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Design Report:
Appendices D.3 through I

Cherry Island Landfill
Expansion Project
Wilmington, Delaware

prepared by:

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Appendix VIb-D.3

Landfill Stability Analyses - Dynamic Phases III to V

GEOSYNTEC CONSULTANTS

COMPUTATION COVER SHEET

Client: DSWA **Project:** Cherry Island **Project/Proposal #:** ME0250 **Task #:** 2.2.5

TITLE OF COMPUTATIONS Landfill Stability Analysis (Seismic) -- Phases III to V

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APPROVAL NOTES: The calculations presented herein are suitable for a landfill elevation of 195 ft-msl. As shown in this calculation package, the design was performed for a more conservative grading configuration than that shown in Drawing 78 entitled "Landfill Final Development and Grading Plan" (Appendix VIb-A).

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LANDFILL STABILITY ANALYSIS (SEISMIC) – PHASES III TO V

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Written by: Carlos Lazarte Date: 03/20/03 Reviewed by: R.D. Espinoza Date: 04/02/03

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LANDFILL STABILITY ANALYSIS (SEISMIC) – PHASES III TO V

1. INTRODUCTION

This calculation package presents an evaluation of the stability of the proposed expansion at Cherry Island Landfill (CIL) when subjected to seismic loading. The purpose of this calculation package is to verify that the proposed design of the final landfill configuration is adequate under seismic loading according to Section 5 "Sanitary Landfills" of the Solid Waste Regulations by the Delaware Department of Natural Resources and Environmental Control (DNREC, 2003).

The evaluation of the stability for seismic loading is based on the calculated permanent deformation of the proposed slopes that arise due to seismic loads. This criterion follows the current and accepted practice of solid waste facilities subjected to earthquake ground motions (e.g., Seed and Bonaparte, 1992; Bray and Repetto, 1994; Augello et al., 1995; Kavazanjian and Matasovic, 2001).

2. PROJECT BACKGROUND

In the proposed landfill expansion configuration, Phase I will remain unchanged, Phase II will remain essentially unchanged (except at its boundaries with Phases III to V, where it will be raised), and Phases III through V will be expanded vertically and horizontally. Whereas the maximum elevation in Phases I and II will remain basically the same, the maximum proposed elevation in Phases III to V are approximately 290 feet above mean sea level (ft-msl). The footprint of Phases III through V will be extended laterally typically about 200 feet toward the Delaware and Christina Rivers, and up to approximately 400 feet near the confluence of the Delaware and Christina Rivers (where the current sedimentation pond is located). A mechanically stabilized earth (MSE) berm ranging in height from about 10 to 60 ft will be constructed along the periphery of Phases III through V to increase stability. Prefabricated vertical drains (PVDs) will be installed around the perimeter of Phases III through V (under the proposed MSE berm and outside the proposed landfill footprint) to accelerate consolidation and thereby soil shear strength under the imposed berm and waste loads. These proposed configurations and subsurface conditions were considered in this seismic stability evaluation. Other geometry and soil conditions used in this calculation package were obtained from the calculation package entitled "Landfill Stability Analysis (Static)" - Phases III to V (Appendix VI.b-D.2).

3. SECTIONS FOR ANALYSIS

The cross sections selected for the landfill static stability analysis are considered for the seismic analysis. The selection of the cross sections for the static analysis is based on representative conditions at various locations that control stability including landfill geometry (e.g., maximum height, bench location, slopes, MSE berm configuration), foundation stratigraphy (e.g., location of soft layers, groundwater elevation), and other surface factors (e.g., distance to the river and wetlands). Of the eight sections analyzed for the static analysis (Sections C through K shown in plan view in Figure 1), the two most critical cross sections that provide the lowest factors of safety for the 37-year and long-term conditions (i.e., Sections E and H, shown in Figures 2 and 3, respectively) under static loads were selected for the analysis for seismic loads. Section E is on the eastern side of CIL (Phase III) and extends from the center of the landfill to the Delaware River. Section H is on the south boundary of Phase V and extends from the center of the landfill to the Christina River. These cross sections were selected for the seismic analysis because they exhibit a combination of geometric and subsurface conditions that resulted in the lowest safety factors for static conditions among all cross sections. For the same level of seismic forces, the seismic performance of a slope is expected to decrease as the static safety factor decreases.

4. DESIGN CRITERIA

It is widely recognized that the seismically induced permanent deformation is a more rational indicator of the seismic performance of a slope than the calculated factor of safety obtained in a pseudo-static stability analysis (e.g., Seed, 1979). Consequently, the criterion established in this calculation package to evaluate seismic stability relies on the assessment of the seismically induced permanent deformation. The current standard of practice is to consider satisfactory a permanent displacement of 12 inches or less in the slopes of waste repository facilities when considering seismically induced deformations (Seed and Bonaparte, 1992).

5. STRATIGRAPHY AND MATERIAL PARAMETERS

5.1 General

The same stratigraphy developed for the landfill static stability is used in the seismic stability analysis (see Appendix VIb-D.2). The stratigraphy is based on the information collected in the Geotechnical Characterization Report (GCR) [GeoSyntec, 2003]. The remainder of this

section discusses the soil parameters used in the stability analysis. A table at the end of this section summarizes the soil parameters used in the analysis.

5.2 Waste

Based on field measurement and comparison with other landfills, the unit weight of the waste is considered to vary as follows:

Depth (ft)	Total Unit Weight (pcf)
0 - 20	60
20 - 100	75
100 - 150	80
150 - 200	85
>200	90

In addition, the saturated unit weight of waste is assumed equal to 100 pounds per cubic foot (pcf).

5.3 Dredge/Alluvium

5.3.1 General

As discussed in the static stability calculation package, the alluvium and dredge are considered the same material for stability purposes. The average total unsaturated unit weight for the dredge/alluvium is 85 pcf while the average saturated unit weight is 97 pcf. At the CIL site, the shear strength in the dredge/alluvium is the controlling strength in most stability analysis. The strength depends on the amount of excess pore pressure that is dissipated during and after loading. In this analysis, three conditions are identified for the dredge/alluvium: (i) consolidated undrained parameters; (ii) partially consolidated undrained parameters; and (iii) drained parameters. A discussion of the strength parameters follows.

5.3.2 Consolidated Undrained Strength Parameters

This condition is applicable to the dredge/alluvium under the waste (outside the proposed PVD area) and in the river sediments, when rapid drainage in these deposits is not possible. In the case of rapid loading, such as seismic loading, it is reasonable to assume that consolidated undrained strength parameters are applicable to the dredge/alluvium in the PVD area below the

existing groundwater. Based on the characterization of this material presented in the GCR, the dredge/alluvium in this zone is normally consolidated. This undrained shear strength (S_u) of this material is modeled as a function of the existing vertical effective pressure (σ'_v) that has developed at this point in the dredge as:

$$S_u / \sigma'_v = 0.29 \quad (1)$$

5.3.3 Partially Consolidated Undrained Parameters

Partially undrained parameters that were used for the 37-year case (static stability) are used for the seismic evaluation during waste placement. Details of the evaluation of these parameters are described in detail in Section 5.3.3 of the calculation package entitled: "Landfill Stability Analysis (Static)-Phases III to V" (Appendix VIb-D.2).

5.3.4 Drained Parameters

Drained parameters are assumed for the dredge/alluvium above the dredge water level. The dredge/alluvium drained shear strength is modeled as a Mohr-Coulomb type envelope based on effective strength parameters obtained from laboratory testing as follows [GeoSyntec, 2003]:

Effective Normal Stress (psf)	Shear Stress (psf)	Effective Friction Angle (Degrees)
0 – 1,000	0 – 1,000	45
1,000 – 3,000	1,000 – 2,678	40
> 3,000	–	34

5.4 Reinforced Soil

The design of the CIL expansion considers materials that are not traditionally used for backfill of MSE berms. Materials being considered for backfill include reconditioned dredge and fly ash, which are relatively light and not so strong, but may be more cost-effective in this project than traditional engineered fill. Therefore, the MSE backfill is represented in the analysis with a unit weight of 90 lbs/ft^3.

5.5 Summary of Properties

A summary table of the soil parameters used in the analysis is provided below.

Material	Label[1]	Condition	Cohesion (psf)	Friction Angle (degrees)	Unit Weight (pcf)	Unit Weight Saturated (pcf)
Waste	Waste (0 to 20)	Drained	0	33	60	100
	Waste (20 to 100)				75	
	Waste (100 to 150)				80	
	Waste (150 to 200)				85	
	Waste (> 200)				90	
Dredge/ Alluvium	Drained PVD Area	Drained	0	34[2]	85	97
	River Sediments, Wetlands, Undrained PVD Area, Undrained Dredge	Consolidated Undrained	0.29 σ'_v	-		
	d11, d12, d13, thorough d56	Partially Consolidated	0.29 σ'_v (t) [3]	-		
Columbia	Columbia Formation	Drained	0	40	–	125
Potomac Formation	Potomac Formation	Undrained	4,500[4]	–	120	120
		Drained	–	21		
MSEB	MSE Wall Soil	Drained	0	29	90	90

(1) Label used for SLIDE analysis (see Figure 3)
(2) Dredge drained parameters is an envelope with a slope of 34 degrees for effective stresses greater than 3,000 psf.
(3) The effective overburden pressure (σ'_v) is a function of time (t), and it is calculated in the calculation package entitled, "Evaluation of the Partially Consolidated Undrained Parameters," (Appendix VIb-D.1). The values used for each of the cross sections are presented in Table 1.
(4) Minimum undrained strength is 4,500 psf and increases with depth.

6. WATER TABLE/LIQUID LEVELS

The water level position in the dredge/alluvium for the seismic stability analysis is selected as the steady-state, long-term elevation, which is controlled largely by the elevation of the water surface in the Delaware and Christina Rivers and the amount of liquids in the waste. As mentioned earlier, the materials that control the stability of the proposed landfill configuration

are the dredge and alluvium. As these materials are modeled as undrained during seismic loads, the location of the water level does have a great influence in the calculation of the factors of safety except for the value of the unit weight. The water table in the different deposits was considered in the seismic stability analysis as follows:

- *In the PVD area*: The proposed PVDs will connect the dredge/alluvium with the Columbia Formation, which is in turn, hydraulically connected to the Delaware and Christina Rivers. As a consequence, water level of the dredge/alluvium within the PVD area is ultimately controlled by the mean water surface elevation of the Delaware River, which is at 3 ft-msl. In this area, the water level is assumed to be at elevation 5 ft-msl, which corresponds to the groundwater elevation of the Columbia Formation around the perimeter berm.

- *Outside the PVD area (river side and wetland areas)*: The water level in this area is also controlled by the water surface elevation in the rivers. In this area the water level is also assumed to be at elevation 5 ft-msl. The water level in wetland areas is assumed to be at the ground surface.

The piezometric level in the Columbia and Potomac Formations is assumed to be equal to the assumed liquid levels in the dredge/alluvium. This assumption is conservative, particularly under the landfill, where the piezometric level in the Columbia and Potomac Formations is likely to be less than the water level in the dredge/alluvium.

7. SEISMIC LOADS

7.1 General

Current solid waste regulations in Delaware (DNREC, 2003) require that any new landfill cell, if located in a seismic impact zone, should be designed to resist the maximum horizontal acceleration (*MHA*) occurring in bedrock at the site. An impact zone is defined as the zone where the MHA in bedrock (e.g., lithified material) is greater than 0.10g, where "g" is the gravity acceleration. The MHA is taken as the peak ground acceleration that has 90 percent probability of not being exceeded in 250 years, or equivalently, 10% probability of being exceeded in 250 years [i.e., the probability of exceedance (P_e) is equal to 10% in 250 years). This risk level corresponds to a rare, extreme seismic event for design, which is applicable to the long-term landfill configuration. In this calculation package, the 37-year landfill configuration, which is a

temporary condition, is also considered in the seismic analysis. Accordingly, the following two scenarios for seismic loads are considered:

(a) **an extreme seismic event.** This event is the seismic risk level defined in DNREC (2000), which is applied to the long-term landfill configuration and soil conditions. This is an extreme seismic event that generates infrequent but relatively high ground motion levels. The MHA = 0.1g , [defined by DNREC (2000)] event at the CIL site has a probability of exceedance (P_e) of 10 percent in 250 years and a relatively long return period (T_R), at 2,475 years. The MHA values for this seismic event are selected from National Seismic Maps (see Section 7.2 below). Note that National Seismic Maps present acceleration values for a seismic event having 2% probability that the MHA will be exceeded in 50 years (i.e., P_e = 2% in 50 years); however, a seismic risk level of P_e = 2% in 50 years is approximately statistically equivalent to the extreme seismic event (i.e., P_e = 10% in 250 years) as this level has a return period T_R = 2,375 years.

(b) **a lower-magnitude seismic event.** This seismic event is applied to the temporary 37-year landfill configuration and soil conditions. It is not statistically justifiably to apply the extreme seismic event, which is rare event with a long return period, during the comparatively short period when landfilling takes place (i.e., less than 40 years). Consequently, it is more reasonable to apply a seismic event that is more frequent but produces smaller MHA values for these temporary situations. This selected seismic event has a 10% probability that the MHA will be exceeded in 50 years (i.e., P_e = 10% in 50 years, and T_R = 475 years). This lower seismic risk level is considered conservative for the 37-year landfill configuration.

