =	4 (i.e., a good stand of grass)
HELP Model Computed Curve Number = 46.2	

Layer	Layer Number	Layer Type
Topsoil	1	1 (vertical percolation layer)
Upper Backfill	2	1 (vertical percolation layer)
Erosion Barrier	3	1 (vertical percolation layer)
Upper Drainage Layer	4	2 (lateral drainage layer)
HDPE Geomembrane & GCL	5	4 (geomembrane liner)
Foundation Layer (1E-06)	6	1 (vertical percolation layer)
Foundation Layer (1E-03)	7	1 (vertical percolation layer)
Soil Fill Adjacent to Vault	8	3 (barrier soil liner)
Soil Fill Adjacent to Vault	9	1 (vertical percolation layer)

Layer #	Layer Type	Layer Thickness (in)	Soil Texture No.	Total Porosity (Vol/Vol)	Field Capacity (Vol/Vol)	Wilting Point (Vol/Vol)	Initial Moisture [2] (Vol/Vol)
1	1	5.55		0.396	0.109	0.047	0.109
2	1	30		0.35	0.252	0.181	0.252
3	1	12		0.15	0.1	0.07	0.1
4	2	12		0.38	0.148	0.1	0.148
5	4	0.26					
6	1	12		0.35	0.252	0.181	0.252
7	1	36		0.457	0.131	0.058	0.131
8	3	12.5		0.457	0.131	0.058	0.131
9	1	298		0.457	0.131	0.058	0.131

Layer #	Layer Type	Sat. Hyd. Conductivity (cm/sec)	Drainage Length (ft)	Drain Slope (%)	Leachate Recirc. (%)	Recirc. to Layer (#)	Subsurface Inflow (in/yr)
1	1	3.1E-03					
2	1	4.1E-05					
3	1	1.3E-04					
4	2	1.4E-03	585	2			
5	4	8.7E-13					
6	1	1.0E-06					
7	1	1.0E-03					68.3714
8	3	1.0E-03					
9	1	1.0E-03					

Layer #	Layer Type	Geomembrane Pinhole Density (#/acre)	Geomembrane Instal. Defects (#/acre)	Geomembrane Placement Quality	Geotextile Transmissivity (cm^2/sec)
5	4	1	8403	2	

Table D-29. HELP Model Input Data for LAWV Off-Vault Year 2,905 (\LAWOFF\LAW11.D10).

Input Parameter (HELP Model Query)	Generic Input Parameter Value
Landfill area =	0.148 acres
Percent of area where runoff is possible =	100%
Do you want to specify initial moisture storage? (Y/N)	Y
Amount of water or snow on surface =	0 inches
CN Input Parameter (HELP Model Query)	CN Input Parameter Value
Slope =	2 %
Slope length =	585 ft
Soil Texture =	4 (HELP model default soil texture)
Vegetation =	4 (i.e., a good stand of grass)
HELP Model Computed Curve Number = 46.2	

Layer	Layer Number	Layer Type
Topsoil	1	1 (vertical percolation layer)
Upper Backfill	2	1 (vertical percolation layer)
Erosion Barrier	3	1 (vertical percolation layer)
Upper Drainage Layer	4	2 (lateral drainage layer)
HDPE Geomembrane & GCL	5	4 (geomembrane liner)
Foundation Layer (1E-06)	6	1 (vertical percolation layer)
Foundation Layer (1E-03)	7	1 (vertical percolation layer)
Soil Fill Adjacent to Vault	8	3 (barrier soil liner)
Soil Fill Adjacent to Vault	9	1 (vertical percolation layer)

Layer #	Layer Type	Layer Thickness (in)	Soil Texture No.	Total Porosity (Vol/Vol)	Field Capacity (Vol/Vol)	Wilting Point (Vol/Vol)	Initial Moisture [2] (Vol/Vol)
1	1	5.53		0.396	0.109	0.047	0.109
2	1	30		0.35	0.252	0.181	0.252
3	1	12		0.15	0.1	0.07	0.1
4	2	12		0.38	0.148	0.1	0.148
5	4	0.26					
6	1	12		0.35	0.252	0.181	0.252
7	1	36		0.457	0.131	0.058	0.131
8	3	12.5		0.457	0.131	0.058	0.131
9	1	298		0.457	0.131	0.058	0.131

Layer #	Layer Type	Sat. Hyd. Conductivity (cm/sec)	Drainage Length (ft)	Drain Slope (%)	Leachate Recirc. (%)	Recirc. to Layer (#)	Subsurface Inflow (in/yr)
1	1	3.1E-03					
2	1	4.1E-05					
3	1	1.3E-04					
4	2	1.4E-03	585	2			
5	4	8.7E-13					
6	1	1.0E-06					
7	1	1.0E-03					68.5677
8	3	1.0E-03					
9	1	1.0E-03					

Layer #	Layer Type	Geomembrane Pinhole Density (#/acre)	Geomembrane Instal. Defects (#/acre)	Geomembrane Placement Quality	Geotextile Transmissivity (cm^2/sec)
5	4	1	9046	2	

Table D-30. HELP Model Input Data for LAWV Off-Vault After Roof Collapse Year 2,905+ (\LAWOFF\LAWCLPSE.D10).

Input Parameter (HELP Model Query)	Generic Input Parameter Value
Landfill area =	0.148 acres
Percent of area where runoff is possible =	100%
Do you want to specify initial moisture storage? (Y/N)	Y
Amount of water or snow on surface =	0 inches
CN Input Parameter (HELP Model Query)	CN Input Parameter Value
Slope =	2 %
Slope length =	585 ft
Soil Texture =	4 (HELP model default soil texture)
Vegetation =	4 (i.e., a good stand of grass)
HELP Model Computed Curve Number = 46.2	

Layer	Layer Number	Layer Type
Topsoil	1	1 (vertical percolation layer)
Upper Backfill	2	1 (vertical percolation layer)
Erosion Barrier	3	1 (vertical percolation layer)
Upper Drainage Layer	4	2 (lateral drainage layer)
HDPE Geomembrane & GCL	5	4 (geomembrane liner)
Foundation Layer (1E-06)	6	1 (vertical percolation layer)
Foundation Layer (1E-03)	7	1 (vertical percolation layer)
Soil Fill Adjacent to Vault	8	3 (barrier soil liner)
Soil Fill Adjacent to Vault	9	1 (vertical percolation layer)

Layer #	Layer Type	Layer Thickness (in)	Soil Texture No.	Total Porosity (Vol/Vol)	Field Capacity (Vol/Vol)	Wilting Point (Vol/Vol)	Initial Moisture [2] (Vol/Vol)
1	1	5.53		0.396	0.109	0.047	0.109
2	1	30		0.35	0.252	0.181	0.252
3	1	12		0.15	0.1	0.07	0.1
4	2	12		0.38	0.148	0.1	0.148
5	4	0.26					
6	1	12		0.35	0.252	0.181	0.252
7	1	36		0.457	0.131	0.058	0.131
8	3	12.5		0.457	0.131	0.058	0.131
9	1	298		0.457	0.131	0.058	0.131

Layer #	Layer Type	Sat. Hyd. Conductivity (cm/sec)	Drainage Length (ft)	Drain Slope (%)	Leachate Recirc. (%)	Recirc. to Layer (#)	Subsurface Inflow (in/yr)
1	1	3.1E-03					
2	1	4.1E-05					
3	1	1.3E-04					
4	2	1.4E-03	585	2			
5	4	8.7E-13					
6	1	1.0E-06					
7	1	1.0E-03					
8	3	1.0E-03					
9	1	1.0E-03					

Layer #	Layer Type	Geomembrane Pinhole Density (#/acre)	Geomembrane Instal. Defects (#/acre)	Geomembrane Placement Quality	Geotextile Transmissivity (cm^2/sec)
5	4	1	9046	2	

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Appendix E. HELP Model Input Data Sheets for ILVs

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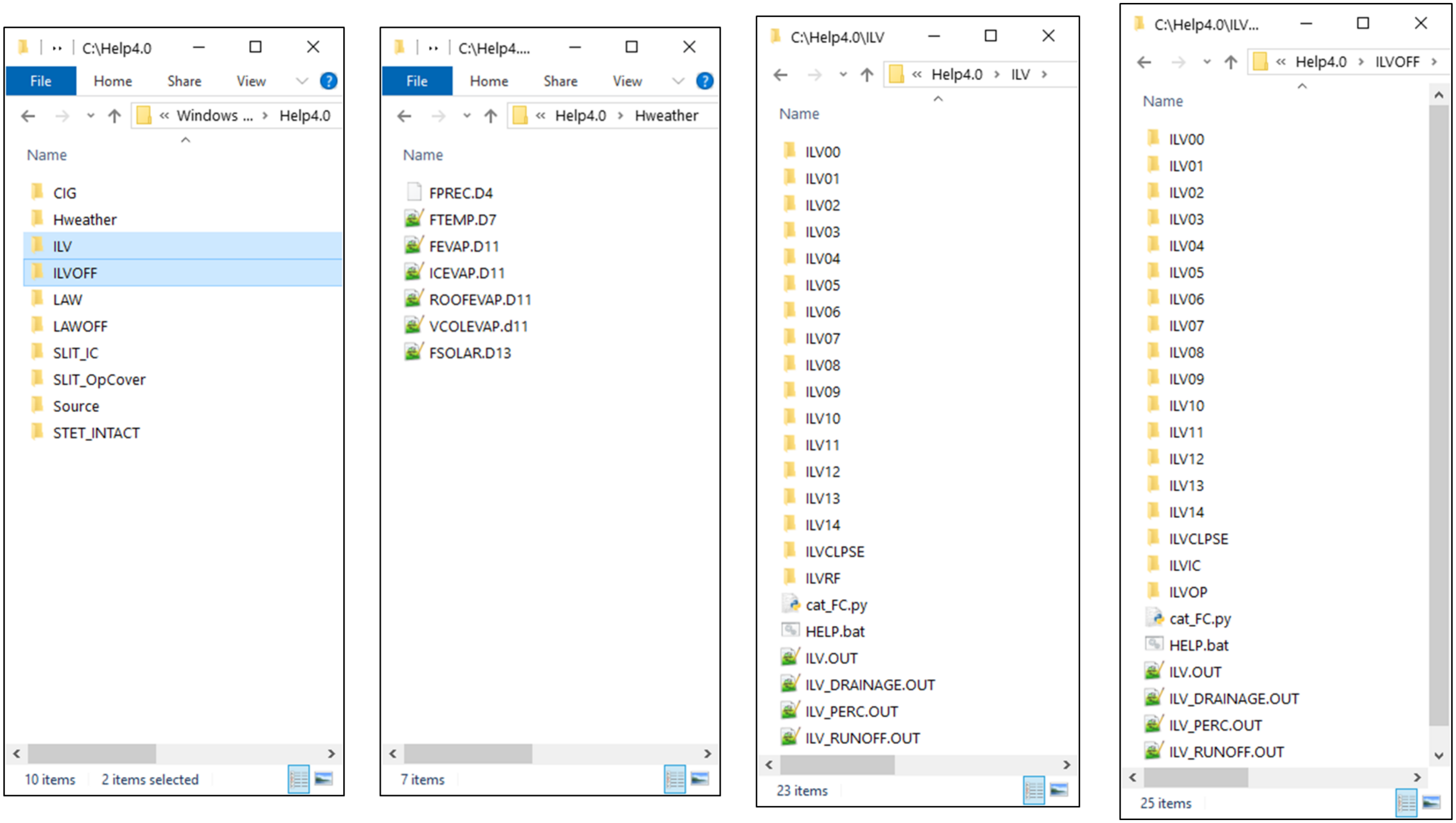

Figure E-1. HELP Model File Hierarchy for ILV On-Vault and Off-Vault Simulations.

Table E-1. Subsurface Inflow Fluxes to Off-Vault Layer 8 for the Off-Vault ILV HELP Model Simulations.

IL Vault Roof Length	49.5 feet		
Off-Vault Width	10 feet		
On-Vault IL Vault Simulation Case	**HELP Model Layer**	**Drainage Rate (inches/year)**	**Subsurface Run-on to Off-Vault Area (inches/year)**
ILV00\OUTPUT\SUMMARY.TXT			
LATERAL DRAINAGE COLLECTED FROM LAYER	4	16.19954	
LATERAL DRAINAGE COLLECTED FROM LAYER	8	0.00014	0.000693
ILV01\OUTPUT\SUMMARY.TXT			
LATERAL DRAINAGE COLLECTED FROM LAYER	4	16.19085	
LATERAL DRAINAGE COLLECTED FROM LAYER	8	0.00089	0.0044055
ILV02\OUTPUT\SUMMARY.TXT			
LATERAL DRAINAGE COLLECTED FROM LAYER	4	16.17589	
LATERAL DRAINAGE COLLECTED FROM LAYER	8	0.019	0.09405
ILV03\OUTPUT\SUMMARY.TXT			
LATERAL DRAINAGE COLLECTED FROM LAYER	4	16.17511	
LATERAL DRAINAGE COLLECTED FROM LAYER	8	0.02059	0.1019205
ILV04\OUTPUT\SUMMARY.TXT			
LATERAL DRAINAGE COLLECTED FROM LAYER	4	16.11612	
LATERAL DRAINAGE COLLECTED FROM LAYER	7	0.07979	0.3949605
ILV05\OUTPUT\SUMMARY.TXT			
LATERAL DRAINAGE COLLECTED FROM LAYER	4	16.09776	
LATERAL DRAINAGE COLLECTED FROM LAYER	7	0.09983	0.4941585
ILV06\OUTPUT\SUMMARY.TXT			
LATERAL DRAINAGE COLLECTED FROM LAYER	4	15.78704	
LATERAL DRAINAGE COLLECTED FROM LAYER	7	0.39965	1.9782675
ILV07\OUTPUT\SUMMARY.TXT			
LATERAL DRAINAGE COLLECTED FROM LAYER	4	14.97541	
LATERAL DRAINAGE COLLECTED FROM LAYER	7	1.16788	5.781006
ILV08\OUTPUT\SUMMARY.TXT			
LATERAL DRAINAGE COLLECTED FROM LAYER	4	12.0852	
LATERAL DRAINAGE COLLECTED FROM LAYER	7	3.83822	18.999189
ILV09\OUTPUT\SUMMARY.TXT			
LATERAL DRAINAGE COLLECTED FROM LAYER	4	6.19056	
LATERAL DRAINAGE COLLECTED FROM LAYER	7	8.65123	42.8235885
ILV10\OUTPUT\SUMMARY.TXT			
LATERAL DRAINAGE COLLECTED FROM LAYER	4	2.85146	
LATERAL DRAINAGE COLLECTED FROM LAYER	7	10.56301	52.2868995

Table E-1 (cont'd). Subsurface Inflow Fluxes to Off-Vault Layer 8 for the Off-Vault ILV HELP Model Simulations.

IL Vault Roof Length	49.5 feet		
Off-Vault Width	10 feet		
On-Vault IL Vault Simulation Case	**HELP Model Layer**	**Drainage Rate (inches/year)**	**Subsurface Run-on to Off-Vault Area (inches/year)**
ILV11\OUTPUT\SUMMARY.TXT			
LATERAL DRAINAGE COLLECTED FROM LAYER	4	2.82781	
LATERAL DRAINAGE COLLECTED FROM LAYER	7	10.60496	52.494552
ILV12\OUTPUT\SUMMARY.TXT			
LATERAL DRAINAGE COLLECTED FROM LAYER	4	2.7885	
LATERAL DRAINAGE COLLECTED FROM LAYER	7	10.67781	52.8551595
ILV13\OUTPUT\SUMMARY.TXT			
LATERAL DRAINAGE COLLECTED FROM LAYER	4	2.66448	
LATERAL DRAINAGE COLLECTED FROM LAYER	7	10.8571	53.742645
ILV14\OUTPUT\SUMMARY.TXT			
LATERAL DRAINAGE COLLECTED FROM LAYER	4	2.62757	
LATERAL DRAINAGE COLLECTED FROM LAYER	7	10.90201	53.9649495

Table E-2. HELP Model Input Data for ILV Concrete Roof Only (\ILV\ILVRF.D10).

Input Parameter (HELP Model Query)	Generic Input Parameter Value
Landfill area =	1.495 acres
Percent of area where runoff is possible =	100%
Do you want to specify initial moisture storage? (Y/N)	Y
Amount of water or snow on surface =	0 inches
User-Specified Curve Number = 97.0	

Layer	Layer Number	Layer Type
Gravel Drainage Layer	1	2 (lateral drainage layer)
Concrete Roof Slab	2	3 (barrier soil liner)
Grout	3	1 (vertical percolation layer)

Layer #	Layer Type	Layer Thickness (in)	Soil Texture No.	Total Porosity (Vol/Vol)	Field Capacity (Vol/Vol)	Wilting Point (Vol/Vol)	Initial Moisture [2] (Vol/Vol)
1	2	0.1		0.38	0.08	0.013	0.08
2	3	27		0.19	0.18	0.17	0.19
3	1	3.0		0.328	0.29	0.05	0.29

Layer #	Layer Type	Sat. Hyd. Conductivity (cm/sec)	Drainage Length (ft)	Drain Slope (%)	Leachate Recirc. (%)	Recirc. to Layer (#)	Subsurface Inflow (in/yr)
1	2	1.0E-01	49.5	2			
2	3	1.0E-12					
3	1	2.2E-06					

Layer #	Layer Type	Geomembrane Pinhole Density (#/acre)	Geomembrane Instal. Defects (#/acre)	Geomembrane Placement Quality	Geotextile Transmissivity (cm^2/sec)

Table E-3. HELP Model Input Data for ILV On-Vault Year 100 (\ILV\ILV00.D10).