Seismic loads during the short period of time in which the MSE berm will be constructed (approximately two years) are not considered because the expected MHA values for such a short exposure time are extremely low in this region.

In addition, current Delaware regulations require that no landfill shall be constructed within 200 ft of a fault that had displacement during Holocene time. There is no indication of a fault has been displaced during Holocene time within 200 ft of the CIL site. Therefore, this requirement is met.

7.2 Site Maximum Horizontal Acceleration (MHA) in Lithified Material

The MHA expected to occur on the site in lithified material is estimated using calculated spectral acceleration values developed by the National Seismic Hazard Mapping Project (Frankel

et al., 1997 and 2002) for the entire United States (Figure 4). The latest version of the U.S. Geological Service (USGS) national seismic maps supersedes previous seismic maps [e.g., Algermissen et al. (1982) and Algermissen (1991)]. To increase the accuracy with which the USGS seismic maps were developed, MHA and spectral accelerations values are presented in a latitude-longitude grid that is spaced 0.1 degrees in each direction (http://geohazards.cr.usgs.gov/eq/).

The MHA values at CIL were calculated by using the site coordinates of latitude 39°43'30"N and longitude 75°30'50"W, extrapolating the MHA values from the closest four grid points surrounding CIL, and applying a weighted average method. For the P_e = 2% in 50 years level (i.e., equivalent to the P_e = 10% in 250 years level), the MHA in rock is 0.141g. A table containing the values of MHA gridded by latitude and longitude for the P_e = 2% in 50 years (as obtained from the USGS site) are included in Attachment A. For the P_e = 10% in 50 years level, the peak ground acceleration in rock is obtained as MHA = 0.035g. A table with the MHA values for P_e = 10% in 50 years is included in Appendix A. It is noted that as the calculated MHA is greater than 0.1g, the site is considered to be located within an impact zone.

7.3 Maximum Horizontal Acceleration in the Waste

7.3.1 Overview

The maximum horizontal acceleration at the base of the landfill must be computed considering the propagation of seismic waves from the bedrock, through the Potomac and Columbia Formations, alluvium, and dredge, to the base of landfill. A simplified method developed by Bray et al. (1998) is used. This method takes into account the most important variables affecting the landfill seismic response, including the size of the potentially unstable waste mass, the shear-wave velocity in waste, and the mean period (i.e., comparable to predominant period) of the ground motion. The simplified method consists of the following steps:

1. Ground motions characterization;
2. Development of seismic loading; and
3. Evaluation of seismic performance through seismic displacements.

A description of each of these steps is presented below.

7.3.2 Ground Motions Characterization

The evaluation of the ground motion characterization involves the following steps: (a) review of regional geology and seismicity; (b) selection of ER magnitude and distance to EQ source; and (c) estimation of MHA in rock and mean period of representative ground motions. A description of each of these steps is presented below.

(a) **Review of regional geology and seismicity:** A review of the regional and site geology [e.g., as contained in the GCR GeoSyntec (2003) and seismicity as cited in Anonymous (1971), Woodruff (1984), Jordan et al. (1972), Baxter (2000a and 2000b)] indicate that there are no identifiable earthquake sources in the adjacency of the site. However, a catalog of earthquakes in Delaware Baxter, 2000a indicates that a relatively large number of low to moderate magnitude (i.e., $M_w \approx 3$ to 4) have been felt or recorded since 1871 through the 1970's in the city of Wilmington.

(b) **Selection of earthquake magnitude and distance to earthquake source.** Due to the relatively high local seismicity and the large distances of other large earthquake sources from the site, the seismic risk around Wilmington is dominated by low to moderate magnitude earthquakes occurring within a short distance. A graphical representation of the disaggregated seismic hazard around Wilmington (Figure 5) shows that low- to moderate-magnitude earthquakes (i.e., $M_w \leq 6.5$) and originated at a distance (R) less than 35 km (22 miles) contribute most to the total seismic risk of the peak ground acceleration. For example, earthquakes with a magnitude $4.5 \leq M_w \leq 6.5$ and originated within 35 km contribute approximately 70 percent of the total seismic risk. Conversely, distant and more capable earthquakes (i.e., $6.6 \leq M_w \leq 7.5$ and 25 km $\leq R \leq$ 300 km) only contribute approximately 11 percent to the total seismic risk. Figure 6 shows a similar trend for the disaggregated seismic hazard for the 0.2-sec. spectral acceleration with $P_e = 2\%$ in 50 years around Wilmington.

(c) **Estimation of MHA in Rock and mean period (T_m) of ground motions.** The maximum horizontal acceleration occurring in bedrock at the site (MHA_{Rock}) were previously obtained from national seismic maps as:

$MHA_{Rock} = 0.141$g ($P_e = 2\%$ in 50 years); and
$MHA_{Rock} = 0.035$g ($P_e = 10\%$ in 50 years)

The mean period (T_m) for representative ground motions can be evaluated using correlations presented by Rathje et al. (1998) for stable continental North American regions including the

Eastern United States. From Figure 7, the mean period varies approximately between 0.22 and 0.29 sec for a representative range of magnitude ($6 \leq M_w \leq 6.5$) and distance ($6 \leq R \leq 30$ km) that dominate the seismicity in the Wilmington area. In addition, it is assumed conservatively that the duration of the significant ground motion, $D_{5\text{-}95}$, (i.e., time during which the vibratory energy of the ground motion is between 5 and 95 percent of the total energy) is 20 seconds. It is estimated that this duration is a very conservative assumption for the critical design magnitude range of 6.0 to 6.5 [e.g., see T_m values for higher M_w in Rathje et al. (1998)] and a local seismic event.

7.3.3 Development of Seismic Loading

The development of seismic loading involves the following four steps:

(a) **Calculation of shear wave velocity of waste.** The shear wave velocity (v_s) has been measured at the site during the 2002 geotechnical investigation conducted for the CIL expansion (GeoSyntec, 2003) and in a 1998 investigation. During the 2003 investigation, nine (9) Spectral Analysis of Surface Waves (SASW) surveys were conducted from the surface of the waste in Phases I through V, and two SASW surveys were conducted from the existing perimeter berm. The location of the seismic surveys is shown in Figure 8. Although the main objective of the SASW surveys was to measure indirectly the magnitude and distribution of the waste unit weight, their results provide valuable shear wave velocity information. A complete SASW results report is included in the GCR appendix P. In 1998, five Seismic Cone Penetration Tests (SCPT) were performed along the perimeter berm. The locations of the SCPTs are also shown in Figure 8.

Figure 9 presents profiles of the different shear wave measurements conducted in the waste and perimeter berm. This figure indicates that the shear wave velocity in the waste varies between approximately 160 and 400 feet per second (fps) up to a depth of about 50 feet. The figure also shows that the dredge and alluvium exhibit a shear wave velocity (below the desiccated crust) varying between 250 and 600 fps. Because shear wave measurements at CIL are limited to the current waste depth of about 50 ft, it was necessary to estimate the shear wave velocity profile for the approximately 250-ft thickness of the final proposes configuration from the other landfills.

Figure 10 shows v_s profiles for waste and the underlying soils. Figure 10 also shows the trend of both measured (up to about 50 ft depth) and estimated v_s values for waste.

The mean v_s values obtained at CIL were compared with those obtained in other landfills [e.g., OII landfill in southern California as presented by Kavazanjian et al. (1996)]. Figure 10 indicates that the trend of mean shear wave velocities in waste at CIL tend to be on the low side of v_s profiles from the OII landfill. A slightly higher and more conservative (from the seismic response viewpoint) estimate of the v_s profile in waste is adopted for CIL. This estimate is designated as "recommended curve" in Figure 10.

(b) **Calculation of the landfill predominant period.** The predominant period (T_s) is obtained for various profiles of waste with varying depth (H). The depth range considered in the analysis varied from 100 to 250 feet, which was representative of the thickness of the potentially sliding mass of waste bounded by the most critical surface obtained in the static stability analysis for the 37-year and long-term configurations. A waste depth of 150 ft is representative of the depth of the center of gravity of the potentially sliding mass.

The predominant period was calculated with the well-known expression for the response of horizontal deposits:

$$T_s = \frac{4H}{v_{s\ average}} \tag{2}$$

where $v_{s\ average}$ is the average shear wave velocity for the waste column of depth H. Calculated values of the predominant periods were computed as:

Waste Depth, H	Average shear wave velocity, $v_{s\ average}$	Predominant period, T_s
(ft)	(fps)	(sec)
100	620	0.64
150	680	0.89
200	720	1.11
250	760	1.31

(c) **Estimation of the seismic amplification.** The simplified method allows estimating the non-linear amplification of seismic waves through the use of a non-linear response factor (NRF), which depends solely on the magnitude of MHA_{Rock}. For the two seismic scenarios considered, NRF was obtained from the inset in Figure 11 as:

for MHA_{Rock} = 0.141g, NRF = 1.28 (P_e = 2% in 50 years); and
for MHA_{Rock} = 0.035g, NRF = 1.43 (P_e = 10% in 50 years).

(d) **Calculation of the equivalent maximum equivalent acceleration in waste.** The complex dynamic response of the waste can be conveniently expressed as an equivalent maximum equivalent acceleration (*MHEA*), which can be idealized as acting at the center of gravity of the column of waste being considered. Normalized response curves of $MHEA$ / ($MHA_{Rock} \times NRF$) were obtained by Bray et al (1998) for the mean and the levels of 16th and 84th percentiles in the probability of exceedance of the cases studied by others. In these analyses, the values at the 16th percentile were conservatively selected. Two cases of potential slippage can be analyzed with these curves: one at the base of the landfill and one through the top of the landfill (see Figure 11). In addition, the method establishes that the response of the final cover system is 25 percent larger than that of the top of the landfill to account for 2-dimensional effects.

For the case of the landfill sliding through the base, the values of *MHEA* were obtained for the range of ground motion mean periods described previously. For the range of variables considered above, the ratio T_s/T_m falls between approximately 3 for shallow waste columns and 6 for deep waste columns. For the case of the depth to the center of gravity (i.e., H = 150 ft), the ratio T_s/T_m falls between 3 and 4, and the normalized value $MHEA$ / ($MHA_{Rock} \times NRF$) is obtained for the base of the landfill. From Figure 11 (top part), the normalized values of $MHEA_{Base}$ were obtained as:

$MHEA_{Base}$ = 0.25 to 0.31 × $MHA_{Rock} \times NRF$, and
$MHEA_{Base}$ = 0.045g to **0.057g** (P_e = 2% in 50 years); and
$MHEA_{Base}$ = 0.013g to **0.016g** (P_e = 10% in 50 years).

For the case of the top of landfill response, the normalized values of $MHEA_{Top}$ were obtained from Figure 11 (bottom part) as:

$MHEA_{Top}$ = 0.73 to 0.81 × $MHA_{Rock} \times NRF$, and
$MHEA_{Top}$ = 0.133g to **0.148g** (P_e = 2% in 50 years); and
$MHEA_{Top}$ = 0.037g to **0.041g** (P_e = 10% in 50 years).

For the final cover system, the MHEA values are calculated as 25 percent larger than the $MHEA_{Top}$ values; therefore, it results:

$MHEA_{Cover}$ = 0.166g to **0.185g** (P_e = 2% in 50 years); and
$MHEA_{Cover}$ = 0.046g to **0.051g** (P_e = 10% in 50 years).

In all cases, the upper bounds of maximum *MHEA* (in bold) were conservatively adopted for further analysis.

7.3.4 Evaluation of Seismic Performance through Seismic Displacements

The simplified method used herein also relies on the evaluation of the seismically induced permanent deformation to assess the seismic performance of landfills. In this procedure, it is assumed that a critical slide mass will develop above a well defined failure surface. The method provides estimates of permanent deformation as a function of magnitude M_w and the ratio of k_y/k_{max}, where k_y is the yield acceleration and k_{max} is the maximum average acceleration coefficient of the sliding mass above the failure surface. The parameter k_{max} is equivalent to *MHEA/g*. The procedure assumes that the materials being affected by the ground motions do not lose significant strength during seismic loading. Seismic displacements are evaluated at the top and bottom of the landfill.

Bottom of Landfill (Liner System):

At the base of the landfill, the yield acceleration is conservatively estimated as the yield acceleration for the critical failure surface that passes through the dredge/alluvium (i.e., immediately below the base of the landfill). The yield acceleration for the 37-year and long-term conditions are estimated as follows:

1. Select the most static critical failure surface (i.e., the one with the lowest factor of safety)
2. For the most critical surface:
   a. For the 37-year case: Modify the shear strength parameters of the dredge/alluvium below the liquid levels in the PVD area and set it equal to the partially consolidated undrained strength parameter
   b. For the long-term conditions: Change the strength parameters of the saturated fine-grain soils (i.e., dredge/alluvium below the liquid levels in the PVD area, the river sediment, the dredge/alluvium under the waste) from drained to normally consolidated strength parameters.
3. For the critical failure surface determined in step 1 and the modified shear strength parameters determined in step 2, select the horizontal acceleration coefficient that yields a factor of safety equal to one.