Input Parameter (HELP Model Query)	Generic Input Parameter Value
Landfill area =	1.495 acres
Percent of area where runoff is possible =	100%
Do you want to specify initial moisture storage? (Y/N)	Y
Amount of water or snow on surface =	0 inches
CN Input Parameter (HELP Model Query)	CN Input Parameter Value
Slope =	2 %
Slope length =	250 ft
Soil Texture =	4 (HELP model default soil texture)
Vegetation =	4 (i.e., a good stand of grass)
HELP Model Computed Curve Number = 49.87	

Layer	Layer Number	Layer Type
Topsoil	1	1 (vertical percolation layer)
Upper Backfill	2	1 (vertical percolation layer)
Erosion Barrier	3	1 (vertical percolation layer)
Upper Drainage Layer	4	2 (lateral drainage layer)
HDPE Geomembrane	5	4 (geomembrane liner)
GCL	6	3 (barrier soil liner)
Foundation Layer (1E-06)	7	1 (vertical percolation layer)
Lower Drainage Layer	8	2 (lateral drainage layer)
Concrete Roof Slab	9	3 (barrier soil liner)

Layer #	Layer Type	Layer Thickness (in)	Soil Texture No.	Total Porosity (Vol/Vol)	Field Capacity (Vol/Vol)	Wilting Point (Vol/Vol)	Initial Moisture [2] (Vol/Vol)
1	1	6		0.396	0.109	0.047	0.109
2	1	30		0.35	0.252	0.181	0.252
3	1	12		0.15	0.1	0.07	0.1
4	2	12		0.417	0.045	0.018	0.045
5	4	0.06					
6	3	0.2		0.75	0.747	0.4	0.75
7	1	12		0.35	0.252	0.181	0.252
8	2	12		0.457	0.131	0.058	0.131
9	3	27		0.19	0.18	0.17	0.19

Layer #	Layer Type	Sat. Hyd. Conductivity (cm/sec)	Drainage Length (ft)	Drain Slope (%)	Leachate Recirc. (%)	Recirc. to Layer (#)	Subsurface Inflow (in/yr)
1	1	3.1E-03					
2	1	4.1E-05					
3	1	1.3E-04					
4	2	5.0E-02	250	2			
5	4	2.0E-13					
6	3	5.0E-09					
7	1	1.0E-06					
8	2	1.0E-03	49.5	2			
9	3	1.0E-12					

Layer #	Layer Type	Geomembrane Pinhole Density (#/acre)	Geomembrane Instal. Defects (#/acre)	Geomembrane Placement Quality	Geotextile Transmissivity (cm^2/sec)
5	4	1	4	2	

Table E-4. HELP Model Input Data for ILV On-Vault Year 180 (\ILV\ILV01.D10).

Input Parameter (HELP Model Query)	Generic Input Parameter Value
Landfill area =	1.495 acres
Percent of area where runoff is possible =	100%
Do you want to specify initial moisture storage? (Y/N)	Y
Amount of water or snow on surface =	0 inches
CN Input Parameter (HELP Model Query)	CN Input Parameter Value
Slope =	2 %
Slope length =	250 ft
Soil Texture =	4 (HELP model default soil texture)
Vegetation =	4 (i.e., a good stand of grass)
HELP Model Computed Curve Number = 49.87	

Layer	Layer Number	Layer Type
Topsoil	1	1 (vertical percolation layer)
Upper Backfill	2	1 (vertical percolation layer)
Erosion Barrier	3	1 (vertical percolation layer)
Upper Drainage Layer	4	2 (lateral drainage layer)
HDPE Geomembrane	5	4 (geomembrane liner)
GCL	6	3 (barrier soil liner)
Foundation Layer (1E-06)	7	1 (vertical percolation layer)
Lower Drainage Layer	8	2 (lateral drainage layer)
Concrete Roof Slab	9	3 (barrier soil liner)

Layer #	Layer Type	Layer Thickness (in)	Soil Texture No.	Total Porosity (Vol/Vol)	Field Capacity (Vol/Vol)	Wilting Point (Vol/Vol)	Initial Moisture [2] (Vol/Vol)
1	1	5.96		0.396	0.109	0.047	0.109
2	1	30		0.35	0.252	0.181	0.252
3	1	12		0.15	0.1	0.07	0.1
4	2	12		0.416	0.048	0.021	0.048
5	4	0.06					
6	3	0.2		0.75	0.747	0.4	0.75
7	1	12		0.35	0.252	0.181	0.252
8	2	12		0.457	0.131	0.058	0.131
9	3	27		0.19	0.18	0.17	0.19

Layer #	Layer Type	Sat. Hyd. Conductivity (cm/sec)	Drainage Length (ft)	Drain Slope (%)	Leachate Recirc. (%)	Recirc. to Layer (#)	Subsurface Inflow (in/yr)
1	1	3.1E-03					
2	1	4.1E-05					
3	1	1.3E-04					
4	2	4.48E-02	250	2			
5	4	2.0E-13					
6	3	5.0E-09					
7	1	1.0E-06					
8	2	1.0E-03	49.5	2			
9	3	1.0E-12					

Layer #	Layer Type	Geomembrane Pinhole Density (#/acre)	Geomembrane Instal. Defects (#/acre)	Geomembrane Placement Quality	Geotextile Transmissivity (cm^2/sec)
5	4	1	40	2	

Table E-5. HELP Model Input Data for ILV On-Vault Year 290 (\ILV\ILV02.D10).

Input Parameter (HELP Model Query)	Generic Input Parameter Value
Landfill area =	1.495 acres
Percent of area where runoff is possible =	100%
Do you want to specify initial moisture storage? (Y/N)	Y
Amount of water or snow on surface =	0 inches
CN Input Parameter (HELP Model Query)	CN Input Parameter Value
Slope =	2 %
Slope length =	250 ft
Soil Texture =	4 (HELP model default soil texture)
Vegetation =	4 (i.e., a good stand of grass)
HELP Model Computed Curve Number = 49.87	

Layer	Layer Number	Layer Type
Topsoil	1	1 (vertical percolation layer)
Upper Backfill	2	1 (vertical percolation layer)
Erosion Barrier	3	1 (vertical percolation layer)
Upper Drainage Layer	4	2 (lateral drainage layer)
HDPE Geomembrane	5	4 (geomembrane liner)
GCL	6	3 (barrier soil liner)
Foundation Layer (1E-06)	7	1 (vertical percolation layer)
Lower Drainage Layer	8	2 (lateral drainage layer)
Concrete Roof Slab	9	3 (barrier soil liner)

Layer #	Layer Type	Layer Thickness (in)	Soil Texture No.	Total Porosity (Vol/Vol)	Field Capacity (Vol/Vol)	Wilting Point (Vol/Vol)	Initial Moisture [2] (Vol/Vol)
1	1	5.90		0.396	0.109	0.047	0.109
2	1	30		0.35	0.252	0.181	0.252
3	1	12		0.15	0.1	0.07	0.1
4	2	12		0.414	0.052	0.024	0.052
5	4	0.06					
6	3	0.2		0.75	0.747	0.4	0.75
7	1	12		0.35	0.252	0.181	0.252
8	2	12		0.457	0.131	0.058	0.131
9	3	27		0.19	0.18	0.17	0.19

Layer #	Layer Type	Sat. Hyd. Conductivity (cm/sec)	Drainage Length (ft)	Drain Slope (%)	Leachate Recirc. (%)	Recirc. to Layer (#)	Subsurface Inflow (in/yr)
1	1	3.1E-03					
2	1	4.1E-05					
3	1	1.3E-04					
4	2	3.86E-02	250	2			
5	4	2.0E-13					
6	3	5.0E-08					
7	1	1.0E-06					
8	2	1.0E-03	49.5	2			
9	3	1.0E-12					

Layer #	Layer Type	Geomembrane Pinhole Density (#/acre)	Geomembrane Instal. Defects (#/acre)	Geomembrane Placement Quality	Geotextile Transmissivity (cm^2/sec)
5	4	1	96	2	

Table E-6. HELP Model Input Data for ILV On-Vault Year 300 (\ILV\ILV03.D10).

Input Parameter (HELP Model Query)	Generic Input Parameter Value
Landfill area =	1.495 acres
Percent of area where runoff is possible =	100%
Do you want to specify initial moisture storage? (Y/N)	Y
Amount of water or snow on surface =	0 inches
CN Input Parameter (HELP Model Query)	CN Input Parameter Value
Slope =	2 %
Slope length =	250 ft
Soil Texture =	4 (HELP model default soil texture)
Vegetation =	4 (i.e., a good stand of grass)
HELP Model Computed Curve Number = 49.87	

Layer	Layer Number	Layer Type
Topsoil	1	1 (vertical percolation layer)
Upper Backfill	2	1 (vertical percolation layer)
Erosion Barrier	3	1 (vertical percolation layer)
Upper Drainage Layer	4	2 (lateral drainage layer)
HDPE Geomembrane	5	4 (geomembrane liner)
GCL	6	3 (barrier soil liner)
Foundation Layer (1E-06)	7	1 (vertical percolation layer)
Lower Drainage Layer	8	2 (lateral drainage layer)
Concrete Roof Slab	9	3 (barrier soil liner)

Layer #	Layer Type	Layer Thickness (in)	Soil Texture No.	Total Porosity (Vol/Vol)	Field Capacity (Vol/Vol)	Wilting Point (Vol/Vol)	Initial Moisture [2] (Vol/Vol)
1	1	5.90		0.396	0.109	0.047	0.109
2	1	30		0.35	0.252	0.181	0.252
3	1	12		0.15	0.1	0.07	0.1
4	2	12		0.414	0.053	0.024	0.053
5	4	0.06					
6	3	0.2		0.75	0.747	0.4	0.75
7	1	12		0.35	0.252	0.181	0.252
8	2	12		0.457	0.131	0.058	0.131
9	3	27		0.19	0.18	0.17	0.19

Layer #	Layer Type	Sat. Hyd. Conductivity (cm/sec)	Drainage Length (ft)	Drain Slope (%)	Leachate Recirc. (%)	Recirc. to Layer (#)	Subsurface Inflow (in/yr)
1	1	3.1E-03					
2	1	4.1E-05					
3	1	1.3E-04					
4	2	3.81E-02	250	2			
5	4	2.0E-13					
6	3	5.0E-08					
7	1	1.0E-06					
8	2	1.0E-03	49.5	2			
9	3	1.0E-12					

Layer #	Layer Type	Geomembrane Pinhole Density (#/acre)	Geomembrane Instal. Defects (#/acre)	Geomembrane Placement Quality	Geotextile Transmissivity (cm^2/sec)
5	4	1	101	2	

Table E-7. HELP Model Input Data for ILV On-Vault Year 340 (\ILV\ILV04.D10).

Input Parameter (HELP Model Query)	Generic Input Parameter Value
Landfill area =	1.495 acres
Percent of area where runoff is possible =	100%
Do you want to specify initial moisture storage? (Y/N)	Y
Amount of water or snow on surface =	0 inches
CN Input Parameter (HELP Model Query)	CN Input Parameter Value
Slope =	2 %
Slope length =	250 ft
Soil Texture =	4 (HELP model default soil texture)
Vegetation =	4 (i.e., a good stand of grass)
HELP Model Computed Curve Number = 49.87	

Layer	Layer Number	Layer Type
Topsoil	1	1 (vertical percolation layer)
Upper Backfill	2	1 (vertical percolation layer)
Erosion Barrier	3	1 (vertical percolation layer)
Upper Drainage Layer	4	2 (lateral drainage layer)
HDPE Geomembrane & GCL	5	4 (geomembrane liner)
Foundation Layer (1E-06)	6	1 (vertical percolation layer)
Lower Drainage Layer	7	2 (lateral drainage layer)
Concrete Roof Slab	8	3 (barrier soil liner)

Layer #	Layer Type	Layer Thickness (in)	Soil Texture No.	Total Porosity (Vol/Vol)	Field Capacity (Vol/Vol)	Wilting Point (Vol/Vol)	Initial Moisture [2] (Vol/Vol)
1	1	5.88		0.396	0.109	0.047	0.109
2	1	30		0.35	0.252	0.181	0.252
3	1	12		0.15	0.1	0.07	0.1
4	2	12		0.414	0.054	0.026	0.054
5	4	0.26					
6	1	12		0.35	0.252	0.181	0.252
7	2	12		0.457	0.131	0.058	0.131
8	3	27		0.19	0.18	0.17	0.19

Layer #	Layer Type	Sat. Hyd. Conductivity (cm/sec)	Drainage Length (ft)	Drain Slope (%)	Leachate Recirc. (%)	Recirc. to Layer (#)	Subsurface Inflow (in/yr)
1	1	3.1E-03					
2	1	4.1E-05					
3	1	1.3E-04					
4	2	3.60E-02	250	2			
5	4	8.7E-13					
6	1	1.0E-06					
7	2	1.0E-03	49.5	2			
8	3	1.0E-12					

Layer #	Layer Type	Geomembrane Pinhole Density (#/acre)	Geomembrane Instal. Defects (#/acre)	Geomembrane Placement Quality	Geotextile Transmissivity (cm^2/sec)
5	4	1	121	2	

Table E-8. HELP Model Input Data for ILV On-Vault Year 380 (\ILV\ILV05.D10).

Input Parameter (HELP Model Query)	Generic Input Parameter Value
Landfill area =	1.495 acres
Percent of area where runoff is possible =	100%
Do you want to specify initial moisture storage? (Y/N)	Y
Amount of water or snow on surface =	0 inches
CN Input Parameter (HELP Model Query)	CN Input Parameter Value
Slope =	2 %
Slope length =	250 ft
Soil Texture =	4 (HELP model default soil texture)
Vegetation =	4 (i.e., a good stand of grass)
HELP Model Computed Curve Number = 49.87	

Layer	Layer Number	Layer Type
Topsoil	1	1 (vertical percolation layer)
Upper Backfill	2	1 (vertical percolation layer)
Erosion Barrier	3	1 (vertical percolation layer)
Upper Drainage Layer	4	2 (lateral drainage layer)
HDPE Geomembrane & GCL	5	4 (geomembrane liner)
Foundation Layer (1E-06)	6	1 (vertical percolation layer)
Lower Drainage Layer	7	2 (lateral drainage layer)
Concrete Roof Slab	8	3 (barrier soil liner)

Layer #	Layer Type	Layer Thickness (in)	Soil Texture No.	Total Porosity (Vol/Vol)	Field Capacity (Vol/Vol)	Wilting Point (Vol/Vol)	Initial Moisture [2] (Vol/Vol)
1	1	5.85		0.396	0.109	0.047	0.109
2	1	30		0.35	0.252	0.181	0.252
3	1	12		0.15	0.1	0.07	0.1
4	2	12		0.413	0.056	0.027	0.056
5	4	0.26					
6	1	12		0.35	0.252	0.181	0.252
7	2	12		0.457	0.131	0.058	0.131
8	3	27		0.19	0.18	0.17	0.19

Layer #	Layer Type	Sat. Hyd. Conductivity (cm/sec)	Drainage Length (ft)	Drain Slope (%)	Leachate Recirc. (%)	Recirc. to Layer (#)	Subsurface Inflow (in/yr)
1	1	3.1E-03					
2	1	4.1E-05					
3	1	1.3E-04					
4	2	3.41E-02	250	2			
5	4	8.7E-13					
6	1	1.0E-06					
7	2	1.0E-03	49.5	2			
8	3	1.0E-12					

Layer #	Layer Type	Geomembrane Pinhole Density (#/acre)	Geomembrane Instal. Defects (#/acre)	Geomembrane Placement Quality	Geotextile Transmissivity (cm^2/sec)
5	4	1	141	2	

Table E-9. HELP Model Input Data for ILV On-Vault Year 480 (\ILV\ILV06.D10).

Input Parameter (HELP Model Query)	Generic Input Parameter Value
Landfill area =	1.495 acres
Percent of area where runoff is possible =	100%
Do you want to specify initial moisture storage? (Y/N)	Y
Amount of water or snow on surface =	0 inches
CN Input Parameter (HELP Model Query)	CN Input Parameter Value
Slope =	2 %
Slope length =	250 ft
Soil Texture =	4 (HELP model default soil texture)
Vegetation =	4 (i.e., a good stand of grass)
HELP Model Computed Curve Number = 49.87	

Layer	Layer Number	Layer Type
Topsoil	1	1 (vertical percolation layer)
Upper Backfill	2	1 (vertical percolation layer)
Erosion Barrier	3	1 (vertical percolation layer)
Upper Drainage Layer	4	2 (lateral drainage layer)
HDPE Geomembrane & GCL	5	4 (geomembrane liner)
Foundation Layer (1E-06)	6	1 (vertical percolation layer)
Lower Drainage Layer	7	2 (lateral drainage layer)
Concrete Roof Slab	8	3 (barrier soil liner)

Layer #	Layer Type	Layer Thickness (in)	Soil Texture No.	Total Porosity (Vol/Vol)	Field Capacity (Vol/Vol)	Wilting Point (Vol/Vol)	Initial Moisture [2] (Vol/Vol)
1	1	5.84		0.396	0.109	0.047	0.109
2	1	30		0.35	0.252	0.181	0.252
3	1	12		0.15	0.1	0.07	0.1
4	2	12		0.412	0.06	0.03	0.06
5	4	0.26					
6	1	12		0.35	0.252	0.181	0.252
7	2	12		0.457	0.131	0.058	0.131
8	3	27		0.19	0.18	0.17	0.19

Layer #	Layer Type	Sat. Hyd. Conductivity (cm/sec)	Drainage Length (ft)	Drain Slope (%)	Leachate Recirc. (%)	Recirc. to Layer (#)	Subsurface Inflow (in/yr)
1	1	3.1E-03					
2	1	4.1E-05					
3	1	1.3E-04					
4	2	2.98E-02	250	2			
5	4	8.7E-13					
6	1	1.0E-06					
7	2	1.0E-03	49.5	2			
8	3	1.0E-12					

Layer #	Layer Type	Geomembrane Pinhole Density (#/acre)	Geomembrane Instal. Defects (#/acre)	Geomembrane Placement Quality	Geotextile Transmissivity (cm^2/sec)
5	4	1	479	2	

Table E-10. HELP Model Input Data for ILV On-Vault Year 660 (\ILV\ILV07.D10).

Input Parameter (HELP Model Query)	Generic Input Parameter Value
Landfill area =	1.495 acres
Percent of area where runoff is possible =	100%
Do you want to specify initial moisture storage? (Y/N)	Y
Amount of water or snow on surface =	0 inches
CN Input Parameter (HELP Model Query)	CN Input Parameter Value
Slope =	2 %
Slope length =	250 ft
Soil Texture =	4 (HELP model default soil texture)
Vegetation =	4 (i.e., a good stand of grass)
HELP Model Computed Curve Number = 49.87	

Layer	Layer Number	Layer Type
Topsoil	1	1 (vertical percolation layer)
Upper Backfill	2	1 (vertical percolation layer)
Erosion Barrier	3	1 (vertical percolation layer)
Upper Drainage Layer	4	2 (lateral drainage layer)
HDPE Geomembrane & GCL	5	4 (geomembrane liner)
Foundation Layer (1E-06)	6	1 (vertical percolation layer)
Lower Drainage Layer	7	2 (lateral drainage layer)
Concrete Roof Slab	8	3 (barrier soil liner)

Layer #	Layer Type	Layer Thickness (in)	Soil Texture No.	Total Porosity (Vol/Vol)	Field Capacity (Vol/Vol)	Wilting Point (Vol/Vol)	Initial Moisture [2] (Vol/Vol)
1	1	5.82		0.396	0.109	0.047	0.109
2	1	30		0.35	0.252	0.181	0.252
3	1	12		0.15	0.1	0.07	0.1
4	2	12		0.409	0.067	0.036	0.067
5	4	0.26					
6	1	12		0.35	0.252	0.181	0.252
7	2	12		0.457	0.131	0.058	0.131
8	3	27		0.19	0.18	0.17	0.19

Layer #	Layer Type	Sat. Hyd. Conductivity (cm/sec)	Drainage Length (ft)	Drain Slope (%)	Leachate Recirc. (%)	Recirc. to Layer (#)	Subsurface Inflow (in/yr)
1	1	3.1E-03					
2	1	4.1E-05					
3	1	1.3E-04					
4	2	2.33E-02	250	2			
5	4	8.7E-13					
6	1	1.0E-06					
7	2	1.0E-03	49.5	2			
8	3	1.0E-12					

Layer #	Layer Type	Geomembrane Pinhole Density (#/acre)	Geomembrane Instal. Defects (#/acre)	Geomembrane Placement Quality	Geotextile Transmissivity (cm^2/sec)
5	4	1	1115	2	

Table E-11. HELP Model Input Data for ILV On-Vault Year 1,100 (\ILV\ILV08.D10).

Input Parameter (HELP Model Query)	Generic Input Parameter Value
Landfill area =	1.495 acres
Percent of area where runoff is possible =	100%
Do you want to specify initial moisture storage? (Y/N)	Y
Amount of water or snow on surface =	0 inches
CN Input Parameter (HELP Model Query)	CN Input Parameter Value
Slope =	2 %
Slope length =	250 ft
Soil Texture =	4 (HELP model default soil texture)
Vegetation =	4 (i.e., a good stand of grass)
HELP Model Computed Curve Number = 49.87	

Layer	Layer Number	Layer Type
Topsoil	1	1 (vertical percolation layer)
Upper Backfill	2	1 (vertical percolation layer)
Erosion Barrier	3	1 (vertical percolation layer)
Upper Drainage Layer	4	2 (lateral drainage layer)
HDPE Geomembrane & GCL	5	4 (geomembrane liner)
Foundation Layer (1E-06)	6	1 (vertical percolation layer)
Lower Drainage Layer	7	2 (lateral drainage layer)
Concrete Roof Slab	8	3 (barrier soil liner)

Layer #	Layer Type	Layer Thickness (in)	Soil Texture No.	Total Porosity (Vol/Vol)	Field Capacity (Vol/Vol)	Wilting Point (Vol/Vol)	Initial Moisture [2] (Vol/Vol)
1	1	5.76		0.396	0.109	0.047	0.109
2	1	30		0.35	0.252	0.181	0.252
3	1	12		0.15	0.1	0.07	0.1
4	2	12		0.403	0.084	0.049	0.084
5	4	0.26					
6	1	12		0.35	0.252	0.181	0.252
7	2	12		0.457	0.131	0.058	0.131
8	3	27		0.19	0.18	0.17	0.19

Layer #	Layer Type	Sat. Hyd. Conductivity (cm/sec)	Drainage Length (ft)	Drain Slope (%)	Leachate Recirc. (%)	Recirc. to Layer (#)	Subsurface Inflow (in/yr)
1	1	3.1E-03					
2	1	4.1E-05					
3	1	1.3E-04					
4	2	1.28E-02	250	2			
5	4	8.7E-13					
6	1	1.0E-06					
7	2	1.0E-03	49.5	2			
8	3	1.0E-12					

Layer #	Layer Type	Geomembrane Pinhole Density (#/acre)	Geomembrane Instal. Defects (#/acre)	Geomembrane Placement Quality	Geotextile Transmissivity (cm^2/sec)
5	4	1	2669	2	

Table E-12. HELP Model Input Data for ILV On-Vault Year 1,900 (\ILV\ILV09.D10).

Input Parameter (HELP Model Query)	Generic Input Parameter Value
Landfill area =	1.495 acres
Percent of area where runoff is possible =	100%
Do you want to specify initial moisture storage? (Y/N)	Y
Amount of water or snow on surface =	0 inches
CN Input Parameter (HELP Model Query)	CN Input Parameter Value
Slope =	2 %
Slope length =	250 ft
Soil Texture =	4 (HELP model default soil texture)
Vegetation =	4 (i.e., a good stand of grass)
HELP Model Computed Curve Number = 49.87	

Layer	Layer Number	Layer Type
Topsoil	1	1 (vertical percolation layer)
Upper Backfill	2	1 (vertical percolation layer)
Erosion Barrier	3	1 (vertical percolation layer)
Upper Drainage Layer	4	2 (lateral drainage layer)
HDPE Geomembrane & GCL	5	4 (geomembrane liner)
Foundation Layer (1E-06)	6	1 (vertical percolation layer)
Lower Drainage Layer	7	2 (lateral drainage layer)
Concrete Roof Slab	8	3 (barrier soil liner)

Layer #	Layer Type	Layer Thickness (in)	Soil Texture No.	Total Porosity (Vol/Vol)	Field Capacity (Vol/Vol)	Wilting Point (Vol/Vol)	Initial Moisture [2] (Vol/Vol)
1	1	5.66		0.396	0.109	0.047	0.109
2	1	30		0.35	0.252	0.181	0.252
3	1	12		0.15	0.1	0.07	0.1
4	2	12		0.392	0.116	0.074	0.116
5	4	0.26					
6	1	12		0.35	0.252	0.181	0.252
7	2	12		0.457	0.131	0.058	0.131
8	3	27		0.19	0.18	0.17	0.19

Layer #	Layer Type	Sat. Hyd. Conductivity (cm/sec)	Drainage Length (ft)	Drain Slope (%)	Leachate Recirc. (%)	Recirc. to Layer (#)	Subsurface Inflow (in/yr)
1	1	3.1E-03					
2	1	4.1E-05					
3	1	1.3E-04					
4	2	4.3E-03	250	2			
5	4	8.7E-13					
6	1	1.0E-06					
7	2	1.0E-03	49.5	2			
8	3	1.0E-12					

Layer #	Layer Type	Geomembrane Pinhole Density (#/acre)	Geomembrane Instal. Defects (#/acre)	Geomembrane Placement Quality	Geotextile Transmissivity (cm^2/sec)
5	4	1	5496	2	

Table E-13. HELP Model Input Data for ILV On-Vault Year 2,723 (\ILV\ILV10.D10).

Input Parameter (HELP Model Query)	Generic Input Parameter Value
Landfill area =	1.495 acres
Percent of area where runoff is possible =	100%
Do you want to specify initial moisture storage? (Y/N)	Y
Amount of water or snow on surface =	0 inches
CN Input Parameter (HELP Model Query)	CN Input Parameter Value
Slope =	2 %
Slope length =	250 ft
Soil Texture =	4 (HELP model default soil texture)
Vegetation =	4 (i.e., a good stand of grass)
HELP Model Computed Curve Number = 49.87	

Layer	Layer Number	Layer Type
Topsoil	1	1 (vertical percolation layer)
Upper Backfill	2	1 (vertical percolation layer)
Erosion Barrier	3	1 (vertical percolation layer)
Upper Drainage Layer	4	2 (lateral drainage layer)
HDPE Geomembrane & GCL	5	4 (geomembrane liner)
Foundation Layer (1E-06)	6	1 (vertical percolation layer)
Lower Drainage Layer	7	2 (lateral drainage layer)
Concrete Roof Slab	8	3 (barrier soil liner)

Layer #	Layer Type	Layer Thickness (in)	Soil Texture No.	Total Porosity (Vol/Vol)	Field Capacity (Vol/Vol)	Wilting Point (Vol/Vol)	Initial Moisture [2] (Vol/Vol)
1	1	5.55		0.396	0.109	0.047	0.109
2	1	30		0.35	0.252	0.181	0.252
3	1	12		0.15	0.1	0.07	0.1
4	2	12		0.38	0.148	0.1	0.148
5	4	0.26					
6	1	12		0.35	0.252	0.181	0.252
7	2	12		0.457	0.131	0.058	0.131
8	3	27		0.19	0.18	0.17	0.19

Layer #	Layer Type	Sat. Hyd. Conductivity (cm/sec)	Drainage Length (ft)	Drain Slope (%)	Leachate Recirc. (%)	Recirc. to Layer (#)	Subsurface Inflow (in/yr)
1	1	3.1E-03					
2	1	4.1E-05					
3	1	1.3E-04					
4	2	1.4E-03	250	2			
5	4	8.7E-13					
6	1	1.0E-06					
7	2	1.0E-03	49.5	2			
8	3	1.0E-12					

Layer #	Layer Type	Geomembrane Pinhole Density (#/acre)	Geomembrane Instal. Defects (#/acre)	Geomembrane Placement Quality	Geotextile Transmissivity (cm^2/sec)
5	4	1	8403	2	

Table E-14. HELP Model Input Data for ILV On-Vault Year 2,905 (\ILV\ILV11.D10).

Input Parameter (HELP Model Query)	Generic Input Parameter Value
Landfill area =	1.495 acres
Percent of area where runoff is possible =	100%
Do you want to specify initial moisture storage? (Y/N)	Y
Amount of water or snow on surface =	0 inches
CN Input Parameter (HELP Model Query)	CN Input Parameter Value
Slope =	2 %
Slope length =	250 ft
Soil Texture =	4 (HELP model default soil texture)
Vegetation =	4 (i.e., a good stand of grass)
HELP Model Computed Curve Number = 49.87	

Layer	Layer Number	Layer Type
Topsoil	1	1 (vertical percolation layer)
Upper Backfill	2	1 (vertical percolation layer)
Erosion Barrier	3	1 (vertical percolation layer)
Upper Drainage Layer	4	2 (lateral drainage layer)
HDPE Geomembrane & GCL	5	4 (geomembrane liner)
Foundation Layer (1E-06)	6	1 (vertical percolation layer)
Lower Drainage Layer	7	2 (lateral drainage layer)
Concrete Roof Slab	8	3 (barrier soil liner)

Layer #	Layer Type	Layer Thickness (in)	Soil Texture No.	Total Porosity (Vol/Vol)	Field Capacity (Vol/Vol)	Wilting Point (Vol/Vol)	Initial Moisture [2] (Vol/Vol)
1	1	5.53		0.396	0.109	0.047	0.109
2	1	30		0.35	0.252	0.181	0.252
3	1	12		0.15	0.1	0.07	0.1
4	2	12		0.38	0.148	0.1	0.148
5	4	0.26					
6	1	12		0.35	0.252	0.181	0.252
7	2	12		0.457	0.131	0.058	0.131
8	3	27		0.19	0.18	0.17	0.19

Layer #	Layer Type	Sat. Hyd. Conductivity (cm/sec)	Drainage Length (ft)	Drain Slope (%)	Leachate Recirc. (%)	Recirc. to Layer (#)	Subsurface Inflow (in/yr)
1	1	3.1E-03					
2	1	4.1E-05					
3	1	1.3E-04					
4	2	1.4E-03	250	2			
5	4	8.7E-13					
6	1	1.0E-06					
7	2	1.0E-03	49.5	2			
8	3	1.0E-12					

Layer #	Layer Type	Geomembrane Pinhole Density (#/acre)	Geomembrane Instal. Defects (#/acre)	Geomembrane Placement Quality	Geotextile Transmissivity (cm^2/sec)
5	4	1	9046	2	

Table E-15. HELP Model Input Data for ILV On-Vault Year 3,300 (\ILV\ILV12.D10).

Input Parameter (HELP Model Query)	Generic Input Parameter Value
Landfill area =	1.495 acres
Percent of area where runoff is possible =	100%
Do you want to specify initial moisture storage? (Y/N)	Y
Amount of water or snow on surface =	0 inches
CN Input Parameter (HELP Model Query)	CN Input Parameter Value
Slope =	2 %
Slope length =	250 ft
Soil Texture =	4 (HELP model default soil texture)
Vegetation =	4 (i.e., a good stand of grass)
HELP Model Computed Curve Number = 49.87	

Layer	Layer Number	Layer Type
Topsoil	1	1 (vertical percolation layer)
Upper Backfill	2	1 (vertical percolation layer)
Erosion Barrier	3	1 (vertical percolation layer)
Upper Drainage Layer	4	2 (lateral drainage layer)
HDPE Geomembrane & GCL	5	4 (geomembrane liner)
Foundation Layer (1E-06)	6	1 (vertical percolation layer)
Lower Drainage Layer	7	2 (lateral drainage layer)
Concrete Roof Slab	8	3 (barrier soil liner)

Layer #	Layer Type	Layer Thickness (in)	Soil Texture No.	Total Porosity (Vol/Vol)	Field Capacity (Vol/Vol)	Wilting Point (Vol/Vol)	Initial Moisture [2] (Vol/Vol)
1	1	5.47		0.396	0.109	0.047	0.109
2	1	30		0.35	0.252	0.181	0.252
3	1	12		0.15	0.1	0.07	0.1
4	2	12		0.38	0.148	0.1	0.148
5	4	0.26					
6	1	12		0.35	0.252	0.181	0.252
7	2	12		0.457	0.131	0.058	0.131
8	3	27		0.19	0.18	0.17	0.19

Layer #	Layer Type	Sat. Hyd. Conductivity (cm/sec)	Drainage Length (ft)	Drain Slope (%)	Leachate Recirc. (%)	Recirc. to Layer (#)	Subsurface Inflow (in/yr)
1	1	3.1E-03					
2	1	4.1E-05					
3	1	1.3E-04					
4	2	1.4E-03	250	2			
5	4	8.7E-13					
6	1	1.0E-06					
7	2	1.0E-03	49.5	2			
8	3	1.0E-12					

Layer #	Layer Type	Geomembrane Pinhole Density (#/acre)	Geomembrane Instal. Defects (#/acre)	Geomembrane Placement Quality	Geotextile Transmissivity (cm^2/sec)
5	4	1	10442	2	

Table E-16. HELP Model Input Data for ILV On-Vault Year 5,700 (\ILV\ILV13.D10).

Input Parameter (HELP Model Query)	Generic Input Parameter Value
Landfill area =	1.495 acres
Percent of area where runoff is possible =	100%
Do you want to specify initial moisture storage? (Y/N)	Y
Amount of water or snow on surface =	0 inches
CN Input Parameter (HELP Model Query)	**CN Input Parameter Value**
Slope =	2 %
Slope length =	250 ft
Soil Texture =	4 (HELP model default soil texture)
Vegetation =	4 (i.e., a good stand of grass)
HELP Model Computed Curve Number = 49.87	

Layer	Layer Number	Layer Type
Topsoil	1	1 (vertical percolation layer)
Upper Backfill	2	1 (vertical percolation layer)
Erosion Barrier	3	1 (vertical percolation layer)
Upper Drainage Layer	4	2 (lateral drainage layer)
HDPE Geomembrane & GCL	5	4 (geomembrane liner)
Foundation Layer (1E-06)	6	1 (vertical percolation layer)
Lower Drainage Layer	7	2 (lateral drainage layer)
Concrete Roof Slab	8	3 (barrier soil liner)

Layer #	Layer Type	Layer Thickness (in)	Soil Texture No.	Total Porosity (Vol/Vol)	Field Capacity (Vol/Vol)	Wilting Point (Vol/Vol)	Initial Moisture [2] (Vol/Vol)
1	1	5.16		0.396	0.109	0.047	0.109
2	1	30		0.35	0.252	0.181	0.252
3	1	12		0.15	0.1	0.07	0.1
4	2	12		0.38	0.148	0.1	0.148
5	4	0.26					
6	1	12		0.35	0.252	0.181	0.252
7	2	12		0.457	0.131	0.058	0.131
8	3	27		0.19	0.18	0.17	0.19

Layer #	Layer Type	Sat. Hyd. Conductivity (cm/sec)	Drainage Length (ft)	Drain Slope (%)	Leachate Recirc. (%)	Recirc. to Layer (#)	Subsurface Inflow (in/yr)
1	1	3.1E-03					
2	1	4.1E-05					
3	1	1.3E-04					
4	2	1.4E-03	250	2			
5	4	8.7E-13					
6	1	1.0E-06					
7	2	1.0E-03	49.5	2			
8	3	1.0E-12					

Layer #	Layer Type	Geomembrane Pinhole Density (#/acre)	Geomembrane Instal. Defects (#/acre)	Geomembrane Placement Quality	Geotextile Transmissivity (cm^2/sec)
5	4	1	18921	2	

Table E-17. HELP Model Input Data for ILV On-Vault Year 7,100 (\ILV\ILV14.D10).

Input Parameter (HELP Model Query)	Generic Input Parameter Value
Landfill area =	1.495 acres
Percent of area where runoff is possible =	100%
Do you want to specify initial moisture storage? (Y/N)	Y
Amount of water or snow on surface =	0 inches
CN Input Parameter (HELP Model Query)	CN Input Parameter Value
Slope =	2 %
Slope length =	250 ft
Soil Texture =	4 (HELP model default soil texture)
Vegetation =	4 (i.e., a good stand of grass)
HELP Model Computed Curve Number = 49.87	

Layer	Layer Number	Layer Type
Topsoil	1	1 (vertical percolation layer)
Upper Backfill	2	1 (vertical percolation layer)
Erosion Barrier	3	1 (vertical percolation layer)
Upper Drainage Layer	4	2 (lateral drainage layer)
HDPE Geomembrane & GCL	5	4 (geomembrane liner)
Foundation Layer (1E-06)	6	1 (vertical percolation layer)
Lower Drainage Layer	7	2 (lateral drainage layer)
Concrete Roof Slab	8	3 (barrier soil liner)

Layer #	Layer Type	Layer Thickness (in)	Soil Texture No.	Total Porosity (Vol/Vol)	Field Capacity (Vol/Vol)	Wilting Point (Vol/Vol)	Initial Moisture [2] (Vol/Vol)
1	1	4.98		0.396	0.109	0.047	0.109
2	1	30		0.35	0.252	0.181	0.252
3	1	12		0.15	0.1	0.07	0.1
4	2	12		0.38	0.148	0.1	0.148
5	4	0.26					
6	1	12		0.35	0.252	0.181	0.252
7	2	12		0.457	0.131	0.058	0.131
8	3	27		0.19	0.18	0.17	0.19

Layer #	Layer Type	Sat. Hyd. Conductivity (cm/sec)	Drainage Length (ft)	Drain Slope (%)	Leachate Recirc. (%)	Recirc. to Layer (#)	Subsurface Inflow (in/yr)
1	1	3.1E-03					
2	1	4.1E-05					
3	1	1.3E-04					
4	2	1.4E-03	250	2			
5	4	8.7E-13					
6	1	1.0E-06					
7	2	1.0E-03	49.5	2			
8	3	1.0E-12					

Layer #	Layer Type	Geomembrane Pinhole Density (#/acre)	Geomembrane Instal. Defects (#/acre)	Geomembrane Placement Quality	Geotextile Transmissivity (cm^2/sec)
5	4	1	23867	2	

Table E-18. HELP Model Input Data for ILV On-Vault After Roof Collapse Year 7,100+ (\ILV\ILVCLPSE.D10).