The evaluation of the yield acceleration following the steps outlined above is presented in Attachments B and C for cross sections E and H, respectively. The yield accelerations at the base of the landfill for 37-year case and long-term condition are summarized in the table below.

Section	Condition (Block Analysis)	k_y	k_{max}	k_y/k_{max}	P_e
H-H	37-year	0.016	0.016	1.0	10% in 50 yr
	Long-Term	0.081	0.057	1.4	2% in 50 yr
E-E	37-year	0.004	0.016	0.25	10% in 50 yr
	Long-Term	0.084	0.057	1.47	2% in 50 yr

The seismically induced permanent deformations (U_{max}) are obtained from Figure 12. Entering the most critical k_y/k_{max} ratios (i.e., Section E-E), the following permanent displacements are obtained (see section 7.3.2 for the value of $D_{5\text{-}95}$):

$U_{max}/(k_{max} \times D_{5\text{-}95}) = 220$ (P_e = 2% in 50 years); and
$U_{max}/(k_{max} \times D_{5\text{-}95}) = << 0.1$ (P_e = 10% in 50 years).

Therefore,

$U_{max} = 220 \times 0.016 \times 20 = 70$ mm = 2.8 in. (P_e = 10% in 50 years); and
U_{max} = negligible (P_e = 2% in 50 years).

Top of Landfill (Final Cover System):

The yield acceleration is calculated at the top of the landfill with expressions presented below (Shewbridge, 1997; Bray et al, 1998).

$$k_y = \tan(\phi - \beta) + \frac{c}{\gamma H \cos^2(1 + \tan\phi \tan\beta)} \quad (4)$$

where: ϕ = internal friction angle of the cover soil; β = slope angle of the cover (measured from the horizontal); c = cohesion of the cover soil; γ = total unit weight of the cover soil; and H = height of the sliding mass of waste. In the static stability analysis, it was assumed conservatively that $\phi = 33$ degrees and $c = 0$; therefore, $k_y = \tan(33 - 18.4) = 0.26$.

With the value of k_y calculated above, the following ratios are obtained for the cover:

$k_y/_{kmax} = k_y/MHA_{Cover}$ = 0.26/0.185 = 1.41 (P_e = 2% in 50 years); and
$k_y/_{kmax}$ = 0.26/0.051 = 5.1 (P_e = 10% in 50 years).

For the top of the siding mass, it can be seen from Figure 12 that the seismically induced permanent deformations are negligible for any magnitude level.

Summary

In summary, the expected range of seismically induced permanent deformations is negligible for the 37-year scenario (i.e., P_e = 10% in 50 years) both at the base and the top of the potentially sliding mass. For the long-term conditions (i.e., P_e = 2% in 50 years) and using the most conservative assumptions, the seismically induced permanent deformations are expected to be negligible at the top of the landfill and between negligible to small at the base (i.e., 25 to 50 mm). The range between 150 to 300 mm is considered moderate based on observations of landfill performance during earthquakes in this country and abroad (Bray et al, 1998). The maximum estimated value of seismically induced permanent displacement of 2.8 inches is smaller than the limiting value of 12 inches, established by the standard practice (e.g., Seed and Bonaparte, 1992). It is emphasized that this value corresponds to a displacement in the dredge, not within the landfill.

The estimated 2.8 inches would occur at the base of the sliding mass within dredge/alluvium deposit. Therefore, no component of the landfill would be affected by this small deformation. At the top of the landfill, where landfill gas mains and pipes and other appurtenant structures are located, the effect of the seismically induced deformation is negligible. Based on these considerations, the proposed configuration is considered satisfactory to sustain the expected seismic loads at the site.

8. CONCLUSIONS

An evaluation of the response of the proposed configuration for the CIL expansion under seismic loads was conducted. The evaluation was based on the assessment of the seismically induced permanent deformation of the proposed slopes. Two scenarios were considered, one for the long-term conditions (using relatively high values for the ground acceleration) and one for the 37-year conditions (with smaller ground accelerations than for the long-term case). The permanent displacement of the slopes was estimated using a simplified methodology developed by Bray et al. (1998) and using conservative assumptions. The estimated values of the seismically induced permanent displacement are always negligible for the 37-year scenario. At the top of the proposed slope, the seismically induced displacement is estimated to be negligible for the long-term conditions. For the most conservative assumptions, the expected seismically induced permanent deformation at the base is negligible to small for the more stringent long-term seismic loads. This range of seismically induced displacement is much smaller than the limit accepted by the standard practice. As no component of the landfill would be affected by the small amount of seismically deformation expected at the site, the proposed configuration is considered satisfactory to sustain the expected seismic loads and thereby satisfies the current Delaware regulations. In addition, the CIL is not within 200 ft of an active fault (one that ruptured during Holocene time), the proposed configuration meets all current DNREC regulations.

9. REFERENCES

Algermissen, S. T., Perkins, D. M., Thenhaus, P. C., Hanson, S. L. and Bender, B. L., (1982) "Probabilistic estimates of maximum acceleration and velocity in rock in the contiguous United States," Open File Report 82-1033; U.S. Geological Survey; Washington, D.C, 99 p.

Algermissen, S.T. (1991). "Probabilistic Earthquake Acceleration and Velocity Maps for the United States and Puerto Rico," U.S. Geological Survey Miscellaneous Field Study Map MF- 2120.

Anonymous (1971) in Earthquake Information Bulletin, May - June, Vol. 3, No. 3.

Augello, A.J., Matasovic, N. Bray, J.D., Kavazanjian, E., Jr., and Seed, R.B. (1995) "Evaluation of Solid Waste Landfill Performance During the Northridge Earthquake," In: Earthquake

Design and Performance of Solid Waste Landfills, ASCE Geotechnical Special Publication No. 54, pp. 17-50.

Baxter, S.J. (2000) "Catalog of earthquakes in Delaware," Open File Report No. 42, Delaware Geological Survey, University of Delaware, Newark, Delaware.

Baxter, S.J. (2000) "Earthquake Basics," Open File Report No. 23, Delaware Geological Survey, University of Delaware, Newark, Delaware.

Bray, J. D., Rathje, E. M., Augello, A. J., and Merry, S. M., (1998)"Simplified Seismic Design Procedure for Lined Solid-Waste Landfills," Geosynthetics International Journal, Vol. 5, Nos. 1-2, pp. 203-235.

Bray, J.D. and P. C. Repetto, (1994). "Seismic Design Considerations for Lined Solid Waste Landfills", Journal of Geotextiles and Geomembranes, International Geotextile Society, Vol.13, No. 8, pp. 497-518, August.

DNREC (2000). "Solid Waste Regulations," Delaware Department of natural Resources and Environmental Control, Solid & Hazardous Waste Management Branch, Dover.

Frankel, A.D., C. S. Mueller, T. P. Barnhard, E. V. Leyendecker, R. L. Wesson, S. C. Harmsen, F. W. Klein, D. M. Perkins, N. C. Dickman, S. L. Hanson, and M. G. Hopper (2000), "USGS national seismic hazard maps," in Earthquake Spectra, Earthquake Engineering Research Institute, Vol. 16, No. 1, February, pp. 1-19.

Frankel, A.D., Mueller, C., Barnhard, T., Perkins, D., Leyendecker, E. V., Dickman, N., Hanson, S., and Hopper, M. (1997) "National 1996 Seismic Hazard Maps," U.S. Geological Survey, Open-File Report 97-131.

GeoSyntec Consultants (2003) "Geotechnical Characterization Report - Cherry Island Landfill Expansion Project," Prepared for Delaware Solid Waste Authority, March 2003.

Jordan, R. R., Pickett, T. E., and Woodruff, K. D., (1972) "Preliminary report on seismic events in northern Delaware," Delaware Geological Survey Open File Report No. 2, p. 15.

Kavazanjian, E. Jr., and Matasovic, N. (2001), "Seismic Design of Mixed and Hazardous Waste Landfills," State of the Art Paper No. 11, Proc. 4th International Conference on Recent Advances in Geotechnical Earthquake Engineering, University of Missouri, Rolla, 27-31 March, San Diego, California, on CD ROM.

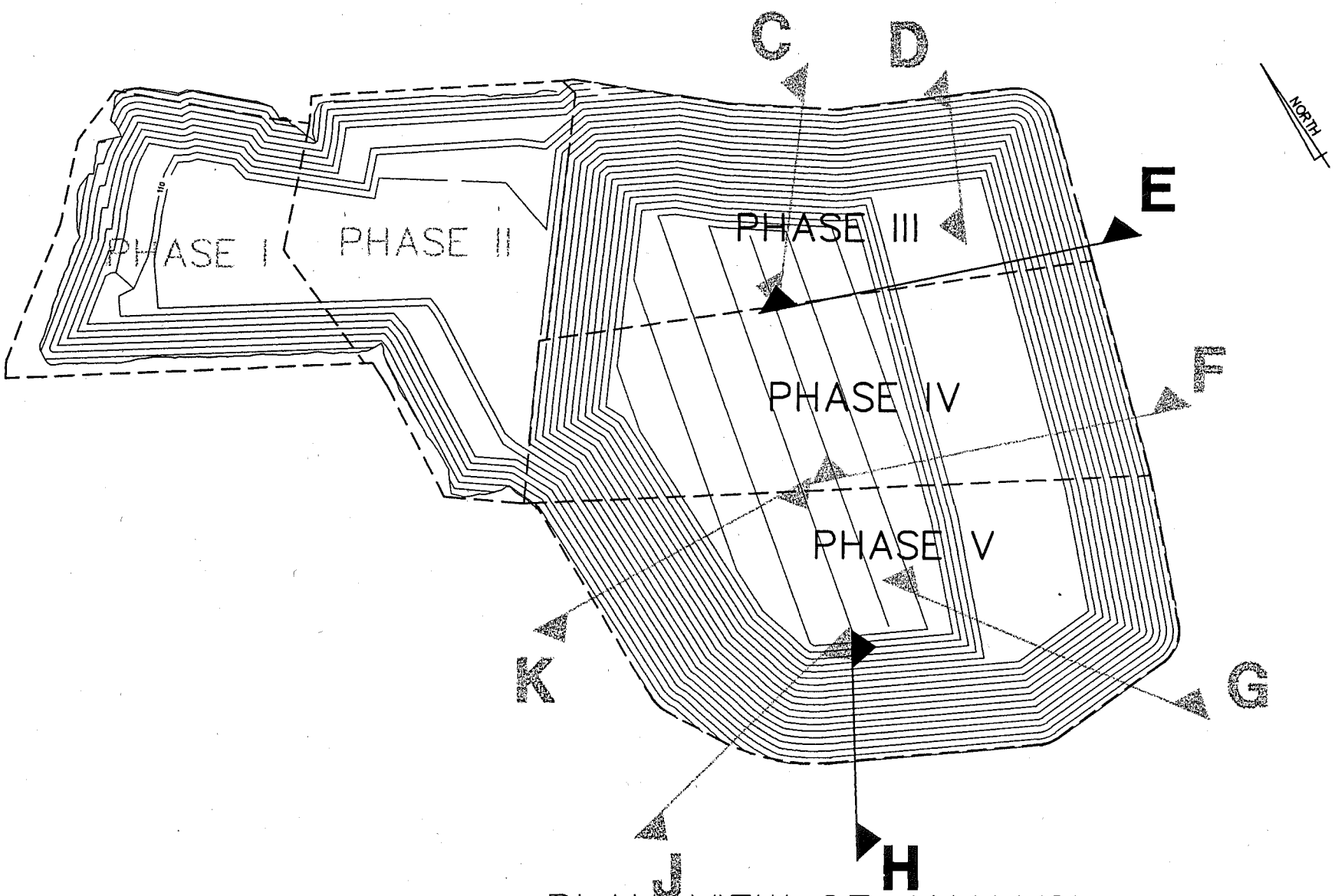
Rathje, E.M.; Abrahamson, N.A., and Bray, J.D. (1998) "Simplified frequency content estimates of earthquake ground motions," Journal of Geotechnical and Geoenvironmental Engineering, American Society of Civil Engineers, Vol. 124, No. 2, pp.150-159.

Seed, R.B., Bonaparte, R. (1992). "Seismic analysis and design of lined waste fills: current practice," Proceedings of the ASCE Special Conference on Stability and Performance of Slopes and Embankments - II, ASCE, (Berkeley, California).

Shewbridge, S. (1996) "Yield Acceleration of Lined Landfills," Journal of Geotechnical Engineering, American Society of Civil Engineers, Vol. 122, No. 2, pp.156-158.

Woodruff, K. D. (1984) "Earthquakes in Delaware and nearby areas from June 1974 through June 1984," Delaware Geological Survey Report of Investigations No. 39, p. 35.