Input Parameter (HELP Model Query)	Generic Input Parameter Value
Landfill area =	1.495 acres
Percent of area where runoff is possible =	0%
Do you want to specify initial moisture storage? (Y/N)	Y
Amount of water or snow on surface =	0 inches
User-Specified Curve Number = 0	

Layer	Layer Number	Layer Type
Topsoil	1	1 (vertical percolation layer)
Upper Backfill	2	1 (vertical percolation layer)
Erosion Barrier	3	1 (vertical percolation layer)
Upper Drainage Layer	4	1 (vertical percolation layer)
Foundation Layer (1E-06)	5	1 (vertical percolation layer)
Foundation Layer (1E-06)	6	1 (vertical percolation layer)
Foundation Layer (1E-03)	7	1 (vertical percolation layer)

Layer #	Layer Type	Layer Thickness (in)	Soil Texture No.	Total Porosity (Vol/Vol)	Field Capacity (Vol/Vol)	Wilting Point (Vol/Vol)	Initial Moisture [2] (Vol/Vol)
1	1	4.98		0.396	0.109	0.047	0.109
2	1	30		0.35	0.252	0.181	0.252
3	1	12		0.15	0.1	0.07	0.1
4	1	12		0.38	0.148	0.1	0.148
5	1	0.26		0.35	0.252	0.181	0.252
6	1	12		0.35	0.252	0.181	0.252
7	1	12		0.457	0.131	0.058	0.131

Layer #	Layer Type	Sat. Hyd. Conductivity (cm/sec)	Drainage Length (ft)	Drain Slope (%)	Leachate Recirc. (%)	Recirc. to Layer (#)	Subsurface Inflow (in/yr)
1	1	3.1E-03					20.548 [1]
2	1	4.1E-05					
3	1	1.3E-04					
4	1	1.4E-03					
5	1	1.0E-06					
6	1	1.0E-06					
7	1	1.0E-03					

Layer #	Layer Type	Geomembrane Pinhole Density (#/acre)	Geomembrane Instal. Defects (#/acre)	Geomembrane Placement Quality	Geotextile Transmissivity (cm^2/sec)

[1] Subsurface inflow following roof collapse equals the area-normalized sum of surface runoff and lateral drainage from the section of the intact final closure cap located upslope of the ILV. Refer to Figure 4-4. The upslope intact cap surface area to IL vault surface area ratio is approximately 4 (51,594 square feet intact cap upslope / 13,000 square feet IL vault surface area = 3.97). The sum of surface runoff and lateral drainage for a 250-foot intact slope length at 7,100 years is 5.137 inches/year. This sum is then multiplied by 4 to obtain the area-normalized flux of 20.548 inches/year that drains into the subsided vault area.

Table E-19. HELP Model Input Data for ILV Off-Vault Operational Period (\ILVOFF\ILVOP.D10).

Input Parameter (HELP Model Query)	Generic Input Parameter Value
Landfill area =	0.1477 acres
Percent of area where runoff is possible =	100%
Do you want to specify initial moisture storage? (Y/N)	Y
Amount of water or snow on surface =	0 inches
CN Input Parameter (HELP Model Query)	CN Input Parameter Value
Slope =	1 %
Slope length =	15 ft
Soil Texture =	4 (HELP model default soil texture)
Vegetation =	1 (i.e., bare ground)
HELP Model Computed Curve Number = 83.64	

Layer	Layer Number	Layer Type
Upper Backfill	1	1 (vertical percolation layer)

Layer #	Layer Type	Layer Thickness (in)	Soil Texture No.	Total Porosity (Vol/Vol)	Field Capacity (Vol/Vol)	Wilting Point (Vol/Vol)	Initial Moisture [2] (Vol/Vol)
1	1	96		0.35	0.252	0.181	0.252

Layer #	Layer Type	Sat. Hyd. Conductivity (cm/sec)	Drainage Length (ft)	Drain Slope (%)	Leachate Recirc. (%)	Recirc. to Layer (#)	Subsurface Inflow (in/yr)
1	1	4.1E-05					

Layer #	Layer Type	Geomembrane Pinhole Density (#/acre)	Geomembrane Instal. Defects (#/acre)	Geomembrane Placement Quality	Geotextile Transmissivity (cm^2/sec)

Table E-20. HELP Model Input Data for ILV Off-Vault Institutional Control Period (\ILVOFF\ILVIC.D10).

Input Parameter (HELP Model Query)	Generic Input Parameter Value
Landfill area =	0.1477 acres
Percent of area where runoff is possible =	100%
Do you want to specify initial moisture storage? (Y/N)	Y
Amount of water or snow on surface =	0 inches
CN Input Parameter (HELP Model Query)	CN Input Parameter Value
Slope =	1 %
Slope length =	15 ft
Soil Texture =	4 (HELP model default soil texture)
Vegetation =	1 (i.e., bare ground)
HELP Model Computed Curve Number = 83.64	

Layer	Layer Number	Layer Type
Upper Backfill	1	1 (vertical percolation layer)

Layer #	Layer Type	Layer Thickness (in)	Soil Texture No.	Total Porosity (Vol/Vol)	Field Capacity (Vol/Vol)	Wilting Point (Vol/Vol)	Initial Moisture [2] (Vol/Vol)
1	1	96		0.35	0.252	0.181	0.252

Layer #	Layer Type	Sat. Hyd. Conductivity (cm/sec)	Drainage Length (ft)	Drain Slope (%)	Leachate Recirc. (%)	Recirc. to Layer (#)	Subsurface Inflow (in/yr)
1	1	4.1E-05					

Layer #	Layer Type	Geomembrane Pinhole Density (#/acre)	Geomembrane Instal. Defects (#/acre)	Geomembrane Placement Quality	Geotextile Transmissivity (cm^2/sec)

Table E-21. HELP Model Input Data for ILV Off-Vault Year 100 (\ILVOFF\ILV00.D10).

Input Parameter (HELP Model Query)	Generic Input Parameter Value
Landfill area =	0.06 acres
Percent of area where runoff is possible =	100%
Do you want to specify initial moisture storage? (Y/N)	Y
Amount of water or snow on surface =	0 inches
CN Input Parameter (HELP Model Query)	CN Input Parameter Value
Slope =	2 %
Slope length =	250 ft
Soil Texture =	4 (HELP model default soil texture)
Vegetation =	4 (i.e., a good stand of grass)
HELP Model Computed Curve Number = 49.87	

Layer	Layer Number	Layer Type
Topsoil	1	1 (vertical percolation layer)
Upper Backfill	2	1 (vertical percolation layer)
Erosion Barrier	3	1 (vertical percolation layer)
Upper Drainage Layer	4	2 (lateral drainage layer)
HDPE Geomembrane	5	4 (geomembrane liner)
GCL	6	3 (barrier soil liner)
Foundation Layer (1E-06)	7	1 (vertical percolation layer)
Foundation Layer (1E-03)	8	1 (vertical percolation layer)
Soil Fill Adjacent to Vault	9	3 (barrier soil liner)
Soil Fill Adjacent to Vault	10	1 (vertical percolation layer)

Layer #	Layer Type	Layer Thickness (in)	Soil Texture No.	Total Porosity (Vol/Vol)	Field Capacity (Vol/Vol)	Wilting Point (Vol/Vol)	Initial Moisture [2] (Vol/Vol)
1	1	6		0.396	0.109	0.047	0.109
2	1	30		0.35	0.252	0.181	0.252
3	1	12		0.15	0.1	0.07	0.1
4	2	12		0.417	0.045	0.018	0.045
5	4	0.06					
6	3	0.2		0.75	0.747	0.4	0.75
7	1	12		0.35	0.252	0.181	0.252
8	1	12		0.457	0.131	0.058	0.131
9	3	27		0.457	0.131	0.058	0.131
10	1	312		0.457	0.131	0.058	0.131

Layer #	Layer Type	Sat. Hyd. Conductivity (cm/sec)	Drainage Length (ft)	Drain Slope (%)	Leachate Recirc. (%)	Recirc. to Layer (#)	Subsurface Inflow (in/yr)
1	1	3.1E-03					
2	1	4.1E-05					
3	1	1.3E-04					
4	2	5.0E-02	250	2			
5	4	2.0E-13					
6	3	5.0E-09					
7	1	1.0E-06					
8	1	1.0E-03					0.000693
9	3	1.0E-03					
10	1	1.0E-03					

Layer #	Layer Type	Geomembrane Pinhole Density (#/acre)	Geomembrane Instal. Defects (#/acre)	Geomembrane Placement Quality	Geotextile Transmissivity (cm^2/sec)
5	4	1	4	2	

Table E-22. HELP Model Input Data for ILV Off-Vault Year 180 (\ILVOFF\ILV01.D10).

Input Parameter (HELP Model Query)	Generic Input Parameter Value
Landfill area =	0.06 acres
Percent of area where runoff is possible =	100%
Do you want to specify initial moisture storage? (Y/N)	Y
Amount of water or snow on surface =	0 inches
CN Input Parameter (HELP Model Query)	CN Input Parameter Value
Slope =	2 %
Slope length =	250 ft
Soil Texture =	4 (HELP model default soil texture)
Vegetation =	4 (i.e., a good stand of grass)
HELP Model Computed Curve Number = 49.87	

Layer	Layer Number	Layer Type
Topsoil	1	1 (vertical percolation layer)
Upper Backfill	2	1 (vertical percolation layer)
Erosion Barrier	3	1 (vertical percolation layer)
Upper Drainage Layer	4	2 (lateral drainage layer)
HDPE Geomembrane	5	4 (geomembrane liner)
GCL	6	3 (barrier soil liner)
Foundation Layer (1E-06)	7	1 (vertical percolation layer)
Foundation Layer (1E-03)	8	1 (vertical percolation layer)
Soil Fill Adjacent to Vault	9	3 (barrier soil liner)
Soil Fill Adjacent to Vault	10	1 (vertical percolation layer)

Layer #	Layer Type	Layer Thickness (in)	Soil Texture No.	Total Porosity (Vol/Vol)	Field Capacity (Vol/Vol)	Wilting Point (Vol/Vol)	Initial Moisture [2] (Vol/Vol)
1	1	5.96		0.396	0.109	0.047	0.109
2	1	30		0.35	0.252	0.181	0.252
3	1	12		0.15	0.1	0.07	0.1
4	2	12		0.416	0.048	0.021	0.048
5	4	0.06					
6	3	0.2		0.75	0.747	0.4	0.75
7	1	12		0.35	0.252	0.181	0.252
8	1	12		0.457	0.131	0.058	0.131
9	3	27		0.457	0.131	0.058	0.131
10	1	312		0.457	0.131	0.058	0.131

Layer #	Layer Type	Sat. Hyd. Conductivity (cm/sec)	Drainage Length (ft)	Drain Slope (%)	Leachate Recirc. (%)	Recirc. to Layer (#)	Subsurface Inflow (in/yr)
1	1	3.1E-03					
2	1	4.1E-05					
3	1	1.3E-04					
4	2	4.48E-02	250	2			
5	4	2.0E-13					
6	3	5.0E-09					
7	1	1.0E-06					
8	1	1.0E-03					0.0044055
9	3	1.0E-03					
10	1	1.0E-03					

Layer #	Layer Type	Geomembrane Pinhole Density (#/acre)	Geomembrane Instal. Defects (#/acre)	Geomembrane Placement Quality	Geotextile Transmissivity (cm^2/sec)
5	4	1	40	2	

Table E-23. HELP Model Input Data for ILV Off-Vault Year 290 (\ILVOFF\ILV02.D10).

Input Parameter (HELP Model Query)	Generic Input Parameter Value
Landfill area =	0.06 acres
Percent of area where runoff is possible =	100%
Do you want to specify initial moisture storage? (Y/N)	Y
Amount of water or snow on surface =	0 inches
CN Input Parameter (HELP Model Query)	CN Input Parameter Value
Slope =	2 %
Slope length =	250 ft
Soil Texture =	4 (HELP model default soil texture)
Vegetation =	4 (i.e., a good stand of grass)
HELP Model Computed Curve Number = 49.87	

Layer	Layer Number	Layer Type
Topsoil	1	1 (vertical percolation layer)
Upper Backfill	2	1 (vertical percolation layer)
Erosion Barrier	3	1 (vertical percolation layer)
Upper Drainage Layer	4	2 (lateral drainage layer)
HDPE Geomembrane	5	4 (geomembrane liner)
GCL	6	3 (barrier soil liner)
Foundation Layer (1E-06)	7	1 (vertical percolation layer)
Foundation Layer (1E-03)	8	1 (vertical percolation layer)
Soil Fill Adjacent to Vault	9	3 (barrier soil liner)
Soil Fill Adjacent to Vault	10	1 (vertical percolation layer)

Layer #	Layer Type	Layer Thickness (in)	Soil Texture No.	Total Porosity (Vol/Vol)	Field Capacity (Vol/Vol)	Wilting Point (Vol/Vol)	Initial Moisture [2] (Vol/Vol)
1	1	5.90		0.396	0.109	0.047	0.109
2	1	30		0.35	0.252	0.181	0.252
3	1	12		0.15	0.1	0.07	0.1
4	2	12		0.414	0.052	0.024	0.052
5	4	0.06					
6	3	0.2		0.75	0.747	0.4	0.75
7	1	12		0.35	0.252	0.181	0.252
8	1	12		0.457	0.131	0.058	0.131
9	3	27		0.457	0.131	0.058	0.131
10	1	312		0.457	0.131	0.058	0.131

Layer #	Layer Type	Sat. Hyd. Conductivity (cm/sec)	Drainage Length (ft)	Drain Slope (%)	Leachate Recirc. (%)	Recirc. to Layer (#)	Subsurface Inflow (in/yr)
1	1	3.1E-03					
2	1	4.1E-05					
3	1	1.3E-04					
4	2	3.86E-02	250	2			
5	4	2.0E-13					
6	3	5.0E-08					
7	1	1.0E-06					
8	1	1.0E-03					0.09405
9	3	1.0E-03					
10	1	1.0E-03					

Layer #	Layer Type	Geomembrane Pinhole Density (#/acre)	Geomembrane Instal. Defects (#/acre)	Geomembrane Placement Quality	Geotextile Transmissivity (cm^2/sec)
5	4	1	96	2	

Table E-24. HELP Model Input Data for ILV Off-Vault Year 300 (\ILVOFF\ILV03.D10).

Input Parameter (HELP Model Query)	Generic Input Parameter Value
Landfill area =	0.06 acres
Percent of area where runoff is possible =	100%
Do you want to specify initial moisture storage? (Y/N)	Y
Amount of water or snow on surface =	0 inches
CN Input Parameter (HELP Model Query)	CN Input Parameter Value
Slope =	2 %
Slope length =	250 ft
Soil Texture =	4 (HELP model default soil texture)
Vegetation =	4 (i.e., a good stand of grass)
HELP Model Computed Curve Number = 49.87	

Layer	Layer Number	Layer Type
Topsoil	1	1 (vertical percolation layer)
Upper Backfill	2	1 (vertical percolation layer)
Erosion Barrier	3	1 (vertical percolation layer)
Upper Drainage Layer	4	2 (lateral drainage layer)
HDPE Geomembrane	5	4 (geomembrane liner)
GCL	6	3 (barrier soil liner)
Foundation Layer (1E-06)	7	1 (vertical percolation layer)
Foundation Layer (1E-03)	8	1 (vertical percolation layer)
Soil Fill Adjacent to Vault	9	3 (barrier soil liner)
Soil Fill Adjacent to Vault	10	1 (vertical percolation layer)

Layer #	Layer Type	Layer Thickness (in)	Soil Texture No.	Total Porosity (Vol/Vol)	Field Capacity (Vol/Vol)	Wilting Point (Vol/Vol)	Initial Moisture [2] (Vol/Vol)
1	1	5.90		0.396	0.109	0.047	0.109
2	1	30		0.35	0.252	0.181	0.252
3	1	12		0.15	0.1	0.07	0.1
4	2	12		0.414	0.053	0.024	0.053
5	4	0.06					
6	3	0.2		0.75	0.747	0.4	0.75
7	1	12		0.35	0.252	0.181	0.252
8	1	12		0.457	0.131	0.058	0.131
9	3	27		0.457	0.131	0.058	0.131
10	1	312		0.457	0.131	0.058	0.131

Layer #	Layer Type	Sat. Hyd. Conductivity (cm/sec)	Drainage Length (ft)	Drain Slope (%)	Leachate Recirc. (%)	Recirc. to Layer (#)	Subsurface Inflow (in/yr)
1	1	3.1E-03					
2	1	4.1E-05					
3	1	1.3E-04					
4	2	3.81E-02	250	2			
5	4	2.0E-13					
6	3	5.0E-08					
7	1	1.0E-06					
8	1	1.0E-03					0.1019205
9	3	1.0E-03					
10	1	1.0E-03					

Layer #	Layer Type	Geomembrane Pinhole Density (#/acre)	Geomembrane Instal. Defects (#/acre)	Geomembrane Placement Quality	Geotextile Transmissivity (cm^2/sec)
5	4	1	101	2	

Table E-25. HELP Model Input Data for ILV Off-Vault Year 340 (\ILVOFF\ILV04.D10).

Input Parameter (HELP Model Query)	Generic Input Parameter Value
Landfill area =	0.06 acres
Percent of area where runoff is possible =	100%
Do you want to specify initial moisture storage? (Y/N)	Y
Amount of water or snow on surface =	0 inches
CN Input Parameter (HELP Model Query)	CN Input Parameter Value
Slope =	2 %
Slope length =	250 ft
Soil Texture =	4 (HELP model default soil texture)
Vegetation =	4 (i.e., a good stand of grass)
HELP Model Computed Curve Number = 49.87	

Layer	Layer Number	Layer Type
Topsoil	1	1 (vertical percolation layer)
Upper Backfill	2	1 (vertical percolation layer)
Erosion Barrier	3	1 (vertical percolation layer)
Upper Drainage Layer	4	2 (lateral drainage layer)
HDPE Geomembrane & GCL	5	4 (geomembrane liner)
Foundation Layer (1E-06)	6	1 (vertical percolation layer)
Foundation Layer (1E-03)	7	1 (vertical percolation layer)
Soil Fill Adjacent to Vault	8	3 (barrier soil liner)
Soil Fill Adjacent to Vault	9	1 (vertical percolation layer)

Layer #	Layer Type	Layer Thickness (in)	Soil Texture No.	Total Porosity (Vol/Vol)	Field Capacity (Vol/Vol)	Wilting Point (Vol/Vol)	Initial Moisture [2] (Vol/Vol)
1	1	5.88		0.396	0.109	0.047	0.109
2	1	30		0.35	0.252	0.181	0.252
3	1	12		0.15	0.1	0.07	0.1
4	2	12		0.414	0.054	0.026	0.054
5	4	0.26					
6	1	12		0.35	0.252	0.181	0.252
7	1	12		0.457	0.131	0.058	0.131
8	3	27		0.457	0.131	0.058	0.131
9	1	312		0.457	0.131	0.058	0.131

Layer #	Layer Type	Sat. Hyd. Conductivity (cm/sec)	Drainage Length (ft)	Drain Slope (%)	Leachate Recirc. (%)	Recirc. to Layer (#)	Subsurface Inflow (in/yr)
1	1	3.1E-03					
2	1	4.1E-05					
3	1	1.3E-04					
4	2	3.60E-02	250	2			
5	4	8.7E-13					
6	1	1.0E-06					
7	1	1.0E-03					0.39496
8	3	1.0E-03					
9	1	1.0E-03					

Layer #	Layer Type	Geomembrane Pinhole Density (#/acre)	Geomembrane Instal. Defects (#/acre)	Geomembrane Placement Quality	Geotextile Transmissivity (cm^2/sec)
5	4	1	121	2	

Table E-26. HELP Model Input Data for ILV Off-Vault Year 380 (\ILVOFF\ILV05.D10).

Input Parameter (HELP Model Query)	Generic Input Parameter Value
Landfill area =	0.06 acres
Percent of area where runoff is possible =	100%
Do you want to specify initial moisture storage? (Y/N)	Y
Amount of water or snow on surface =	0 inches

CN Input Parameter (HELP Model Query)	CN Input Parameter Value
Slope =	2 %
Slope length =	250 ft
Soil Texture =	4 (HELP model default soil texture)
Vegetation =	4 (i.e., a good stand of grass)
HELP Model Computed Curve Number = 49.87	

Layer	Layer Number	Layer Type
Topsoil	1	1 (vertical percolation layer)
Upper Backfill	2	1 (vertical percolation layer)
Erosion Barrier	3	1 (vertical percolation layer)
Upper Drainage Layer	4	2 (lateral drainage layer)
HDPE Geomembrane & GCL	5	4 (geomembrane liner)
Foundation Layer (1E-06)	6	1 (vertical percolation layer)
Foundation Layer (1E-03)	7	1 (vertical percolation layer)
Soil Fill Adjacent to Vault	8	3 (barrier soil liner)
Soil Fill Adjacent to Vault	9	1 (vertical percolation layer)

Layer #	Layer Type	Layer Thickness (in)	Soil Texture No.	Total Porosity (Vol/Vol)	Field Capacity (Vol/Vol)	Wilting Point (Vol/Vol)	Initial Moisture [2] (Vol/Vol)
1	1	5.85		0.396	0.109	0.047	0.109
2	1	30		0.35	0.252	0.181	0.252
3	1	12		0.15	0.1	0.07	0.1
4	2	12		0.413	0.056	0.027	0.056
5	4	0.26					
6	1	12		0.35	0.252	0.181	0.252
7	1	12		0.457	0.131	0.058	0.131
8	3	27		0.457	0.131	0.058	0.131
9	1	312		0.457	0.131	0.058	0.131

Layer #	Layer Type	Sat. Hyd. Conductivity (cm/sec)	Drainage Length (ft)	Drain Slope (%)	Leachate Recirc. (%)	Recirc. to Layer (#)	Subsurface Inflow (in/yr)
1	1	3.1E-03					
2	1	4.1E-05					
3	1	1.3E-04					
4	2	3.41E-02	250	2			
5	4	8.7E-13					
6	1	1.0E-06					
7	1	1.0E-03					0.4941585
8	3	1.0E-03					
9	1	1.0E-03					

Layer #	Layer Type	Geomembrane Pinhole Density (#/acre)	Geomembrane Instal. Defects (#/acre)	Geomembrane Placement Quality	Geotextile Transmissivity (cm^2/sec)
5	4	1	141	2	

Table E-27. HELP Model Input Data for ILV Off-Vault Year 480 (\ILVOFF\ILV06.D10).

Input Parameter (HELP Model Query)	Generic Input Parameter Value
Landfill area =	0.06 acres
Percent of area where runoff is possible =	100%
Do you want to specify initial moisture storage? (Y/N)	Y
Amount of water or snow on surface =	0 inches
CN Input Parameter (HELP Model Query)	CN Input Parameter Value
Slope =	2 %
Slope length =	250 ft
Soil Texture =	4 (HELP model default soil texture)
Vegetation =	4 (i.e., a good stand of grass)
HELP Model Computed Curve Number = 49.87	

Layer	Layer Number	Layer Type
Topsoil	1	1 (vertical percolation layer)
Upper Backfill	2	1 (vertical percolation layer)
Erosion Barrier	3	1 (vertical percolation layer)
Upper Drainage Layer	4	2 (lateral drainage layer)
HDPE Geomembrane & GCL	5	4 (geomembrane liner)
Foundation Layer (1E-06)	6	1 (vertical percolation layer)
Foundation Layer (1E-03)	7	1 (vertical percolation layer)
Soil Fill Adjacent to Vault	8	3 (barrier soil liner)
Soil Fill Adjacent to Vault	9	1 (vertical percolation layer)

Layer #	Layer Type	Layer Thickness (in)	Soil Texture No.	Total Porosity (Vol/Vol)	Field Capacity (Vol/Vol)	Wilting Point (Vol/Vol)	Initial Moisture [2] (Vol/Vol)
1	1	5.84		0.396	0.109	0.047	0.109
2	1	30		0.35	0.252	0.181	0.252
3	1	12		0.15	0.1	0.07	0.1
4	2	12		0.412	0.06	0.03	0.06
5	4	0.26					
6	1	12		0.35	0.252	0.181	0.252
7	1	12		0.457	0.131	0.058	0.131
8	3	27		0.457	0.131	0.058	0.131
9	1	312		0.457	0.131	0.058	0.131

Layer #	Layer Type	Sat. Hyd. Conductivity (cm/sec)	Drainage Length (ft)	Drain Slope (%)	Leachate Recirc. (%)	Recirc. to Layer (#)	Subsurface Inflow (in/yr)
1	1	3.1E-03					
2	1	4.1E-05					
3	1	1.3E-04					
4	2	2.98E-02	250	2			
5	4	8.7E-13					
6	1	1.0E-06					
7	1	1.0E-03					1.9782675
8	3	1.0E-03					
9	1	1.0E-03					

Layer #	Layer Type	Geomembrane Pinhole Density (#/acre)	Geomembrane Instal. Defects (#/acre)	Geomembrane Placement Quality	Geotextile Transmissivity (cm^2/sec)
5	4	1	479	2	

Table E-28. HELP Model Input Data for ILV Off-Vault Year 660 (\ILVOFF\ILV07.D10).

Input Parameter (HELP Model Query)	Generic Input Parameter Value
Landfill area =	0.06 acres
Percent of area where runoff is possible =	100%
Do you want to specify initial moisture storage? (Y/N)	Y
Amount of water or snow on surface =	0 inches
CN Input Parameter (HELP Model Query)	CN Input Parameter Value
Slope =	2 %
Slope length =	250 ft
Soil Texture =	4 (HELP model default soil texture)
Vegetation =	4 (i.e., a good stand of grass)
HELP Model Computed Curve Number = 49.87	

Layer	Layer Number	Layer Type
Topsoil	1	1 (vertical percolation layer)
Upper Backfill	2	1 (vertical percolation layer)
Erosion Barrier	3	1 (vertical percolation layer)
Upper Drainage Layer	4	2 (lateral drainage layer)
HDPE Geomembrane & GCL	5	4 (geomembrane liner)
Foundation Layer (1E-06)	6	1 (vertical percolation layer)
Foundation Layer (1E-03)	7	1 (vertical percolation layer)
Soil Fill Adjacent to Vault	8	3 (barrier soil liner)
Soil Fill Adjacent to Vault	9	1 (vertical percolation layer)

Layer #	Layer Type	Layer Thickness (in)	Soil Texture No.	Total Porosity (Vol/Vol)	Field Capacity (Vol/Vol)	Wilting Point (Vol/Vol)	Initial Moisture [2] (Vol/Vol)
1	1	5.82		0.396	0.109	0.047	0.109
2	1	30		0.35	0.252	0.181	0.252
3	1	12		0.15	0.1	0.07	0.1
4	2	12		0.409	0.067	0.036	0.067
5	4	0.26					
6	1	12		0.35	0.252	0.181	0.252
7	1	12		0.457	0.131	0.058	0.131
8	3	27		0.457	0.131	0.058	0.131
9	1	312		0.457	0.131	0.058	0.131

Layer #	Layer Type	Sat. Hyd. Conductivity (cm/sec)	Drainage Length (ft)	Drain Slope (%)	Leachate Recirc. (%)	Recirc. to Layer (#)	Subsurface Inflow (in/yr)
1	1	3.1E-03					
2	1	4.1E-05					
3	1	1.3E-04					
4	2	2.33E-02	250	2			
5	4	8.7E-13					
6	1	1.0E-06					
7	1	1.0E-03					5.781006
8	3	1.0E-03					
9	1	1.0E-03					

Layer #	Layer Type	Geomembrane Pinhole Density (#/acre)	Geomembrane Instal. Defects (#/acre)	Geomembrane Placement Quality	Geotextile Transmissivity (cm^2/sec)
5	4	1	1115	2	

Table E-29. HELP Model Input Data for ILV Off-Vault Year 1,100 (\ILVOFF\ILV08.D10).

Input Parameter (HELP Model Query)	Generic Input Parameter Value
Landfill area =	0.06 acres
Percent of area where runoff is possible =	100%
Do you want to specify initial moisture storage? (Y/N)	Y
Amount of water or snow on surface =	0 inches
CN Input Parameter (HELP Model Query)	CN Input Parameter Value
Slope =	2 %
Slope length =	250 ft
Soil Texture =	4 (HELP model default soil texture)
Vegetation =	4 (i.e., a good stand of grass)
HELP Model Computed Curve Number = 49.87	

Layer	Layer Number	Layer Type
Topsoil	1	1 (vertical percolation layer)
Upper Backfill	2	1 (vertical percolation layer)
Erosion Barrier	3	1 (vertical percolation layer)
Upper Drainage Layer	4	2 (lateral drainage layer)
HDPE Geomembrane & GCL	5	4 (geomembrane liner)
Foundation Layer (1E-06)	6	1 (vertical percolation layer)
Foundation Layer (1E-03)	7	1 (vertical percolation layer)
Soil Fill Adjacent to Vault	8	3 (barrier soil liner)
Soil Fill Adjacent to Vault	9	1 (vertical percolation layer)

Layer #	Layer Type	Layer Thickness (in)	Soil Texture No.	Total Porosity (Vol/Vol)	Field Capacity (Vol/Vol)	Wilting Point (Vol/Vol)	Initial Moisture [2] (Vol/Vol)
1	1	5.76		0.396	0.109	0.047	0.109
2	1	30		0.35	0.252	0.181	0.252
3	1	12		0.15	0.1	0.07	0.1
4	2	12		0.403	0.084	0.049	0.084
5	4	0.26					
6	1	12		0.35	0.252	0.181	0.252
7	1	12		0.457	0.131	0.058	0.131
8	3	27		0.457	0.131	0.058	0.131
9	1	312		0.457	0.131	0.058	0.131

Layer #	Layer Type	Sat. Hyd. Conductivity (cm/sec)	Drainage Length (ft)	Drain Slope (%)	Leachate Recirc. (%)	Recirc. to Layer (#)	Subsurface Inflow (in/yr)
1	1	3.1E-03					
2	1	4.1E-05					
3	1	1.3E-04					
4	2	1.28E-02	250	2			
5	4	8.7E-13					
6	1	1.0E-06					
7	1	1.0E-03					18.999189
8	3	1.0E-03					
9	1	1.0E-03					

Layer #	Layer Type	Geomembrane Pinhole Density (#/acre)	Geomembrane Instal. Defects (#/acre)	Geomembrane Placement Quality	Geotextile Transmissivity (cm^2/sec)
5	4	1	2669	2	

Table E-30. HELP Model Input Data for ILV Off-Vault Year 1,900 (\ILVOFF\ILV09.D10).

Input Parameter (HELP Model Query)	Generic Input Parameter Value
Landfill area =	0.06 acres
Percent of area where runoff is possible =	100%
Do you want to specify initial moisture storage? (Y/N)	Y
Amount of water or snow on surface =	0 inches
CN Input Parameter (HELP Model Query)	CN Input Parameter Value
Slope =	2 %
Slope length =	250 ft
Soil Texture =	4 (HELP model default soil texture)
Vegetation =	4 (i.e., a good stand of grass)
HELP Model Computed Curve Number = 49.87	

Layer	Layer Number	Layer Type
Topsoil	1	1 (vertical percolation layer)
Upper Backfill	2	1 (vertical percolation layer)
Erosion Barrier	3	1 (vertical percolation layer)
Upper Drainage Layer	4	2 (lateral drainage layer)
HDPE Geomembrane & GCL	5	4 (geomembrane liner)
Foundation Layer (1E-06)	6	1 (vertical percolation layer)
Foundation Layer (1E-03)	7	1 (vertical percolation layer)
Soil Fill Adjacent to Vault	8	3 (barrier soil liner)
Soil Fill Adjacent to Vault	9	1 (vertical percolation layer)

Layer #	Layer Type	Layer Thickness (in)	Soil Texture No.	Total Porosity (Vol/Vol)	Field Capacity (Vol/Vol)	Wilting Point (Vol/Vol)	Initial Moisture [2] (Vol/Vol)
1	1	5.66		0.396	0.109	0.047	0.109
2	1	30		0.35	0.252	0.181	0.252
3	1	12		0.15	0.1	0.07	0.1
4	2	12		0.392	0.116	0.074	0.116
5	4	0.26					
6	1	12		0.35	0.252	0.181	0.252
7	1	12		0.457	0.131	0.058	0.131
8	3	27		0.457	0.131	0.058	0.131
9	1	312		0.457	0.131	0.058	0.131

Layer #	Layer Type	Sat. Hyd. Conductivity (cm/sec)	Drainage Length (ft)	Drain Slope (%)	Leachate Recirc. (%)	Recirc. to Layer (#)	Subsurface Inflow (in/yr)
1	1	3.1E-03					
2	1	4.1E-05					
3	1	1.3E-04					
4	2	4.3E-03	250	2			
5	4	8.7E-13					
6	1	1.0E-06					
7	1	1.0E-03					42.823589
8	3	1.0E-03					
9	1	1.0E-03					

Layer #	Layer Type	Geomembrane Pinhole Density (#/acre)	Geomembrane Instal. Defects (#/acre)	Geomembrane Placement Quality	Geotextile Transmissivity (cm^2/sec)
5	4	1	5496	2	

Table E-31. HELP Model Input Data for ILV Off-Vault Year 2,723 (\ILVOFF\ILV10.D10).

Input Parameter (HELP Model Query)	Generic Input Parameter Value
Landfill area =	0.06 acres
Percent of area where runoff is possible =	100%
Do you want to specify initial moisture storage? (Y/N)	Y
Amount of water or snow on surface =	0 inches
CN Input Parameter (HELP Model Query)	CN Input Parameter Value
Slope =	2 %
Slope length =	250 ft
Soil Texture =	4 (HELP model default soil texture)
Vegetation =	4 (i.e., a good stand of grass)
HELP Model Computed Curve Number = 49.87	

Layer	Layer Number	Layer Type
Topsoil	1	1 (vertical percolation layer)
Upper Backfill	2	1 (vertical percolation layer)
Erosion Barrier	3	1 (vertical percolation layer)
Upper Drainage Layer	4	2 (lateral drainage layer)
HDPE Geomembrane & GCL	5	4 (geomembrane liner)
Foundation Layer (1E-06)	6	1 (vertical percolation layer)
Foundation Layer (1E-03)	7	1 (vertical percolation layer)
Soil Fill Adjacent to Vault	8	3 (barrier soil liner)
Soil Fill Adjacent to Vault	9	1 (vertical percolation layer)

Layer #	Layer Type	Layer Thickness (in)	Soil Texture No.	Total Porosity (Vol/Vol)	Field Capacity (Vol/Vol)	Wilting Point (Vol/Vol)	Initial Moisture [2] (Vol/Vol)
1	1	5.55		0.396	0.109	0.047	0.109
2	1	30		0.35	0.252	0.181	0.252
3	1	12		0.15	0.1	0.07	0.1
4	2	12		0.38	0.148	0.1	0.148
5	4	0.26					
6	1	12		0.35	0.252	0.181	0.252
7	1	12		0.457	0.131	0.058	0.131
8	3	27		0.457	0.131	0.058	0.131
9	1	312		0.457	0.131	0.058	0.131

Layer #	Layer Type	Sat. Hyd. Conductivity (cm/sec)	Drainage Length (ft)	Drain Slope (%)	Leachate Recirc. (%)	Recirc. to Layer (#)	Subsurface Inflow (in/yr)
1	1	3.1E-03					
2	1	4.1E-05					
3	1	1.3E-04					
4	2	1.4E-03	250	2			
5	4	8.7E-13					
6	1	1.0E-06					
7	1	1.0E-03					52.2869
8	3	1.0E-03					
9	1	1.0E-03					

Layer #	Layer Type	Geomembrane Pinhole Density (#/acre)	Geomembrane Instal. Defects (#/acre)	Geomembrane Placement Quality	Geotextile Transmissivity (cm^2/sec)
5	4	1	8403	2	

Table E-32. HELP Model Input Data for ILV Off-Vault Year 2,905 (\ILVOFF\ILV11.D10).