FIGURES



PLAN VIEW OF ANALYSIS SECTIONS

450 225 0 450

SCALE: 1" = 450'

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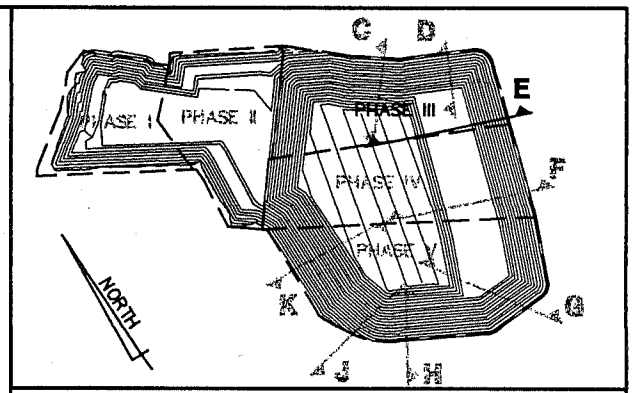
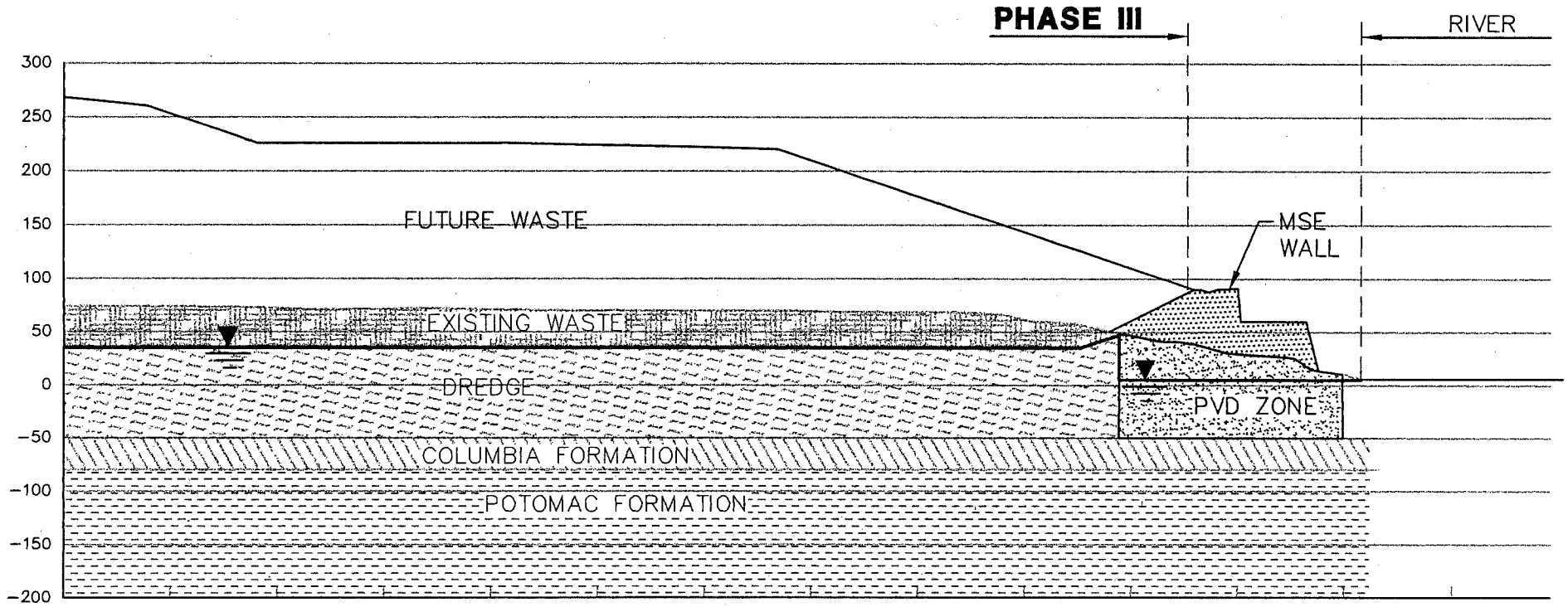
FIGURE NO.	1
PROJECT NO.	ME0250
DOCUMENT NO.	
FILE NO.	0250F609-2

SECTION E

STA 50+00



KEY MAP



150 75 0 150

SCALE: 1" = 150'

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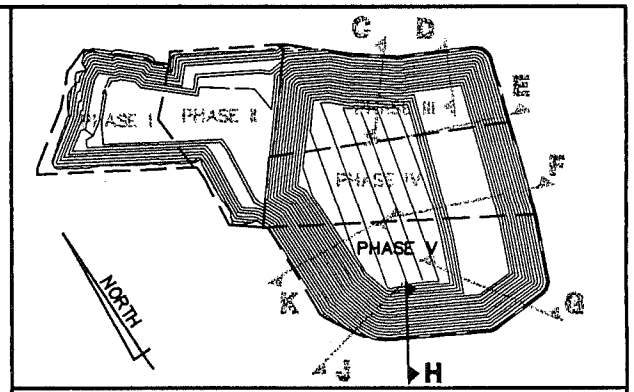
COLUMBIA, MARYLAND

FIGURE NO.	2
PROJECT NO.	ME0250
DOCUMENT NO.	
FILE NO.	0250F609-2

SECTION H

STA 83+00



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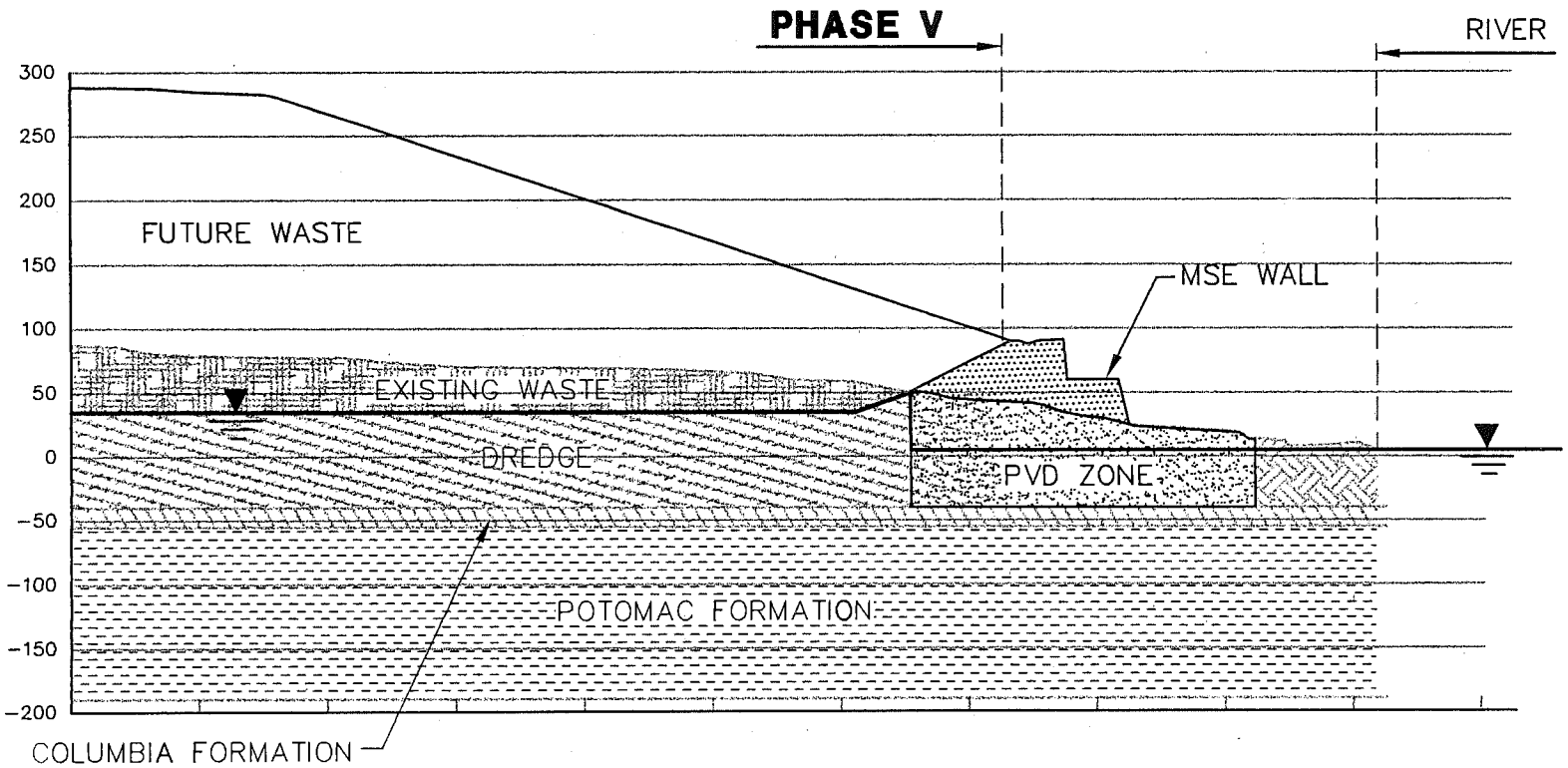


150 75 0 150

SCALE: 1" = 150'

GEOSYNTEC CONSULTANTS

COLUMBIA, MARYLAND

FIGURE NO.	3
PROJECT NO.	ME0250
DOCUMENT NO.	
FILE NO.	0250F609-2

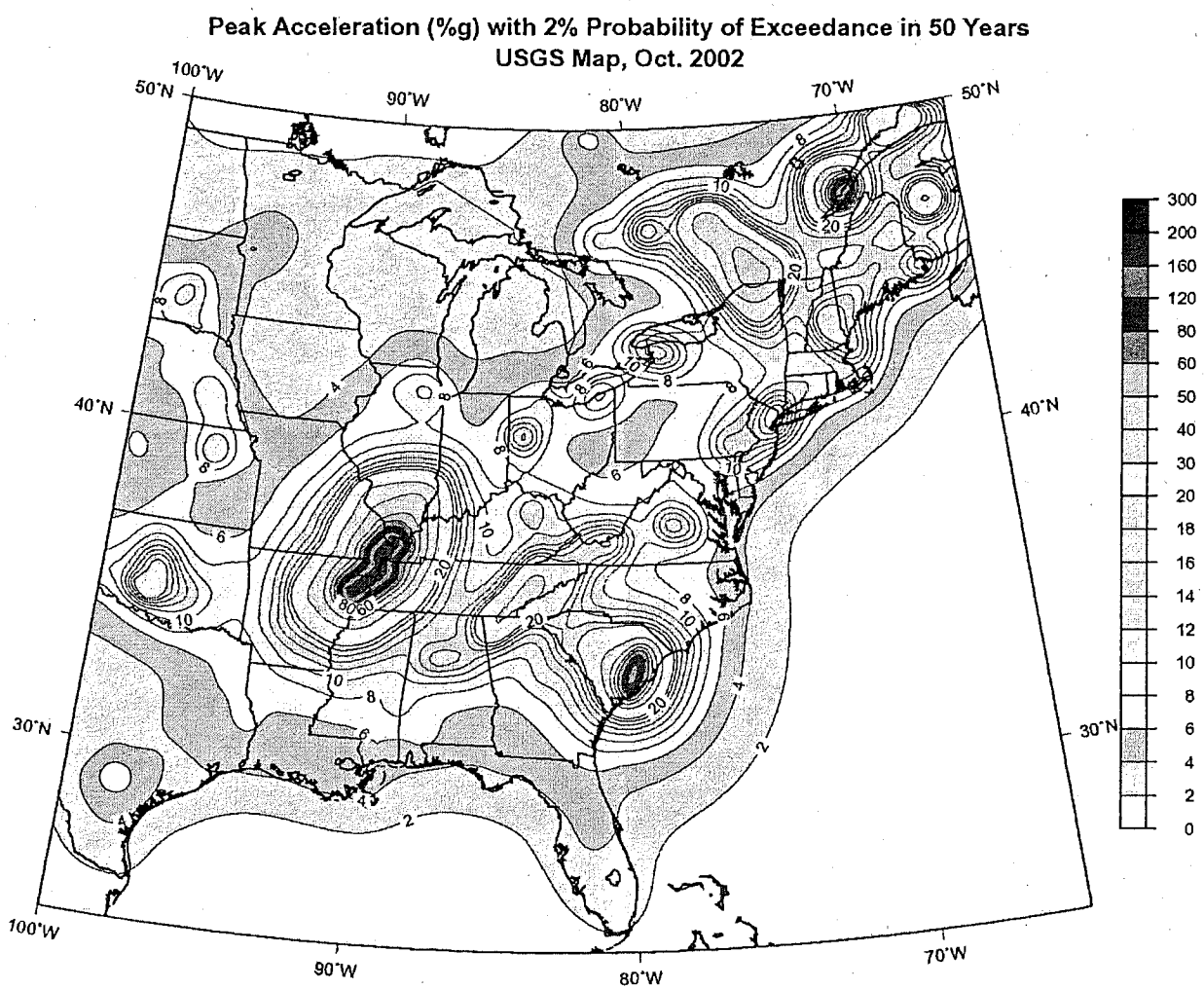


Figure 4: USGS National Seismic Map for the Eastern United States showing the Peak Ground Acceleration (%g) with 2% Probability of Exceedance in 50 Years.

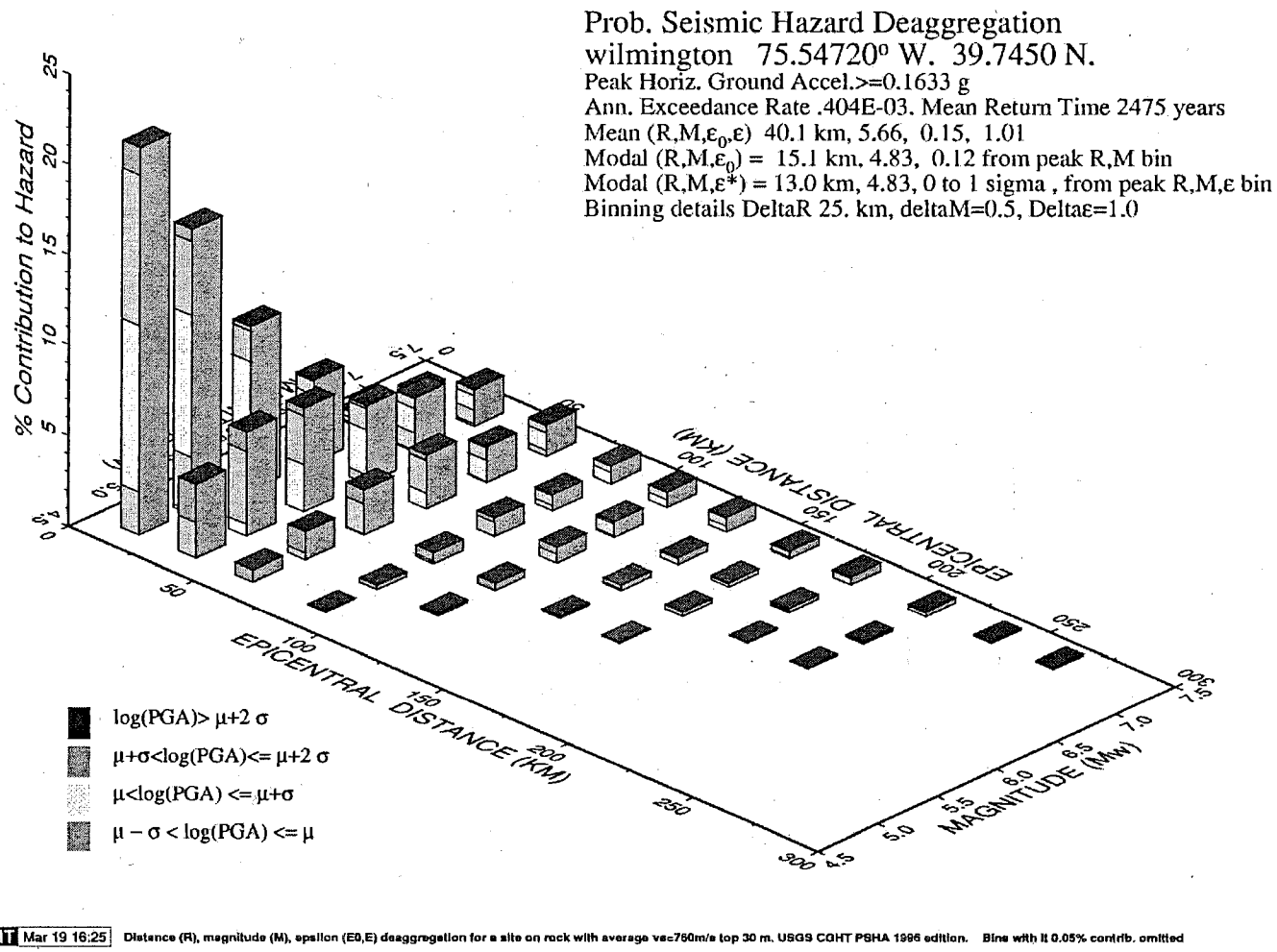


Figure 5: Disaggregated seismic hazard around the Wilmington for the peak ground acceleration with 2% Probability of Exceedance in 50 Years (1996 version)

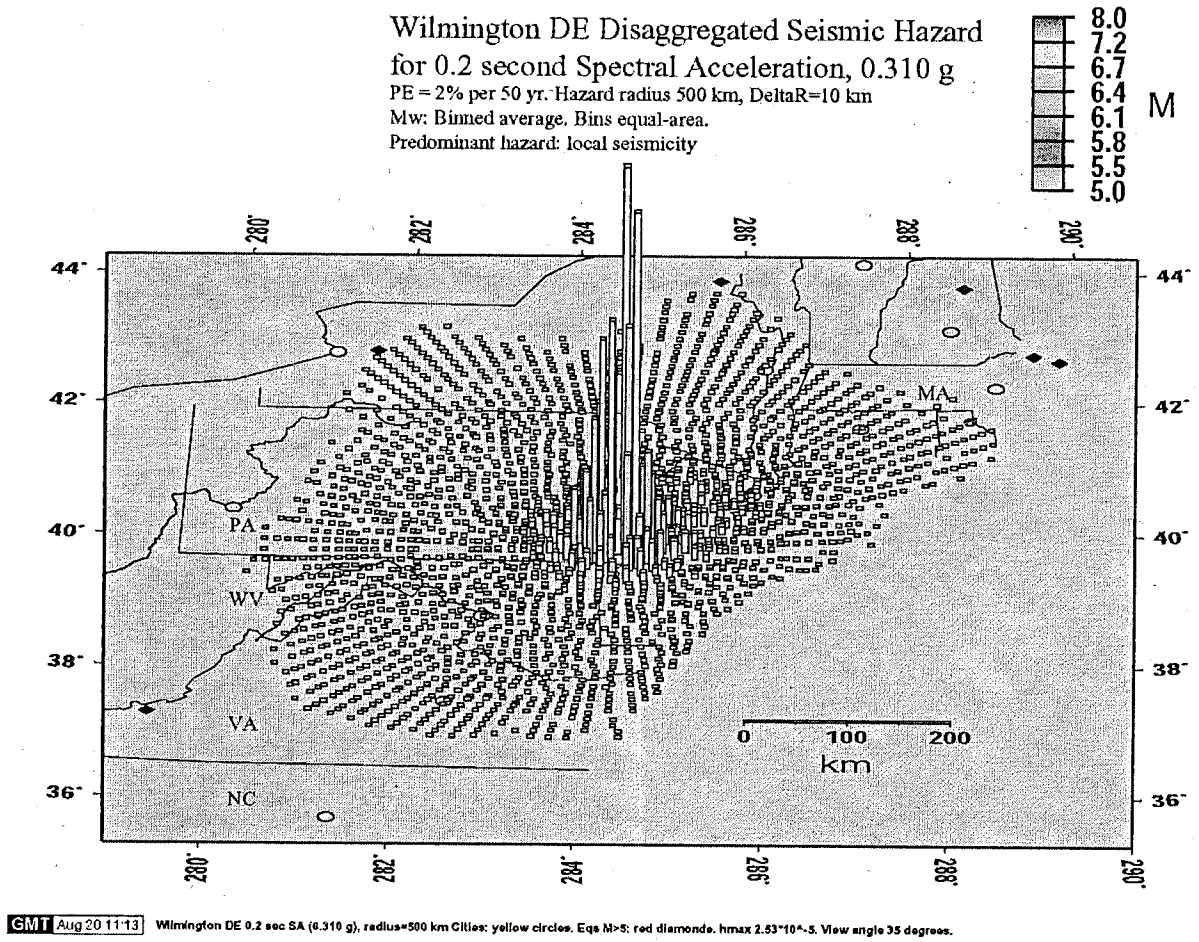
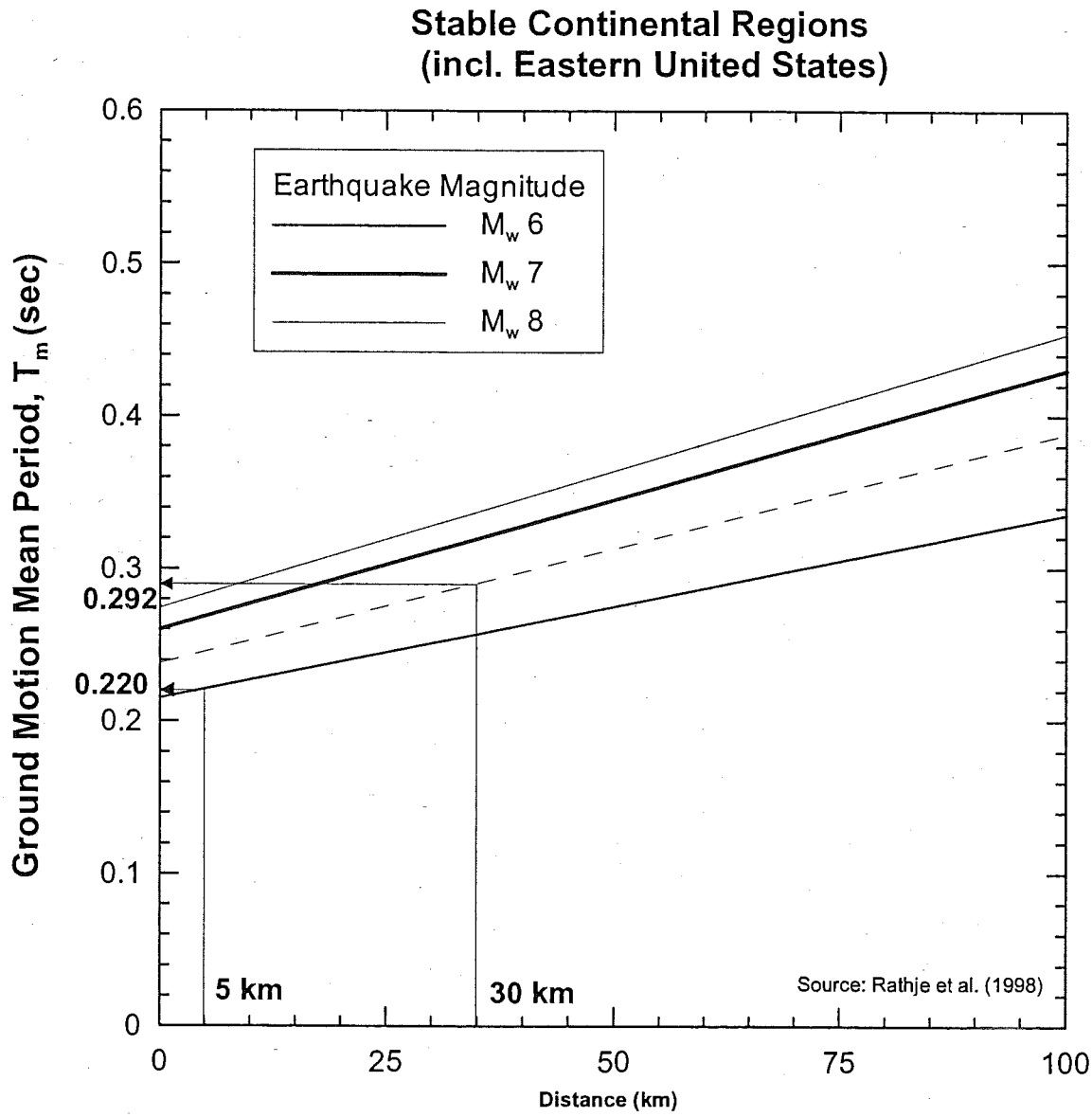


Figure 6: USGS National Seismic Map for the Eastern United States showing the disaggregated seismic hazard around the Wilmington for the 0.2 sec. Spectral acceleration with 2% Probability of Exceedance in 50 Years