Input Parameter (HELP Model Query)	Generic Input Parameter Value
Landfill area =	0.06 acres
Percent of area where runoff is possible =	100%
Do you want to specify initial moisture storage? (Y/N)	Y
Amount of water or snow on surface =	0 inches
CN Input Parameter (HELP Model Query)	CN Input Parameter Value
Slope =	2 %
Slope length =	250 ft
Soil Texture =	4 (HELP model default soil texture)
Vegetation =	4 (i.e., a good stand of grass)
HELP Model Computed Curve Number = 49.87	

Layer	Layer Number	Layer Type
Topsoil	1	1 (vertical percolation layer)
Upper Backfill	2	1 (vertical percolation layer)
Erosion Barrier	3	1 (vertical percolation layer)
Upper Drainage Layer	4	2 (lateral drainage layer)
HDPE Geomembrane & GCL	5	4 (geomembrane liner)
Foundation Layer (1E-06)	6	1 (vertical percolation layer)
Foundation Layer (1E-03)	7	1 (vertical percolation layer)
Soil Fill Adjacent to Vault	8	3 (barrier soil liner)
Soil Fill Adjacent to Vault	9	1 (vertical percolation layer)

Layer #	Layer Type	Layer Thickness (in)	Soil Texture No.	Total Porosity (Vol/Vol)	Field Capacity (Vol/Vol)	Wilting Point (Vol/Vol)	Initial Moisture [2] (Vol/Vol)
1	1	5.53		0.396	0.109	0.047	0.109
2	1	30		0.35	0.252	0.181	0.252
3	1	12		0.15	0.1	0.07	0.1
4	2	12		0.38	0.148	0.1	0.148
5	4	0.26					
6	1	12		0.35	0.252	0.181	0.252
7	1	12		0.457	0.131	0.058	0.131
8	3	27		0.457	0.131	0.058	0.131
9	1	312		0.457	0.131	0.058	0.131

Layer #	Layer Type	Sat. Hyd. Conductivity (cm/sec)	Drainage Length (ft)	Drain Slope (%)	Leachate Recirc. (%)	Recirc. to Layer (#)	Subsurface Inflow (in/yr)
1	1	3.1E-03					
2	1	4.1E-05					
3	1	1.3E-04					
4	2	1.4E-03	250	2			
5	4	8.7E-13					
6	1	1.0E-06					
7	1	1.0E-03					52.494552
8	3	1.0E-03					
9	1	1.0E-03					

Layer #	Layer Type	Geomembrane Pinhole Density (#/acre)	Geomembrane Instal. Defects (#/acre)	Geomembrane Placement Quality	Geotextile Transmissivity (cm^2/sec)
5	4	1	9046	2	

Table E-33. HELP Model Input Data for ILV Off-Vault Year 3,300 (\ILVOFF\ILV12.D10).

Input Parameter (HELP Model Query)	Generic Input Parameter Value
Landfill area =	0.06 acres
Percent of area where runoff is possible =	100%
Do you want to specify initial moisture storage? (Y/N)	Y
Amount of water or snow on surface =	0 inches
CN Input Parameter (HELP Model Query)	CN Input Parameter Value
Slope =	2 %
Slope length =	250 ft
Soil Texture =	4 (HELP model default soil texture)
Vegetation =	4 (i.e., a good stand of grass)
HELP Model Computed Curve Number = 49.87	

Layer	Layer Number	Layer Type
Topsoil	1	1 (vertical percolation layer)
Upper Backfill	2	1 (vertical percolation layer)
Erosion Barrier	3	1 (vertical percolation layer)
Upper Drainage Layer	4	2 (lateral drainage layer)
HDPE Geomembrane & GCL	5	4 (geomembrane liner)
Foundation Layer (1E-06)	6	1 (vertical percolation layer)
Foundation Layer (1E-03)	7	1 (vertical percolation layer)
Soil Fill Adjacent to Vault	8	3 (barrier soil liner)
Soil Fill Adjacent to Vault	9	1 (vertical percolation layer)

Layer #	Layer Type	Layer Thickness (in)	Soil Texture No.	Total Porosity (Vol/Vol)	Field Capacity (Vol/Vol)	Wilting Point (Vol/Vol)	Initial Moisture [2] (Vol/Vol)
1	1	5.47		0.396	0.109	0.047	0.109
2	1	30		0.35	0.252	0.181	0.252
3	1	12		0.15	0.1	0.07	0.1
4	2	12		0.38	0.148	0.1	0.148
5	4	0.26					
6	1	12		0.35	0.252	0.181	0.252
7	1	12		0.457	0.131	0.058	0.131
8	3	27		0.457	0.131	0.058	0.131
9	1	312		0.457	0.131	0.058	0.131

Layer #	Layer Type	Sat. Hyd. Conductivity (cm/sec)	Drainage Length (ft)	Drain Slope (%)	Leachate Recirc. (%)	Recirc. to Layer (#)	Subsurface Inflow (in/yr)
1	1	3.1E-03					
2	1	4.1E-05					
3	1	1.3E-04					
4	2	1.4E-03	250	2			
5	4	8.7E-13					
6	1	1.0E-06					
7	1	1.0E-03					52.85516
8	3	1.0E-03					
9	1	1.0E-03					

Layer #	Layer Type	Geomembrane Pinhole Density (#/acre)	Geomembrane Instal. Defects (#/acre)	Geomembrane Placement Quality	Geotextile Transmissivity (cm^2/sec)
5	4	1	10442	2	

Table E-34. HELP Model Input Data for ILV Off-Vault Year 5,700 (\ILVOFF\ILV13.D10).

Input Parameter (HELP Model Query)	Generic Input Parameter Value
Landfill area =	0.06 acres
Percent of area where runoff is possible =	100%
Do you want to specify initial moisture storage? (Y/N)	Y
Amount of water or snow on surface =	0 inches
CN Input Parameter (HELP Model Query)	CN Input Parameter Value
Slope =	2 %
Slope length =	250 ft
Soil Texture =	4 (HELP model default soil texture)
Vegetation =	4 (i.e., a good stand of grass)
HELP Model Computed Curve Number = 49.87	

Layer	Layer Number	Layer Type
Topsoil	1	1 (vertical percolation layer)
Upper Backfill	2	1 (vertical percolation layer)
Erosion Barrier	3	1 (vertical percolation layer)
Upper Drainage Layer	4	2 (lateral drainage layer)
HDPE Geomembrane & GCL	5	4 (geomembrane liner)
Foundation Layer (1E-06)	6	1 (vertical percolation layer)
Foundation Layer (1E-03)	7	1 (vertical percolation layer)
Soil Fill Adjacent to Vault	8	3 (barrier soil liner)
Soil Fill Adjacent to Vault	9	1 (vertical percolation layer)

Layer #	Layer Type	Layer Thickness (in)	Soil Texture No.	Total Porosity (Vol/Vol)	Field Capacity (Vol/Vol)	Wilting Point (Vol/Vol)	Initial Moisture [2] (Vol/Vol)
1	1	5.16		0.396	0.109	0.047	0.109
2	1	30		0.35	0.252	0.181	0.252
3	1	12		0.15	0.1	0.07	0.1
4	2	12		0.38	0.148	0.1	0.148
5	4	0.26					
6	1	12		0.35	0.252	0.181	0.252
7	1	12		0.457	0.131	0.058	0.131
8	3	27		0.457	0.131	0.058	0.131
9	1	312		0.457	0.131	0.058	0.131

Layer #	Layer Type	Sat. Hyd. Conductivity (cm/sec)	Drainage Length (ft)	Drain Slope (%)	Leachate Recirc. (%)	Recirc. to Layer (#)	Subsurface Inflow (in/yr)
1	1	3.1E-03					
2	1	4.1E-05					
3	1	1.3E-04					
4	2	1.4E-03	250	2			
5	4	8.7E-13					
6	1	1.0E-06					
7	1	1.0E-03					53.742645
8	3	1.0E-03					
9	1	1.0E-03					

Layer #	Layer Type	Geomembrane Pinhole Density (#/acre)	Geomembrane Instal. Defects (#/acre)	Geomembrane Placement Quality	Geotextile Transmissivity (cm^2/sec)
5	4	1	18921	2	

Table E-35. HELP Model Input Data for ILV Off-Vault Year 7,100 (\ILVOFF\ILV14.D10).

Input Parameter (HELP Model Query)	Generic Input Parameter Value
Landfill area =	0.06 acres
Percent of area where runoff is possible =	100%
Do you want to specify initial moisture storage? (Y/N)	Y
Amount of water or snow on surface =	0 inches
CN Input Parameter (HELP Model Query)	CN Input Parameter Value
Slope =	2 %
Slope length =	250 ft
Soil Texture =	4 (HELP model default soil texture)
Vegetation =	4 (i.e., a good stand of grass)
HELP Model Computed Curve Number = 49.87	

Layer	Layer Number	Layer Type
Topsoil	1	1 (vertical percolation layer)
Upper Backfill	2	1 (vertical percolation layer)
Erosion Barrier	3	1 (vertical percolation layer)
Upper Drainage Layer	4	2 (lateral drainage layer)
HDPE Geomembrane & GCL	5	4 (geomembrane liner)
Foundation Layer (1E-06)	6	1 (vertical percolation layer)
Foundation Layer (1E-03)	7	1 (vertical percolation layer)
Soil Fill Adjacent to Vault	8	3 (barrier soil liner)
Soil Fill Adjacent to Vault	9	1 (vertical percolation layer)

Layer #	Layer Type	Layer Thickness (in)	Soil Texture No.	Total Porosity (Vol/Vol)	Field Capacity (Vol/Vol)	Wilting Point (Vol/Vol)	Initial Moisture [2] (Vol/Vol)
1	1	4.98		0.396	0.109	0.047	0.109
2	1	30		0.35	0.252	0.181	0.252
3	1	12		0.15	0.1	0.07	0.1
4	2	12		0.38	0.148	0.1	0.148
5	4	0.26					
6	1	12		0.35	0.252	0.181	0.252
7	1	12		0.457	0.131	0.058	0.131
8	3	27		0.457	0.131	0.058	0.131
9	1	312		0.457	0.131	0.058	0.131

Layer #	Layer Type	Sat. Hyd. Conductivity (cm/sec)	Drainage Length (ft)	Drain Slope (%)	Leachate Recirc. (%)	Recirc. to Layer (#)	Subsurface Inflow (in/yr)
1	1	3.1E-03					
2	1	4.1E-05					
3	1	1.3E-04					
4	2	1.4E-03	250	2			
5	4	8.7E-13					
6	1	1.0E-06					
7	1	1.0E-03					53.96495
8	3	1.0E-03					
9	1	1.0E-03					

Layer #	Layer Type	Geomembrane Pinhole Density (#/acre)	Geomembrane Instal. Defects (#/acre)	Geomembrane Placement Quality	Geotextile Transmissivity (cm^2/sec)
5	4	1	23867	2	

Table E-36. HELP Model Input Data for ILV Off-Vault After Roof Collapse Year 7,100+ (\ILVOFF\ILVCLPSE.D10).

Input Parameter (HELP Model Query)	Generic Input Parameter Value
Landfill area =	0.06 acres
Percent of area where runoff is possible =	100%
Do you want to specify initial moisture storage? (Y/N)	Y
Amount of water or snow on surface =	0 inches
CN Input Parameter (HELP Model Query)	CN Input Parameter Value
Slope =	2 %
Slope length =	250 ft
Soil Texture =	4 (HELP model default soil texture)
Vegetation =	4 (i.e., a good stand of grass)
HELP Model Computed Curve Number = 49.87	

Layer	Layer Number	Layer Type
Topsoil	1	1 (vertical percolation layer)
Upper Backfill	2	1 (vertical percolation layer)
Erosion Barrier	3	1 (vertical percolation layer)
Upper Drainage Layer	4	2 (lateral drainage layer)
HDPE Geomembrane & GCL	5	4 (geomembrane liner)
Foundation Layer (1E-06)	6	1 (vertical percolation layer)
Foundation Layer (1E-03)	7	1 (vertical percolation layer)
Soil Fill Adjacent to Vault	8	3 (barrier soil liner)
Soil Fill Adjacent to Vault	9	1 (vertical percolation layer)

Layer #	Layer Type	Layer Thickness (in)	Soil Texture No.	Total Porosity (Vol/Vol)	Field Capacity (Vol/Vol)	Wilting Point (Vol/Vol)	Initial Moisture [2] (Vol/Vol)
1	1	4.98		0.396	0.109	0.047	0.109
2	1	30		0.35	0.252	0.181	0.252
3	1	12		0.15	0.1	0.07	0.1
4	2	12		0.38	0.148	0.1	0.148
5	4	0.26					
6	1	12		0.35	0.252	0.181	0.252
7	1	12		0.457	0.131	0.058	0.131
8	3	27		0.457	0.131	0.058	0.131
9	1	312		0.457	0.131	0.058	0.131

Layer #	Layer Type	Sat. Hyd. Conductivity (cm/sec)	Drainage Length (ft)	Drain Slope (%)	Leachate Recirc. (%)	Recirc. to Layer (#)	Subsurface Inflow (in/yr)
1	1	3.1E-03					
2	1	4.1E-05					
3	1	1.3E-04					
4	2	1.4E-03	250	2			
5	4	8.7E-13					
6	1	1.0E-06					
7	1	1.0E-03					
8	3	1.0E-03					
9	1	1.0E-03					

Layer #	Layer Type	Geomembrane Pinhole Density (#/acre)	Geomembrane Instal. Defects (#/acre)	Geomembrane Placement Quality	Geotextile Transmissivity (cm^2/sec)
5	4	1	23867	2	

Appendix F. HELP Model Input Data Sheets for Component-in-Grout Special Waste Form

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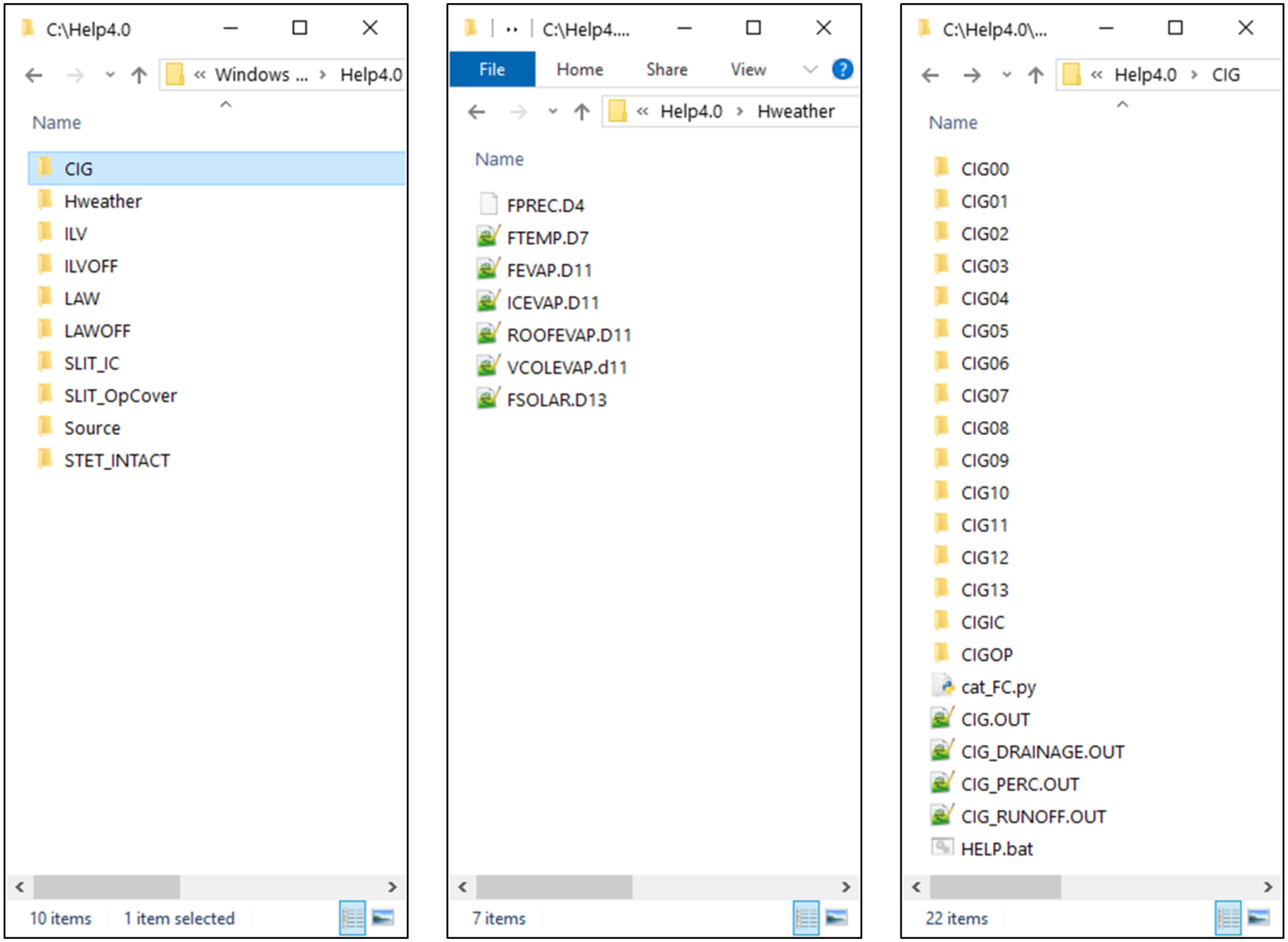

Figure F-1. HELP Model File Hierarchy for CIG Special Waste Form Simulations.

Table F-1. HELP Model Input Data for Operational Soil Cover (CIGOP.D10).