T_m: Ground Motion Mean Period (sec)
M_W: Moment Magnitude

Predominant Period.grf 3/21/03

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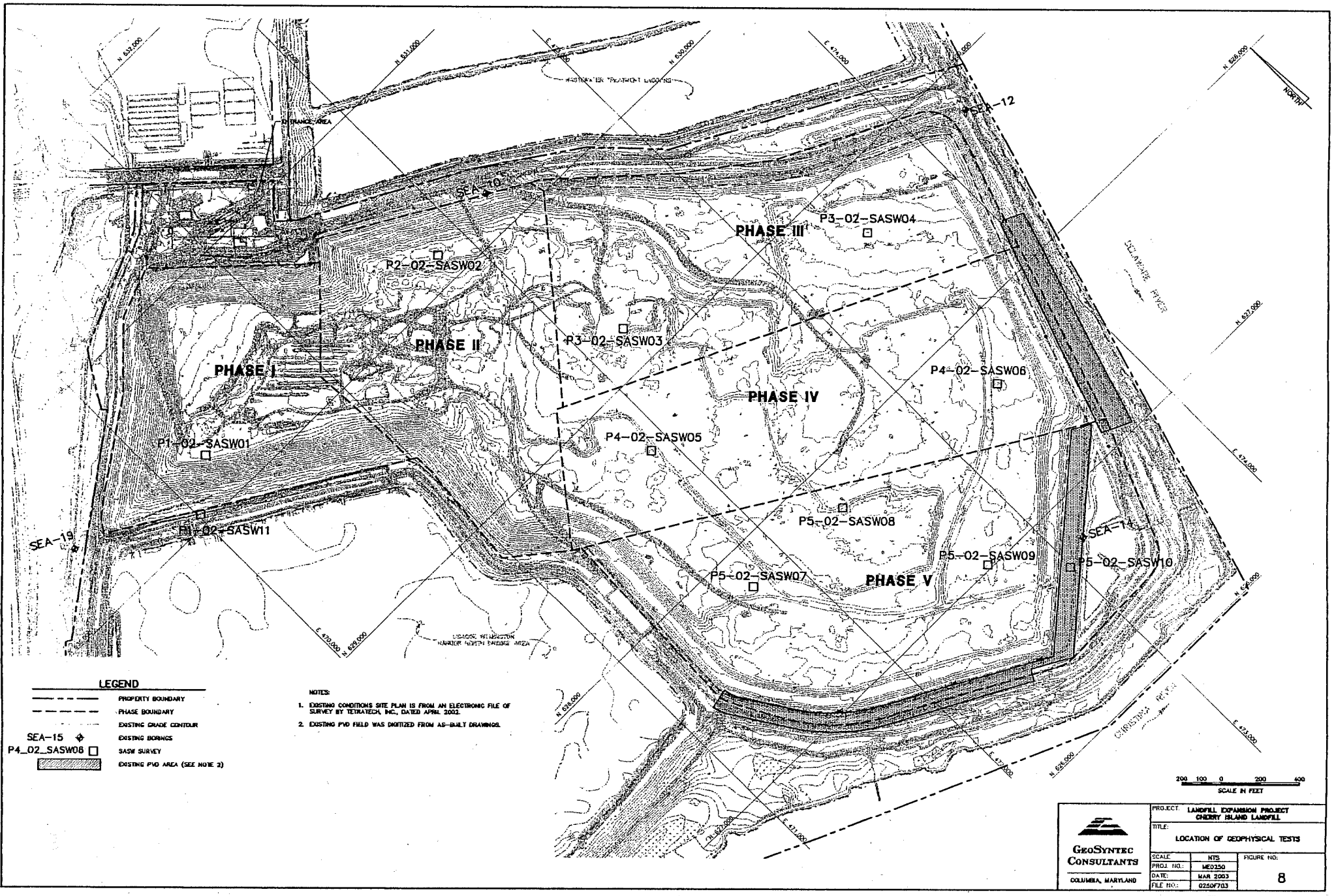
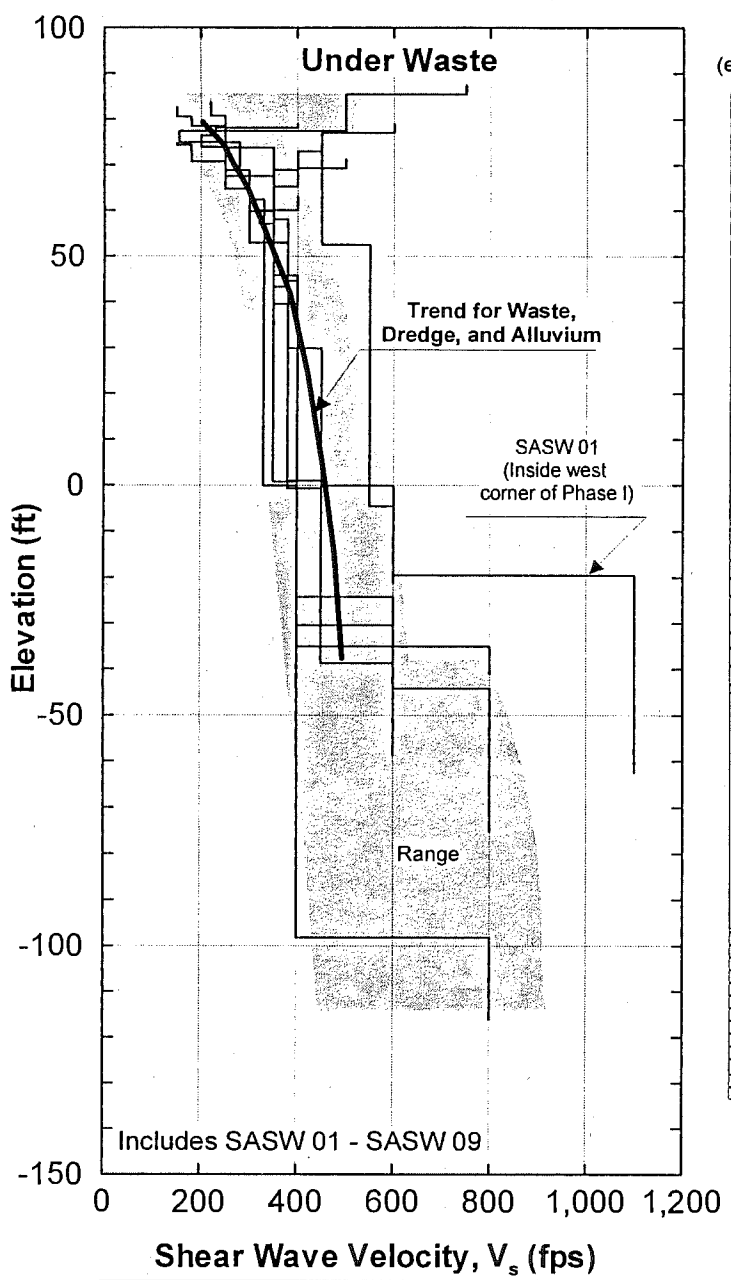
Ground Motion Mean Period as a function of distance from Earthquake

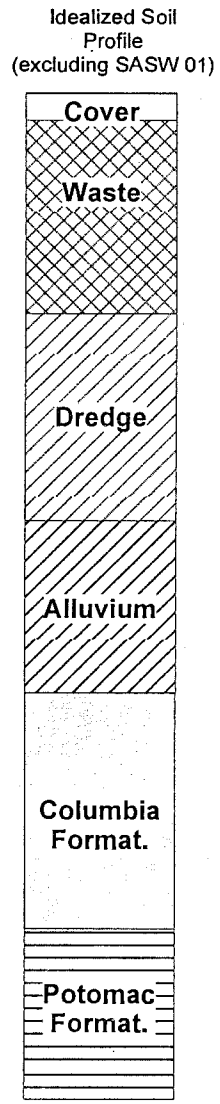
FIGURE 7

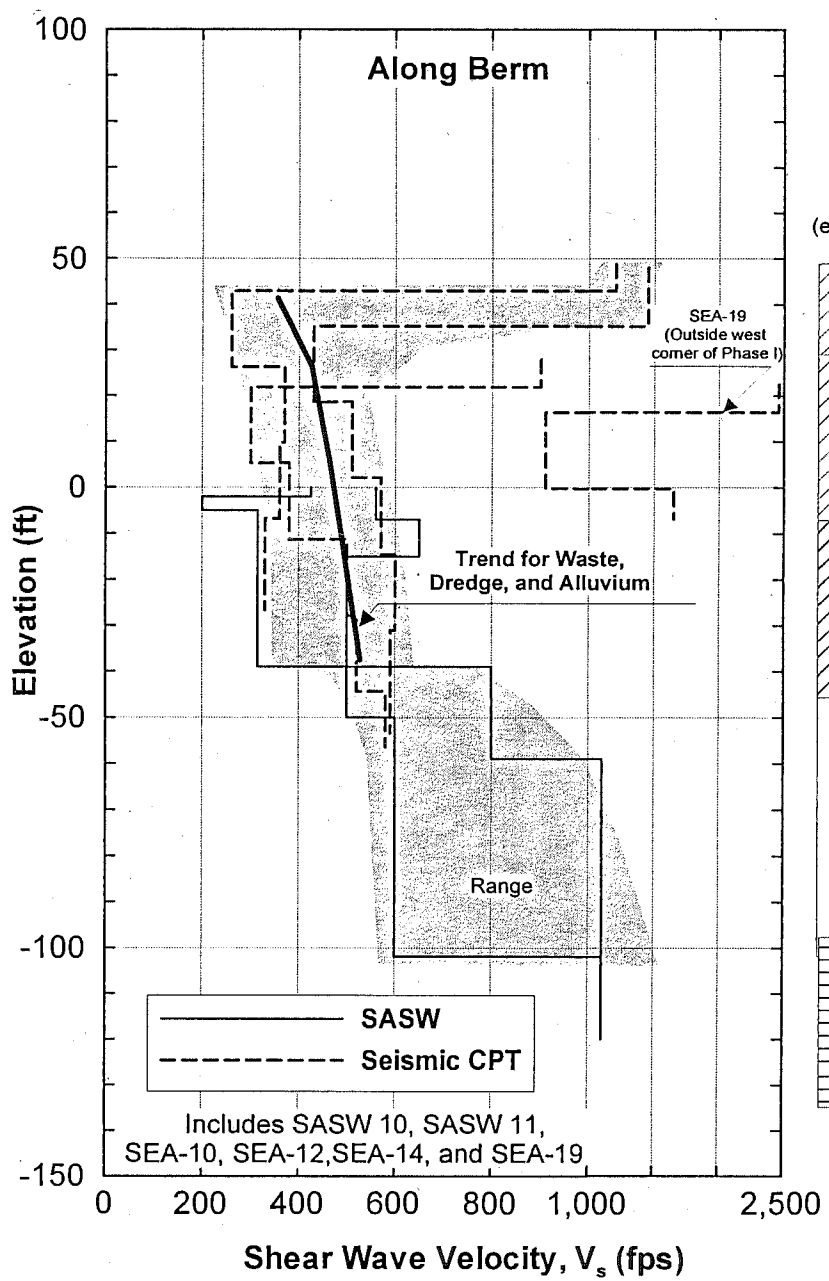
PROJECT ME0247
Cherry Island

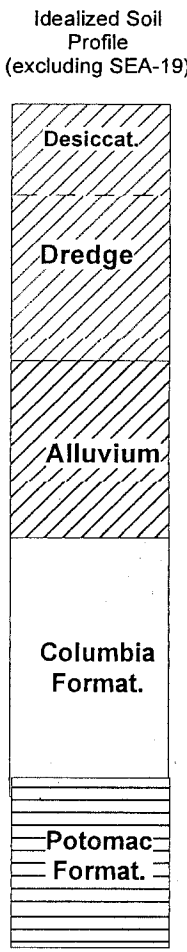


PHASE I
PHASE II
PHASE III
PHASE IV
PHASE V
SEA-10
SEA-12
SEA-14
SEA-19
P1-02-SASW01
P1-02-SASW11
P2-02-SASW02
P3-02-SASW03
P3-02-SASW04
P4-02-SASW05
P4-02-SASW06
P5-02-SASW07
P5-02-SASW08
P5-02-SASW09
P5-02-SASW10
ENTRANCE AREA
WASTEWATER TREATMENT LAGOONS
DELAWARE RIVER
CHRISTINA RIVER
NORTH
N 632,000
N 631,000
N 630,000
N 629,000
N 628,000
N 627,000
N 626,000
E 470,000
E 471,000
E 472,000
E 473,000
E 474,000
LEGEND
PROPERTY BOUNDARY
PHASE BOUNDARY
EXISTING GRADE CONTOUR
SEA-15 EXISTING BORINGS
P4_02_SASW06 SASW SURVEY
EXISTING PVD AREA (SEE NOTE 2)
NOTES:
1. EXISTING CONDITIONS SITE PLAN IS FROM AN ELECTRONIC FILE OF SURVEY BY TETRATECH, INC., DATED APRIL 2002.
2. EXISTING PVD FIELD WAS DIGITIZED FROM AS-BUILT DRAWINGS.
200 100 0 200 400
SCALE IN FEET
GEOSYNTEC CONSULTANTS
COLUMBIA, MARYLAND
PROJECT: LANDFILL EXPANSION PROJECT CHERRY ISLAND LANDFILL
TITLE: LOCATION OF GEOPHYSICAL TESTS
SCALE: NTS
PROJ. NO.: ME0250
DATE: MAR 2003
FILE NO.: 0250F703
FIGURE NO: 8