Input Parameter (HELP Model Query)	Generic Input Parameter Value
Landfill area =	0.0689 acres
Percent of area where runoff is possible =	100%
Do you want to specify initial moisture storage? (Y/N)	Y
Amount of water or snow on surface =	0 inches
CN Input Parameter (HELP Model Query)	CN Input Parameter Value
Slope =	1 %
Slope length =	80 ft
Soil Texture =	4 (HELP model default soil texture)
Vegetation =	4 (i.e., a good stand of grass)
HELP Model Computed Curve Number = 53.06	

Layer	Layer Number	Layer Type
Topsoil	1	1 (vertical percolation layer)

Layer #	Layer Type	Layer Thickness (in)	Soil Texture No.	Total Porosity (Vol/Vol)	Field Capacity (Vol/Vol)	Wilting Point (Vol/Vol)	Initial Moisture [2] (Vol/Vol)
1	1	48		0.396	0.109	0.047	0.109

Layer #	Layer Type	Sat. Hyd. Conductivity (cm/sec)	Drainage Length (ft)	Drain Slope (%)	Leachate Recirc. (%)	Recirc. to Layer (#)	Subsurface Inflow (in/yr)
1	1	1.0E-03					

Layer #	Layer Type	Geomembrane Pinhole Density (#/acre)	Geomembrane Instal. Defects (#/acre)	Geomembrane Placement Quality	Geotextile Transmissivity (cm^2/sec)

Table F-2. HELP Model Input Data for Institutional Control (CIGIC.D10).

Input Parameter (HELP Model Query)	Generic Input Parameter Value
Landfill area =	0.0689 acres
Percent of area where runoff is possible =	100%
Do you want to specify initial moisture storage? (Y/N)	Y
Amount of water or snow on surface =	0 inches
CN Input Parameter (HELP Model Query)	CN Input Parameter Value
Slope =	2 %
Slope length =	585 ft
Soil Texture =	4 (HELP model default soil texture)
Vegetation =	4 (i.e., a good stand of grass)
HELP Model Computed Curve Number = 46.2	

Layer	Layer Number	Layer Type
Topsoil	1	1 (vertical percolation layer)
GCL	2	4 (geomembrane liner)
Topsoil	3	1 (vertical percolation layer)

Layer #	Layer Type	Layer Thickness (in)	Soil Texture No.	Total Porosity (Vol/Vol)	Field Capacity (Vol/Vol)	Wilting Point (Vol/Vol)	Initial Moisture [2] (Vol/Vol)
1	1	0.0001		0.396	0.109	0.047	0.109
2	4	0.06		0.75	0.747	0.4	0.75
3	1	48		0.396	0.109	0.047	0.109

Layer #	Layer Type	Sat. Hyd. Conductivity (cm/sec)	Drainage Length (ft)	Drain Slope (%)	Leachate Recirc. (%)	Recirc. to Layer (#)	Subsurface Inflow (in/yr)
1	1	1.0E-03					
2	4	5.0E-08					
3	1	1.0E-03					

Layer #	Layer Type	Geomembrane Pinhole Density (#/acre)	Geomembrane Instal. Defects (#/acre)	Geomembrane Placement Quality	Geotextile Transmissivity (cm^2/sec)
2	4	1	4	3	

Table F-3. HELP Model Input Data for Year 100 (CIG00.D10).

Input Parameter (HELP Model Query)	Generic Input Parameter Value
Landfill area =	0.2686 acres
Percent of area where runoff is possible =	100%
Do you want to specify initial moisture storage? (Y/N)	Y
Amount of water or snow on surface =	0 inches
CN Input Parameter (HELP Model Query)	CN Input Parameter Value
Slope =	2 %
Slope length =	585 ft
Soil Texture =	4 (HELP model default soil texture)
Vegetation =	4 (i.e., a good stand of grass)
HELP Model Computed Curve Number = 46.2	

Layer	Layer Number	Layer Type
Topsoil	1	1 (vertical percolation layer)
Upper Backfill	2	1 (vertical percolation layer)
Erosion Barrier	3	1 (vertical percolation layer)
Lateral Drainage Layer	4	2 (lateral drainage layer)
HDPE Geomembrane	5	4 (geomembrane liner)
GCL	6	3 (barrier soil liner)
Foundation Layer (1E-06)	7	1 (vertical percolation layer)
Foundation Layer (1E-03)	8	1 (vertical percolation layer)

Layer #	Layer Type	Layer Thickness (in)	Soil Texture No.	Total Porosity (Vol/Vol)	Field Capacity (Vol/Vol)	Wilting Point (Vol/Vol)	Initial Moisture [2] (Vol/Vol)
1	1	6		0.396	0.109	0.047	0.109
2	1	30		0.35	0.252	0.181	0.252
3	1	12		0.15	0.1	0.07	0.1
4	2	12		0.417	0.045	0.018	0.045
5	4	0.06					
6	3	0.2		0.75	0.747	0.4	0.75
7	1	12		0.35	0.252	0.181	0.252
8	1	72		0.457	0.131	0.058	0.131

Layer #	Layer Type	Sat. Hyd. Conductivity (cm/sec)	Drainage Length (ft)	Drain Slope (%)	Leachate Recirc. (%)	Recirc. to Layer (#)	Subsurface Inflow (in/yr)
1	1	3.1E-03					
2	1	4.1E-05					
3	1	1.3E-04					
4	2	5.0E-02	585	2			
5	4	2.0E-13					
6	3	5.0E-09					
7	1	1.0E-06					
8	1	1.0E-03					

Layer #	Layer Type	Geomembrane Pinhole Density (#/acre)	Geomembrane Instal. Defects (#/acre)	Geomembrane Placement Quality	Geotextile Transmissivity (cm^2/sec)
5	4	1	4	2	

Table F-4. HELP Model Input Data for Year 180 (CIG01.D10).

Input Parameter (HELP Model Query)	Generic Input Parameter Value
Landfill area =	0.2686 acres
Percent of area where runoff is possible =	100%
Do you want to specify initial moisture storage? (Y/N)	Y
Amount of water or snow on surface =	0 inches
CN Input Parameter (HELP Model Query)	CN Input Parameter Value
Slope =	2 %
Slope length =	585 ft
Soil Texture =	4 (HELP model default soil texture)
Vegetation =	4 (i.e., a good stand of grass)
HELP Model Computed Curve Number = 46.2	

Layer	Layer Number	Layer Type
Topsoil	1	1 (vertical percolation layer)
Upper Backfill	2	1 (vertical percolation layer)
Erosion Barrier	3	1 (vertical percolation layer)
Lateral Drainage Layer	4	2 (lateral drainage layer)
HDPE Geomembrane	5	4 (geomembrane liner)
GCL	6	3 (barrier soil liner)
Foundation Layer (1E-06)	7	1 (vertical percolation layer)
Foundation Layer (1E-03)	8	1 (vertical percolation layer)

Layer #	Layer Type	Layer Thickness (in)	Soil Texture No.	Total Porosity (Vol/Vol)	Field Capacity (Vol/Vol)	Wilting Point (Vol/Vol)	Initial Moisture [2] (Vol/Vol)
1	1	5.96		0.396	0.109	0.047	0.109
2	1	30		0.35	0.252	0.181	0.252
3	1	12		0.15	0.1	0.07	0.1
4	2	12		0.416	0.048	0.021	0.048
5	4	0.06					
6	3	0.2		0.75	0.747	0.4	0.75
7	1	12		0.35	0.252	0.181	0.252
8	1	72		0.457	0.131	0.058	0.131

Layer #	Layer Type	Sat. Hyd. Conductivity (cm/sec)	Drainage Length (ft)	Drain Slope (%)	Leachate Recirc. (%)	Recirc. to Layer (#)	Subsurface Inflow (in/yr)
1	1	3.1E-03					
2	1	4.1E-05					
3	1	1.3E-04					
4	2	4.48E-02	585	2			
5	4	2.0E-13					
6	3	5.0E-09					
7	1	1.0E-06					
8	1	1.0E-03					

Layer #	Layer Type	Geomembrane Pinhole Density (#/acre)	Geomembrane Instal. Defects (#/acre)	Geomembrane Placement Quality	Geotextile Transmissivity (cm^2/sec)
5	4	1	40	2	

Table F-5. HELP Model Input Data for Year 290 (CIG02.D10).

Input Parameter (HELP Model Query)	Generic Input Parameter Value
Landfill area =	0.2686 acres
Percent of area where runoff is possible =	100%
Do you want to specify initial moisture storage? (Y/N)	Y
Amount of water or snow on surface =	0 inches
CN Input Parameter (HELP Model Query)	CN Input Parameter Value
Slope =	2 %
Slope length =	585 ft
Soil Texture =	4 (HELP model default soil texture)
Vegetation =	4 (i.e., a good stand of grass)
HELP Model Computed Curve Number = 46.2	

Layer	Layer Number	Layer Type
Topsoil	1	1 (vertical percolation layer)
Upper Backfill	2	1 (vertical percolation layer)
Erosion Barrier	3	1 (vertical percolation layer)
Lateral Drainage Layer	4	2 (lateral drainage layer)
HDPE Geomembrane	5	4 (geomembrane liner)
GCL	6	3 (barrier soil liner)
Foundation Layer (1E-06)	7	1 (vertical percolation layer)
Foundation Layer (1E-03)	8	1 (vertical percolation layer)

Layer #	Layer Type	Layer Thickness (in)	Soil Texture No.	Total Porosity (Vol/Vol)	Field Capacity (Vol/Vol)	Wilting Point (Vol/Vol)	Initial Moisture [2] (Vol/Vol)
1	1	5.90		0.396	0.109	0.047	0.109
2	1	30		0.35	0.252	0.181	0.252
3	1	12		0.15	0.1	0.07	0.1
4	2	12		0.414	0.052	0.024	0.052
5	4	0.06					
6	3	0.2		0.75	0.747	0.4	0.75
7	1	12		0.35	0.252	0.181	0.252
8	1	72		0.457	0.131	0.058	0.131

Layer #	Layer Type	Sat. Hyd. Conductivity (cm/sec)	Drainage Length (ft)	Drain Slope (%)	Leachate Recirc. (%)	Recirc. to Layer (#)	Subsurface Inflow (in/yr)
1	1	3.1E-03					
2	1	4.1E-05					
3	1	1.3E-04					
4	2	3.86E-02	585	2			
5	4	2.0E-13					
6	3	5.0E-08					
7	1	1.0E-06					
8	1	1.0E-03					

Layer #	Layer Type	Geomembrane Pinhole Density (#/acre)	Geomembrane Instal. Defects (#/acre)	Geomembrane Placement Quality	Geotextile Transmissivity (cm^2/sec)
5	4	1	96	2	

Table F-6. HELP Model Input Data for Year 300 (CIG03.D10).

Input Parameter (HELP Model Query)	Generic Input Parameter Value
Landfill area =	0.2686 acres
Percent of area where runoff is possible =	100%
Do you want to specify initial moisture storage? (Y/N)	Y
Amount of water or snow on surface =	0 inches
CN Input Parameter (HELP Model Query)	CN Input Parameter Value
Slope =	2 %
Slope length =	585 ft
Soil Texture =	4 (HELP model default soil texture)
Vegetation =	4 (i.e., a good stand of grass)
HELP Model Computed Curve Number = 46.2	

Layer	Layer Number	Layer Type
Topsoil	1	1 (vertical percolation layer)
Upper Backfill	2	1 (vertical percolation layer)
Erosion Barrier	3	1 (vertical percolation layer)
Lateral Drainage Layer	4	2 (lateral drainage layer)
HDPE Geomembrane	5	4 (geomembrane liner)
GCL	6	3 (barrier soil liner)
Foundation Layer (1E-06)	7	1 (vertical percolation layer)
Foundation Layer (1E-03)	8	1 (vertical percolation layer)

Layer #	Layer Type	Layer Thickness (in)	Soil Texture No.	Total Porosity (Vol/Vol)	Field Capacity (Vol/Vol)	Wilting Point (Vol/Vol)	Initial Moisture [2] (Vol/Vol)
1	1	5.90		0.396	0.109	0.047	0.109
2	1	30		0.35	0.252	0.181	0.252
3	1	12		0.15	0.1	0.07	0.1
4	2	12		0.414	0.053	0.024	0.053
5	4	0.06					
6	3	0.2		0.75	0.747	0.4	0.75
7	1	12		0.35	0.252	0.181	0.252
8	1	72		0.457	0.131	0.058	0.131

Layer #	Layer Type	Sat. Hyd. Conductivity (cm/sec)	Drainage Length (ft)	Drain Slope (%)	Leachate Recirc. (%)	Recirc. to Layer (#)	Subsurface Inflow (in/yr)
1	1	3.1E-03					
2	1	4.1E-05					
3	1	1.3E-04					
4	2	3.81E-02	585	2			
5	4	2.0E-13					
6	3	5.0E-08					
7	1	1.0E-06					
8	1	1.0E-03					

Layer #	Layer Type	Geomembrane Pinhole Density (#/acre)	Geomembrane Instal. Defects (#/acre)	Geomembrane Placement Quality	Geotextile Transmissivity (cm^2/sec)
5	4	1	101	2	

Table F-7. HELP Model Input Data for Year 300– After Subsidence (CIG04.D10).

Input Parameter (HELP Model Query)	Generic Input Parameter Value
Landfill area =	0.2686 acres
Percent of area where runoff is possible =	0%
Do you want to specify initial moisture storage? (Y/N)	Y
Amount of water or snow on surface =	0 inches
User-Specified Curve Number = 0	

Layer	Layer Number	Layer Type
Topsoil	1	1 (vertical percolation layer)
Upper Backfill	2	1 (vertical percolation layer)
Erosion Barrier	3	1 (vertical percolation layer)
Degraded Lat. Drainage Layer	4	1 (vertical percolation layer)
Degraded HDPE Geomembrane	5	4 (geomembrane liner)
Degraded GCL	6	3 (barrier soil liner)
Foundation Layer (1E-06)	7	1 (vertical percolation layer)
Foundation Layer (1E-03)	8	1 (vertical percolation layer)

Layer #	Layer Type	Layer Thickness (in)	Soil Texture No.	Total Porosity (Vol/Vol)	Field Capacity (Vol/Vol)	Wilting Point (Vol/Vol)	Initial Moisture [2] (Vol/Vol)
1	1	5.90		0.396	0.109	0.047	0.109
2	1	30		0.35	0.252	0.181	0.252
3	1	12		0.15	0.1	0.07	0.1
4	1	12		0.414	0.053	0.024	0.053
5	4	0.06					
6	3	0.2		0.75	0.747	0.4	0.75
7	1	12		0.35	0.252	0.181	0.252
8	1	72		0.457	0.131	0.058	0.131

Layer #	Layer Type	Sat. Hyd. Conductivity (cm/sec)	Drainage Length (ft)	Drain Slope (%)	Leachate Recirc. (%)	Recirc. to Layer (#)	Subsurface Inflow (in/yr)
1	1	3.1E-03					
2	1	4.1E-05					
3	1	1.3E-04					
4	1	3.81E-02					
5	4	5.0E-05					
6	3	5.0E-05					
7	1	1.0E-06					
8	1	1.0E-03					

Layer #	Layer Type	Geomembrane Pinhole Density (#/acre)	Geomembrane Instal. Defects (#/acre)	Geomembrane Placement Quality	Geotextile Transmissivity (cm^2/sec)
5	4			4	

Table F-8. HELP Model Input Data for Year 400 – After Subsidence (CIG05.D10).

Input Parameter (HELP Model Query)	Generic Input Parameter Value
Landfill area =	0.2686 acres
Percent of area where runoff is possible =	0%
Do you want to specify initial moisture storage? (Y/N)	Y
Amount of water or snow on surface =	0 inches
User-Specified Curve Number = 0	

Layer	Layer Number	Layer Type
Topsoil	1	1 (vertical percolation layer)
Upper Backfill	2	1 (vertical percolation layer)
Erosion Barrier	3	1 (vertical percolation layer)
Degraded Lat. Drainage Layer	4	1 (vertical percolation layer)
Degraded HDPE Geomembrane	5	4 (geomembrane liner)
Degraded GCL	6	3 (barrier soil liner)
Foundation Layer (1E-06)	7	1 (vertical percolation layer)
Foundation Layer (1E-03)	8	1 (vertical percolation layer)

Layer #	Layer Type	Layer Thickness (in)	Soil Texture No.	Total Porosity (Vol/Vol)	Field Capacity (Vol/Vol)	Wilting Point (Vol/Vol)	Initial Moisture [2] (Vol/Vol)
1	1	5.85		0.396	0.109	0.047	0.109
2	1	30		0.35	0.252	0.181	0.252
3	1	12		0.15	0.1	0.07	0.1
4	1	12		0.413	0.057	0.027	0.057
5	4	0.06					
6	3	0.2		0.75	0.747	0.4	0.75
7	1	12		0.35	0.252	0.181	0.252
8	1	72		0.457	0.131	0.058	0.131

Layer #	Layer Type	Sat. Hyd. Conductivity (cm/sec)	Drainage Length (ft)	Drain Slope (%)	Leachate Recirc. (%)	Recirc. to Layer (#)	Subsurface Inflow (in/yr)
1	1	3.1E-03					
2	1	4.1E-05					
3	1	1.3E-04					
4	1	3.32E-02					
5	4	5.0E-05					
6	3	5.0E-05					
7	1	1.0E-06					
8	1	1.0E-03					

Layer #	Layer Type	Geomembrane Pinhole Density (#/acre)	Geomembrane Instal. Defects (#/acre)	Geomembrane Placement Quality	Geotextile Transmissivity (cm^2/sec)
5	4			4	

Table F-9. HELP Model Input Data for Year 480 – After Subsidence (CIG06.D10).

Input Parameter (HELP Model Query)	Generic Input Parameter Value
Landfill area =	0.2686 acres
Percent of area where runoff is possible =	0%
Do you want to specify initial moisture storage? (Y/N)	Y
Amount of water or snow on surface =	0 inches
User-Specified Curve Number = 0	

Layer	Layer Number	Layer Type
Topsoil	1	1 (vertical percolation layer)
Upper Backfill	2	1 (vertical percolation layer)
Erosion Barrier	3	1 (vertical percolation layer)
Degraded Lat. Drainage Layer	4	1 (vertical percolation layer)
Degraded HDPE Geomembrane	5	4 (geomembrane liner)
Degraded GCL	6	3 (barrier soil liner)
Foundation Layer (1E-06)	7	1 (vertical percolation layer)
Foundation Layer (1E-03)	8	1 (vertical percolation layer)

Layer #	Layer Type	Layer Thickness (in)	Soil Texture No.	Total Porosity (Vol/Vol)	Field Capacity (Vol/Vol)	Wilting Point (Vol/Vol)	Initial Moisture [2] (Vol/Vol)
1	1	5.84		0.396	0.109	0.047	0.109
2	1	30		0.35	0.252	0.181	0.252
3	1	12		0.15	0.1	0.07	0.1
4	1	12		0.412	0.06	0.03	0.06
5	4	0.06					
6	3	0.2		0.75	0.747	0.4	0.75
7	1	12		0.35	0.252	0.181	0.252
8	1	72		0.457	0.131	0.058	0.131

Layer #	Layer Type	Sat. Hyd. Conductivity (cm/sec)	Drainage Length (ft)	Drain Slope (%)	Leachate Recirc. (%)	Recirc. to Layer (#)	Subsurface Inflow (in/yr)
1	1	3.1E-03					
2	1	4.1E-05					
3	1	1.3E-04					
4	1	2.98E-02					
5	4	5.0E-05					
6	3	5.0E-05					
7	1	1.0E-06					
8	1	1.0E-03					

Layer #	Layer Type	Geomembrane Pinhole Density (#/acre)	Geomembrane Instal. Defects (#/acre)	Geomembrane Placement Quality	Geotextile Transmissivity (cm^2/sec)
5	4			4	

Table F-10. HELP Model Input Data for Year 660 – After Subsidence (CIG07.D10).