Shear Wave Velocities.grf 3/21/03

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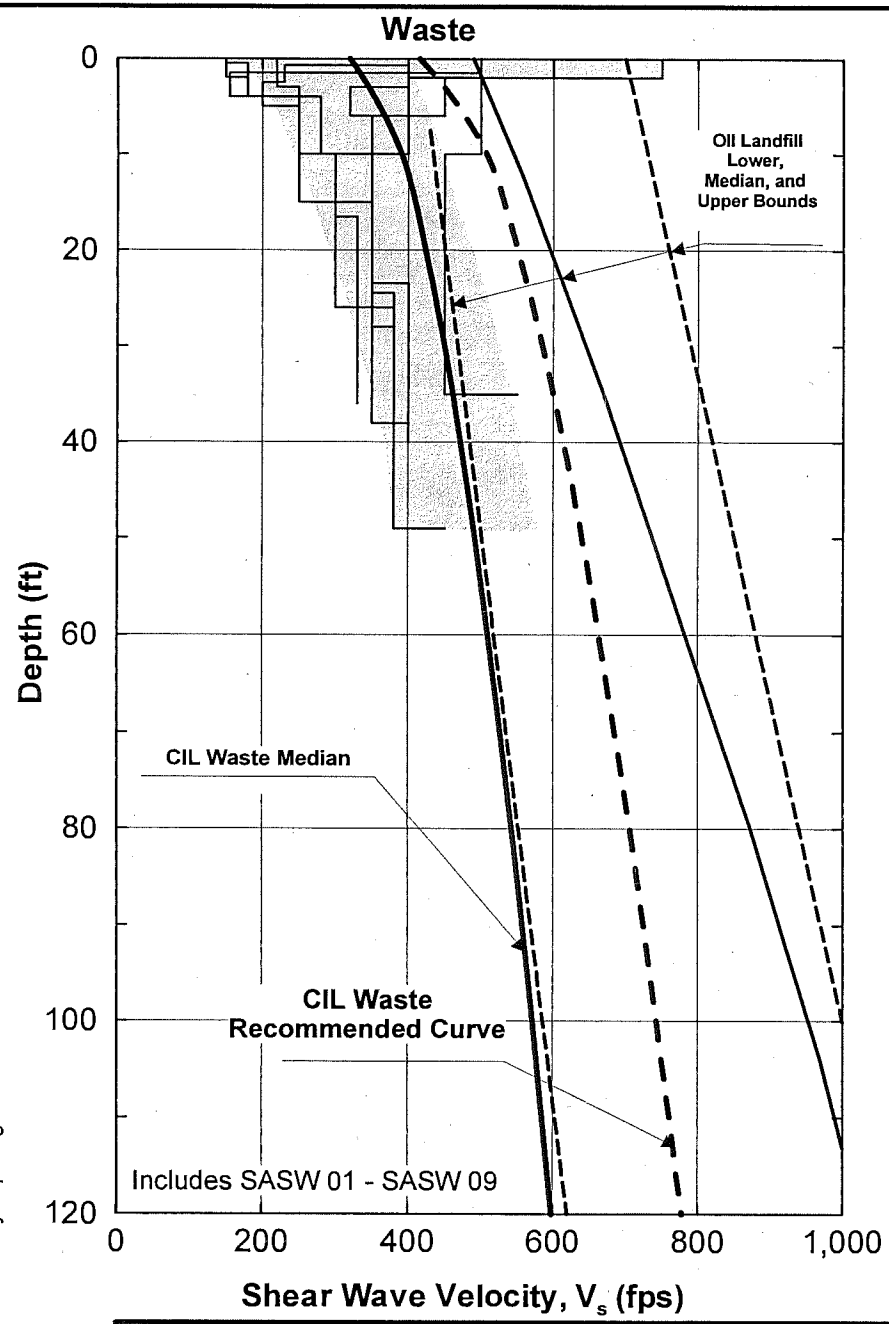
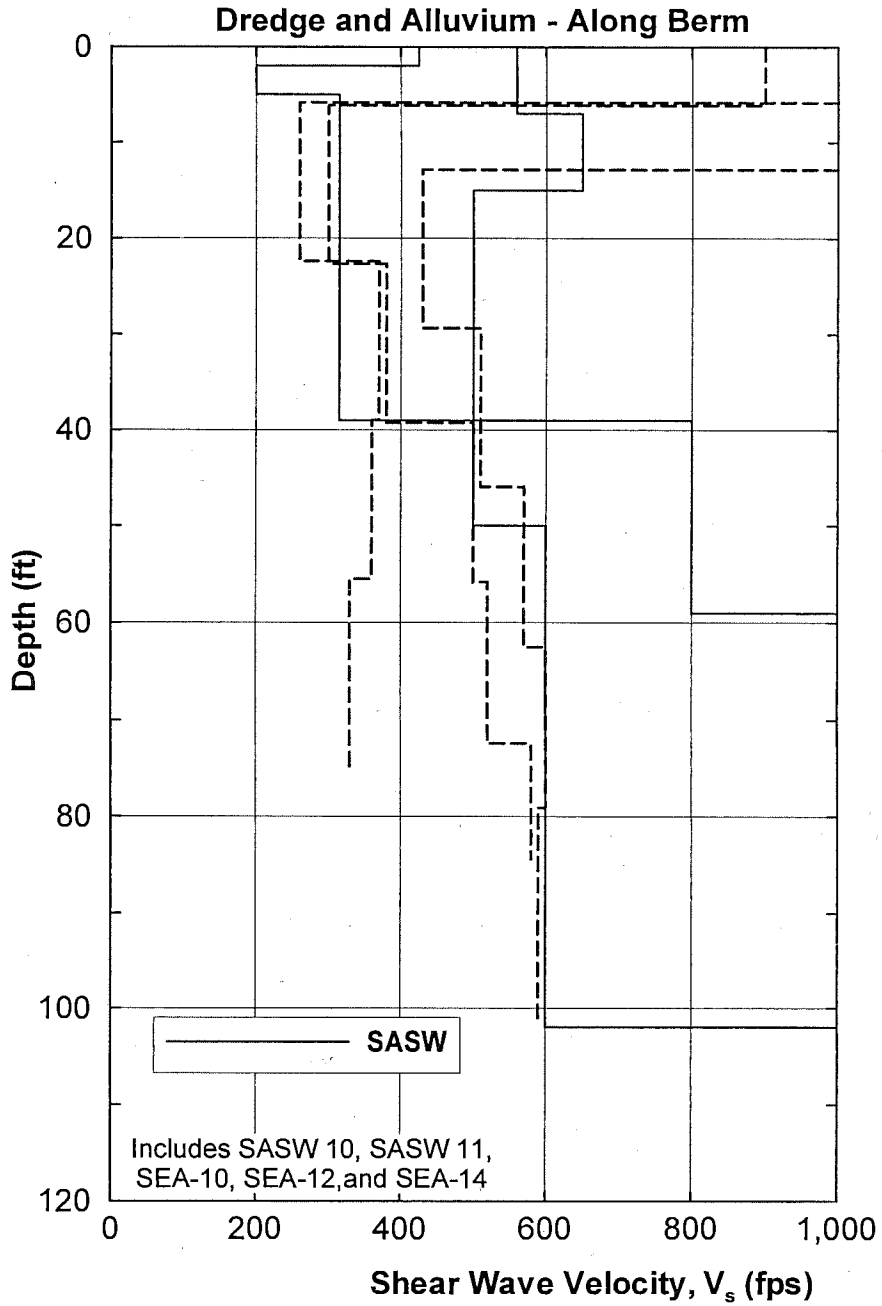
SASW and CPT Shear Wave Velocity Profiles

FIGURE 9

PROJECT: ME0250 Cherry Island





Shear Wave Velocities by depth2.grf 3/26/03

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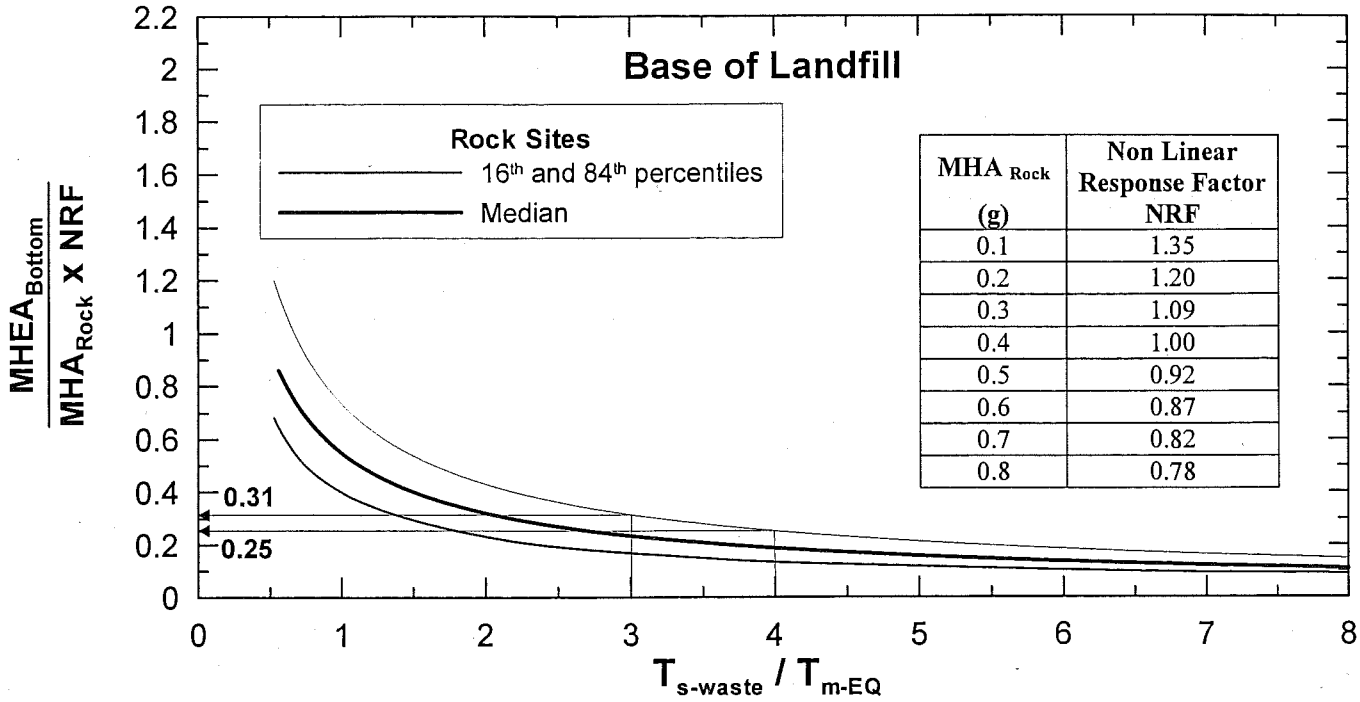
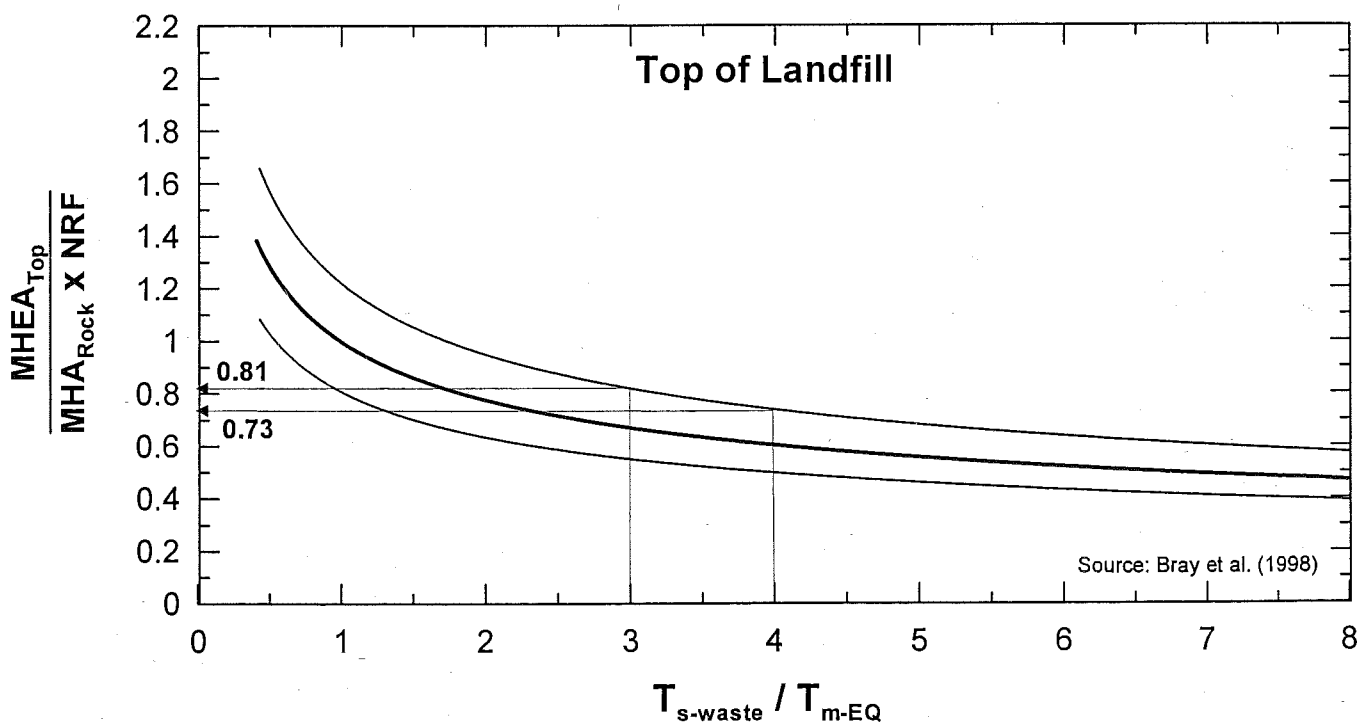
Shear Wave Velocity Profiles

FIGURE 10

PROJECT: ME0250 Cherry Island



MHA Rock (g)	Non Linear Response Factor NRF
0.1	1.35
0.2	1.20
0.3	1.09
0.4	1.00
0.5	0.92
0.6	0.87
0.7	0.82
0.8	0.78



MHA_{Rock}: Maximum Horizontal Acceleration in Rock (g)
$MHEA_{Base}$: Maximum Equivalent Horizontal Acceleration at Base (g)
$MHEA_{Top}$: Maximum Equivalent Horizontal Acceleration at Top (g)
NRF: Non Linear Response Factor (ND)
$T_{s\text{-}WASTE}$: Landfill Fundamental Period (sec)
$T_{m\text{-}EQ}$: Ground Motion Mean Period (sec)