Input Parameter (HELP Model Query)	Generic Input Parameter Value
Landfill area =	0.2686 acres
Percent of area where runoff is possible =	0%
Do you want to specify initial moisture storage? (Y/N)	Y
Amount of water or snow on surface =	0 inches
User-Specified Curve Number = 0	

Layer	Layer Number	Layer Type
Topsoil	1	1 (vertical percolation layer)
Upper Backfill	2	1 (vertical percolation layer)
Erosion Barrier	3	1 (vertical percolation layer)
Degraded Lat. Drainage Layer	4	1 (vertical percolation layer)
Degraded HDPE Geomembrane	5	4 (geomembrane liner)
Degraded GCL	6	3 (barrier soil liner)
Foundation Layer (1E-06)	7	1 (vertical percolation layer)
Foundation Layer (1E-03)	8	1 (vertical percolation layer)

Layer #	Layer Type	Layer Thickness (in)	Soil Texture No.	Total Porosity (Vol/Vol)	Field Capacity (Vol/Vol)	Wilting Point (Vol/Vol)	Initial Moisture [2] (Vol/Vol)
1	1	5.82		0.396	0.109	0.047	0.109
2	1	30		0.35	0.252	0.181	0.252
3	1	12		0.15	0.1	0.07	0.1
4	1	12		0.409	0.067	0.036	0.067
5	4	0.06					
6	3	0.2		0.75	0.747	0.4	0.75
7	1	12		0.35	0.252	0.181	0.252
8	1	72		0.457	0.131	0.058	0.131

Layer #	Layer Type	Sat. Hyd. Conductivity (cm/sec)	Drainage Length (ft)	Drain Slope (%)	Leachate Recirc. (%)	Recirc. to Layer (#)	Subsurface Inflow (in/yr)
1	1	3.1E-03					
2	1	4.1E-05					
3	1	1.3E-04					
4	1	2.33E-02					
5	4	5.0E-05					
6	3	5.0E-05					
7	1	1.0E-06					
8	1	1.0E-03					

Layer #	Layer Type	Geomembrane Pinhole Density (#/acre)	Geomembrane Instal. Defects (#/acre)	Geomembrane Placement Quality	Geotextile Transmissivity (cm^2/sec)
5	4			4	

Table F-11. HELP Model Input Data for Year 1,100 – After Subsidence (CIG08.D10).

Input Parameter (HELP Model Query)	Generic Input Parameter Value
Landfill area =	0.2686 acres
Percent of area where runoff is possible =	0%
Do you want to specify initial moisture storage? (Y/N)	Y
Amount of water or snow on surface =	0 inches
User-Specified Curve Number = 0	

Layer	Layer Number	Layer Type
Topsoil	1	1 (vertical percolation layer)
Upper Backfill	2	1 (vertical percolation layer)
Erosion Barrier	3	1 (vertical percolation layer)
Degraded Lat. Drainage Layer	4	1 (vertical percolation layer)
Degraded HDPE Geomembrane	5	4 (geomembrane liner)
Degraded GCL	6	3 (barrier soil liner)
Foundation Layer (1E-06)	7	1 (vertical percolation layer)
Foundation Layer (1E-03)	8	1 (vertical percolation layer)

Layer #	Layer Type	Layer Thickness (in)	Soil Texture No.	Total Porosity (Vol/Vol)	Field Capacity (Vol/Vol)	Wilting Point (Vol/Vol)	Initial Moisture [2] (Vol/Vol)
1	1	5.76		0.396	0.109	0.047	0.109
2	1	30		0.35	0.252	0.181	0.252
3	1	12		0.15	0.1	0.07	0.1
4	1	12		0.403	0.084	0.049	0.084
5	4	0.06					
6	3	0.2		0.75	0.747	0.4	0.75
7	1	12		0.35	0.252	0.181	0.252
8	1	72		0.457	0.131	0.058	0.131

Layer #	Layer Type	Sat. Hyd. Conductivity (cm/sec)	Drainage Length (ft)	Drain Slope (%)	Leachate Recirc. (%)	Recirc. to Layer (#)	Subsurface Inflow (in/yr)
1	1	3.1E-03					
2	1	4.1E-05					
3	1	1.3E-04					
4	1	1.28E-02					
5	4	5.0E-05					
6	3	5.0E-05					
7	1	1.0E-06					
8	1	1.0E-03					

Layer #	Layer Type	Geomembrane Pinhole Density (#/acre)	Geomembrane Instal. Defects (#/acre)	Geomembrane Placement Quality	Geotextile Transmissivity (cm^2/sec)
5	4			4	

Table F-12. HELP Model Input Data for Year 1,900 – After Subsidence (CIG09.D10).

Input Parameter (HELP Model Query)	Generic Input Parameter Value
Landfill area =	0.2686 acres
Percent of area where runoff is possible =	0%
Do you want to specify initial moisture storage? (Y/N)	Y
Amount of water or snow on surface =	0 inches
User-Specified Curve Number = 0	

Layer	Layer Number	Layer Type
Topsoil	1	1 (vertical percolation layer)
Upper Backfill	2	1 (vertical percolation layer)
Erosion Barrier	3	1 (vertical percolation layer)
Degraded Lat. Drainage Layer	4	1 (vertical percolation layer)
Degraded HDPE Geomembrane	5	4 (geomembrane liner)
Degraded GCL	6	3 (barrier soil liner)
Foundation Layer (1E-06)	7	1 (vertical percolation layer)
Foundation Layer (1E-03)	8	1 (vertical percolation layer)

Layer #	Layer Type	Layer Thickness (in)	Soil Texture No.	Total Porosity (Vol/Vol)	Field Capacity (Vol/Vol)	Wilting Point (Vol/Vol)	Initial Moisture [2] (Vol/Vol)
1	1	5.66		0.396	0.109	0.047	0.109
2	1	30		0.35	0.252	0.181	0.252
3	1	12		0.15	0.1	0.07	0.1
4	1	12		0.392	0.116	0.074	0.116
5	4	0.06					
6	3	0.2		0.75	0.747	0.4	0.75
7	1	12		0.35	0.252	0.181	0.252
8	1	72		0.457	0.131	0.058	0.131

Layer #	Layer Type	Sat. Hyd. Conductivity (cm/sec)	Drainage Length (ft)	Drain Slope (%)	Leachate Recirc. (%)	Recirc. to Layer (#)	Subsurface Inflow (in/yr)
1	1	3.1E-03					
2	1	4.1E-05					
3	1	1.3E-04					
4	1	4.3E-03					
5	4	5.0E-05					
6	3	5.0E-05					
7	1	1.0E-06					
8	1	1.0E-03					

Layer #	Layer Type	Geomembrane Pinhole Density (#/acre)	Geomembrane Instal. Defects (#/acre)	Geomembrane Placement Quality	Geotextile Transmissivity (cm^2/sec)
5	4			4	

Table F-13. HELP Model Input Data for Year 2,723 – After Subsidence (CIG10.D10).

Input Parameter (HELP Model Query)	Generic Input Parameter Value
Landfill area =	0.2686 acres
Percent of area where runoff is possible =	0%
Do you want to specify initial moisture storage? (Y/N)	Y
Amount of water or snow on surface =	0 inches
User-Specified Curve Number = 0	

Layer	Layer Number	Layer Type
Topsoil	1	1 (vertical percolation layer)
Upper Backfill	2	1 (vertical percolation layer)
Erosion Barrier	3	1 (vertical percolation layer)
Degraded Lat. Drainage Layer	4	1 (vertical percolation layer)
Degraded HDPE Geomembrane	5	4 (geomembrane liner)
Degraded GCL	6	3 (barrier soil liner)
Foundation Layer (1E-06)	7	1 (vertical percolation layer)
Foundation Layer (1E-03)	8	1 (vertical percolation layer)

Layer #	Layer Type	Layer Thickness (in)	Soil Texture No.	Total Porosity (Vol/Vol)	Field Capacity (Vol/Vol)	Wilting Point (Vol/Vol)	Initial Moisture [2] (Vol/Vol)
1	1	5.55		0.396	0.109	0.047	0.109
2	1	30		0.35	0.252	0.181	0.252
3	1	12		0.15	0.1	0.07	0.1
4	1	12		0.38	0.148	0.10	0.148
5	4	0.06					
6	3	0.2		0.75	0.747	0.4	0.75
7	1	12		0.35	0.252	0.181	0.252
8	1	72		0.457	0.131	0.058	0.131

Layer #	Layer Type	Sat. Hyd. Conductivity (cm/sec)	Drainage Length (ft)	Drain Slope (%)	Leachate Recirc. (%)	Recirc. to Layer (#)	Subsurface Inflow (in/yr)
1	1	3.1E-03					
2	1	4.1E-05					
3	1	1.3E-04					
4	1	1.4E-03					
5	4	5.0E-05					
6	3	5.0E-05					
7	1	1.0E-06					
8	1	1.0E-03					

Layer #	Layer Type	Geomembrane Pinhole Density (#/acre)	Geomembrane Instal. Defects (#/acre)	Geomembrane Placement Quality	Geotextile Transmissivity (cm^2/sec)
5	4			4	

Table F-14. HELP Model Input Data for Year 3,300 – After Subsidence (CIG11.D10).

Input Parameter (HELP Model Query)	Generic Input Parameter Value
Landfill area =	0.2686 acres
Percent of area where runoff is possible =	0%
Do you want to specify initial moisture storage? (Y/N)	Y
Amount of water or snow on surface =	0 inches
User-Specified Curve Number = 0	

Layer	Layer Number	Layer Type
Topsoil	1	1 (vertical percolation layer)
Upper Backfill	2	1 (vertical percolation layer)
Erosion Barrier	3	1 (vertical percolation layer)
Degraded Lat. Drainage Layer	4	1 (vertical percolation layer)
Degraded HDPE Geomembrane	5	4 (geomembrane liner)
Degraded GCL	6	3 (barrier soil liner)
Foundation Layer (1E-06)	7	1 (vertical percolation layer)
Foundation Layer (1E-03)	8	1 (vertical percolation layer)

Layer #	Layer Type	Layer Thickness (in)	Soil Texture No.	Total Porosity (Vol/Vol)	Field Capacity (Vol/Vol)	Wilting Point (Vol/Vol)	Initial Moisture [2] (Vol/Vol)
1	1	5.47		0.396	0.109	0.047	0.109
2	1	30		0.35	0.252	0.181	0.252
3	1	12		0.15	0.1	0.07	0.1
4	1	12		0.38	0.148	0.10	0.148
5	4	0.06					
6	3	0.2		0.75	0.747	0.4	0.75
7	1	12		0.35	0.252	0.181	0.252
8	1	72		0.457	0.131	0.058	0.131

Layer #	Layer Type	Sat. Hyd. Conductivity (cm/sec)	Drainage Length (ft)	Drain Slope (%)	Leachate Recirc. (%)	Recirc. to Layer (#)	Subsurface Inflow (in/yr)
1	1	3.1E-03					
2	1	4.1E-05					
3	1	1.3E-04					
4	1	1.4E-03					
5	4	5.0E-05					
6	3	5.0E-05					
7	1	1.0E-06					
8	1	1.0E-03					

Layer #	Layer Type	Geomembrane Pinhole Density (#/acre)	Geomembrane Instal. Defects (#/acre)	Geomembrane Placement Quality	Geotextile Transmissivity (cm^2/sec)
5	4			4	

Table F-15. HELP Model Input Data for Year 5,700 – After Subsidence (CIG12.D10).

Input Parameter (HELP Model Query)	Generic Input Parameter Value
Landfill area =	0.2686 acres
Percent of area where runoff is possible =	0%
Do you want to specify initial moisture storage? (Y/N)	Y
Amount of water or snow on surface =	0 inches
User-Specified Curve Number = 0	

Layer	Layer Number	Layer Type
Topsoil	1	1 (vertical percolation layer)
Upper Backfill	2	1 (vertical percolation layer)
Erosion Barrier	3	1 (vertical percolation layer)
Degraded Lat. Drainage Layer	4	1 (vertical percolation layer)
Degraded HDPE Geomembrane	5	4 (geomembrane liner)
Degraded GCL	6	3 (barrier soil liner)
Foundation Layer (1E-06)	7	1 (vertical percolation layer)
Foundation Layer (1E-03)	8	1 (vertical percolation layer)

Layer #	Layer Type	Layer Thickness (in)	Soil Texture No.	Total Porosity (Vol/Vol)	Field Capacity (Vol/Vol)	Wilting Point (Vol/Vol)	Initial Moisture [2] (Vol/Vol)
1	1	5.16		0.396	0.109	0.047	0.109
2	1	30		0.35	0.252	0.181	0.252
3	1	12		0.15	0.1	0.07	0.1
4	1	12		0.38	0.148	0.10	0.148
5	4	0.06					
6	3	0.2		0.75	0.747	0.4	0.75
7	1	12		0.35	0.252	0.181	0.252
8	1	72		0.457	0.131	0.058	0.131

Layer #	Layer Type	Sat. Hyd. Conductivity (cm/sec)	Drainage Length (ft)	Drain Slope (%)	Leachate Recirc. (%)	Recirc. to Layer (#)	Subsurface Inflow (in/yr)
1	1	3.1E-03					
2	1	4.1E-05					
3	1	1.3E-04					
4	1	1.4E-03					
5	4	5.0E-05					
6	3	5.0E-05					
7	1	1.0E-06					
8	1	1.0E-03					

Layer #	Layer Type	Geomembrane Pinhole Density (#/acre)	Geomembrane Instal. Defects (#/acre)	Geomembrane Placement Quality	Geotextile Transmissivity (cm^2/sec)
5	4			4	

Table F-16. HELP Model Input Data for Year 10,100 – After Subsidence (CIG13.D10).

Input Parameter (HELP Model Query)	Generic Input Parameter Value
Landfill area =	0.2686 acres
Percent of area where runoff is possible =	0%
Do you want to specify initial moisture storage? (Y/N)	Y
Amount of water or snow on surface =	0 inches
User-Specified Curve Number = 0	

Layer	Layer Number	Layer Type
Topsoil	1	1 (vertical percolation layer)
Upper Backfill	2	1 (vertical percolation layer)
Erosion Barrier	3	1 (vertical percolation layer)
Degraded Lat. Drainage Layer	4	1 (vertical percolation layer)
Degraded HDPE Geomembrane	5	4 (geomembrane liner)
Degraded GCL	6	3 (barrier soil liner)
Foundation Layer (1E-06)	7	1 (vertical percolation layer)
Foundation Layer (1E-03)	8	1 (vertical percolation layer)

Layer #	Layer Type	Layer Thickness (in)	Soil Texture No.	Total Porosity (Vol/Vol)	Field Capacity (Vol/Vol)	Wilting Point (Vol/Vol)	Initial Moisture [2] (Vol/Vol)
1	1	4.59		0.396	0.109	0.047	0.109
2	1	30		0.35	0.252	0.181	0.252
3	1	12		0.15	0.1	0.07	0.1
4	1	12		0.38	0.148	0.10	0.148
5	4	0.06					
6	3	0.2		0.75	0.747	0.4	0.75
7	1	12		0.35	0.252	0.181	0.252
8	1	72		0.457	0.131	0.058	0.131

Layer #	Layer Type	Sat. Hyd. Conductivity (cm/sec)	Drainage Length (ft)	Drain Slope (%)	Leachate Recirc. (%)	Recirc. to Layer (#)	Subsurface Inflow (in/yr)
1	1	3.1E-03					
2	1	4.1E-05					
3	1	1.3E-04					
4	1	1.4E-03					
5	4	5.0E-05					
6	3	5.0E-05					
7	1	1.0E-06					
8	1	1.0E-03					

Layer #	Layer Type	Geomembrane Pinhole Density (#/acre)	Geomembrane Instal. Defects (#/acre)	Geomembrane Placement Quality	Geotextile Transmissivity (cm^2/sec)
5	4			4	

Distribution:

timothy.brown@srnl.doe.gov
alex.cozzi@srnl.doe.gov
david.crowley@srnl.doe.gov
c.diprete@srnl.doe.gov
a.fellinger@srnl.doe.gov
samuel.fink@srnl.doe.gov
nancy.halverson@srnl.doe.gov
erich.hansen@srnl.doe.gov
connie.herman@srnl.doe.gov
patricia.lee@srnl.doe.gov
Joseph.Manna@srnl.doe.gov
john.mayer@srnl.doe.gov
daniel.mccabe@srnl.doe.gov
Gregg.Morgan@srnl.doe.gov
frank.pennebaker@srnl.doe.gov
Amy.Ramsey@srnl.doe.gov
William.Ramsey@SRNL.DOE.gov
michael.stone@srnl.doe.gov
Boyd.Wiedenman@srnl.doe.gov
bill.wilmarth@srnl.doe.gov
sebastian.aleman@srnl.doe.gov
paul.andrews@srs.gov
dan.burns@srs.gov
tom.butcher@srnl.doe.gov
kerri.crawford@srs.gov
Thomas.Danielson@srnl.doe.gov
kenneth.dixon@srnl.doe.gov
James.Dyer@srnl.doe.gov
peter.fairchild@srs.gov
gregory.flach@srs.gov
luther.hamm@srnl.doe.gov
thong.hang@srnl.doe.gov
tim.jannik@srnl.doe.gov
daniel.kaplan@srnl.doe.gov
steven.mentrup@srs.gov
verne.mooneyhan@srs.gov
ralph.nichols@srnl.doe.gov
Virgina.Rigsby@srs.gov
Jansen.Simmons@srs.gov
Frank.Smith@srnl.doe.gov
Brooke.Stagich@srnl.doe.gov
Ira.Stewart@srs.gov
Tad.Whiteside@srnl.doe.gov
Jennifer.Wohlwend@srnl.doe.gov
Records Administration (EDWS)