Normalized Seismic Response.grf 3/26/03

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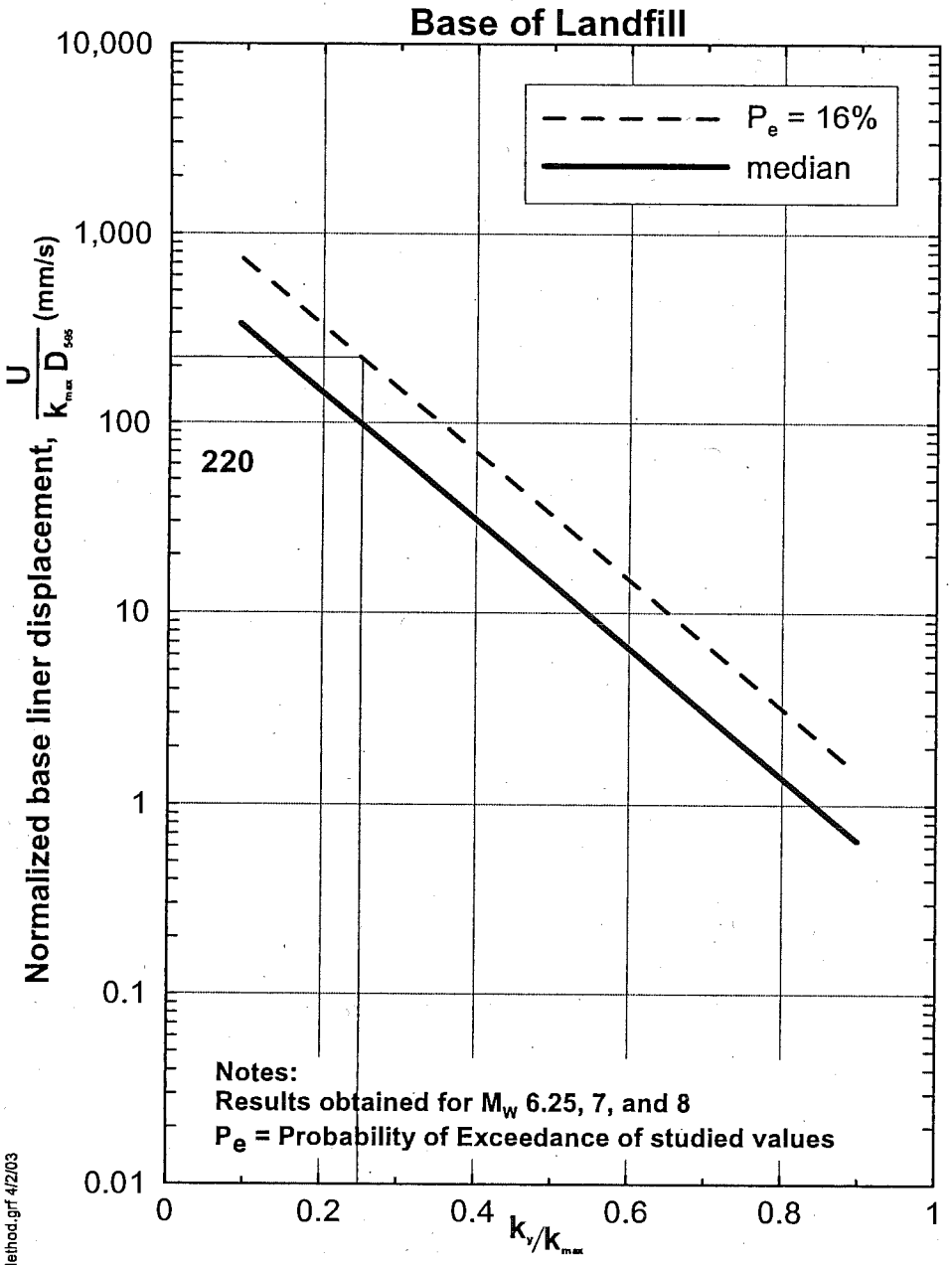
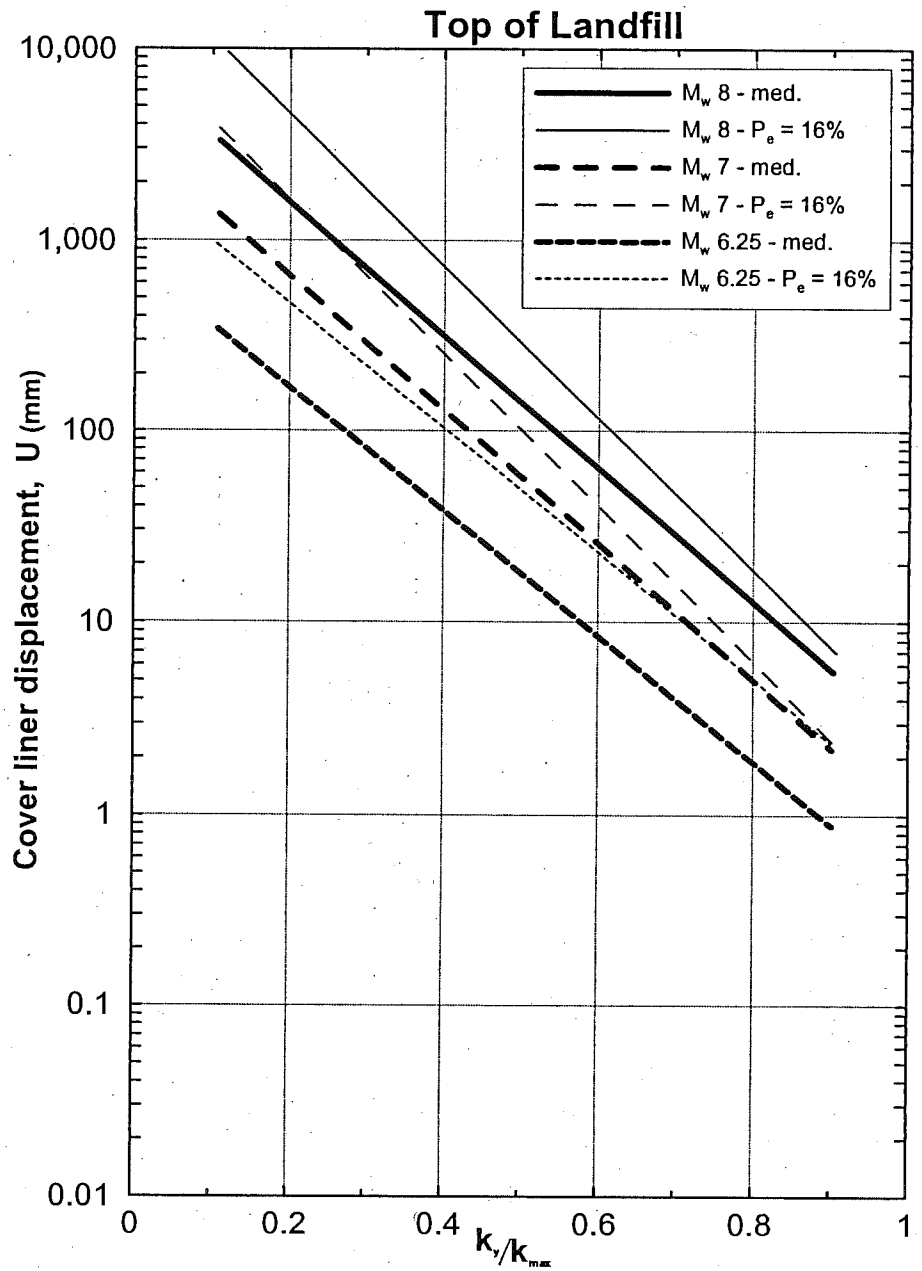
Simplified Method

Normalized Seismic Response

FIGURE 11

PROJECT ME0247
Cherry Island





Source: Bray et al. (1998)

Deformation-Simplified Method.grf 4/2/03

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Seismically Induced Permanent Deformations

FIGURE 12

PROJECT: ME0250 Cherry Island

ATTACHMENT A

Values of Peak Ground Acceleration in Rock From National Seismic Maps

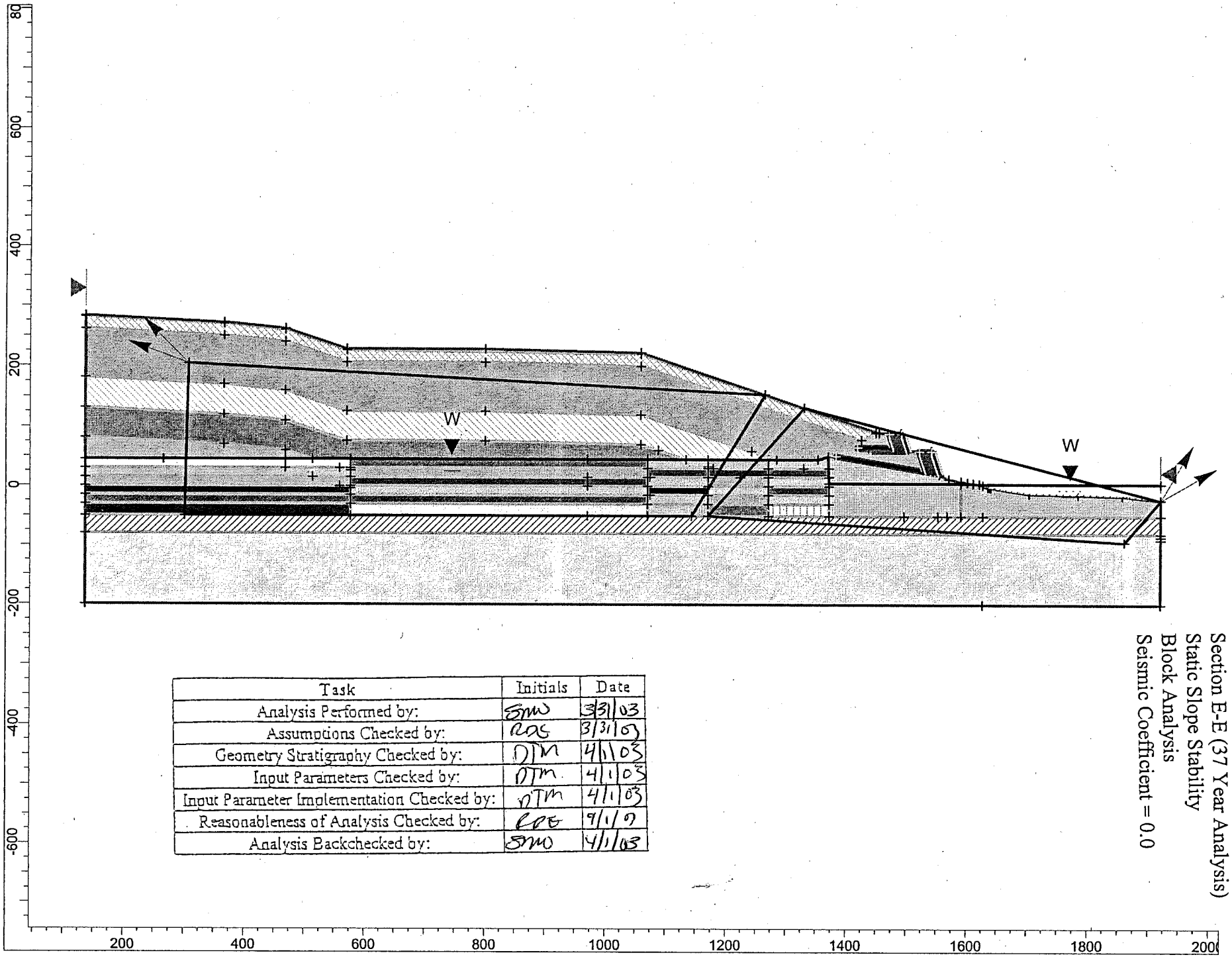
Peak Ground Acceleration (PGA) from National Seismic Maps

Longitude	Latitude	PGA (% of g)[1]	
(degrees)	(degrees)	P_e = 2% in 50 yr	P_e = 10% in 50 yr
-75.9000	39.8000	14.1921	3.49535
-75.8000	39.8000	14.5840	3.55996
-75.7000	39.8000	14.7311	3.59700
-75.6000[2]	**39.8000**	**14.8782**	**3.63413**
-75.5000	**39.8000**	**14.7692**	**3.64113**
-75.4000	39.8000	14.6613	3.64805
-75.3000	39.8000	14.3362	3.62893
-75.2000	39.8000	14.0121	3.61019
-75.1000	39.8000	13.6057	3.57349
-75.0000	39.8000	13.2091	3.53764
-76.0000	39.7000	12.8504	3.28057
-75.9000	39.7000	13.2191	3.33476
-75.8000	39.7000	13.5926	3.38990
-75.7000	39.7000	13.7506	3.42036
-75.6000	**39.7000**	**13.9090**	**3.45096**
-75.5000	**39.7000**	**13.8038**	**3.45349**
-75.4000	39.7000	13.6996	3.45598
-75.3000	39.7000	13.3760	3.43352
-75.2000	39.7000	13.0596	3.41149
-75.1000	39.7000	12.6530	3.37182
-75.0000	39.7000	12.2567	3.33311

Notes: (1) Abridged from http://geohazards.cr.usgs.gov/eq/html/data2002.html
(2) Values in bold are closest grid points to site coordinates of latitude 39°43'30"N (39.725°N) and longitude 75°30'50"W (-75.514°)

ATTACHMENT B

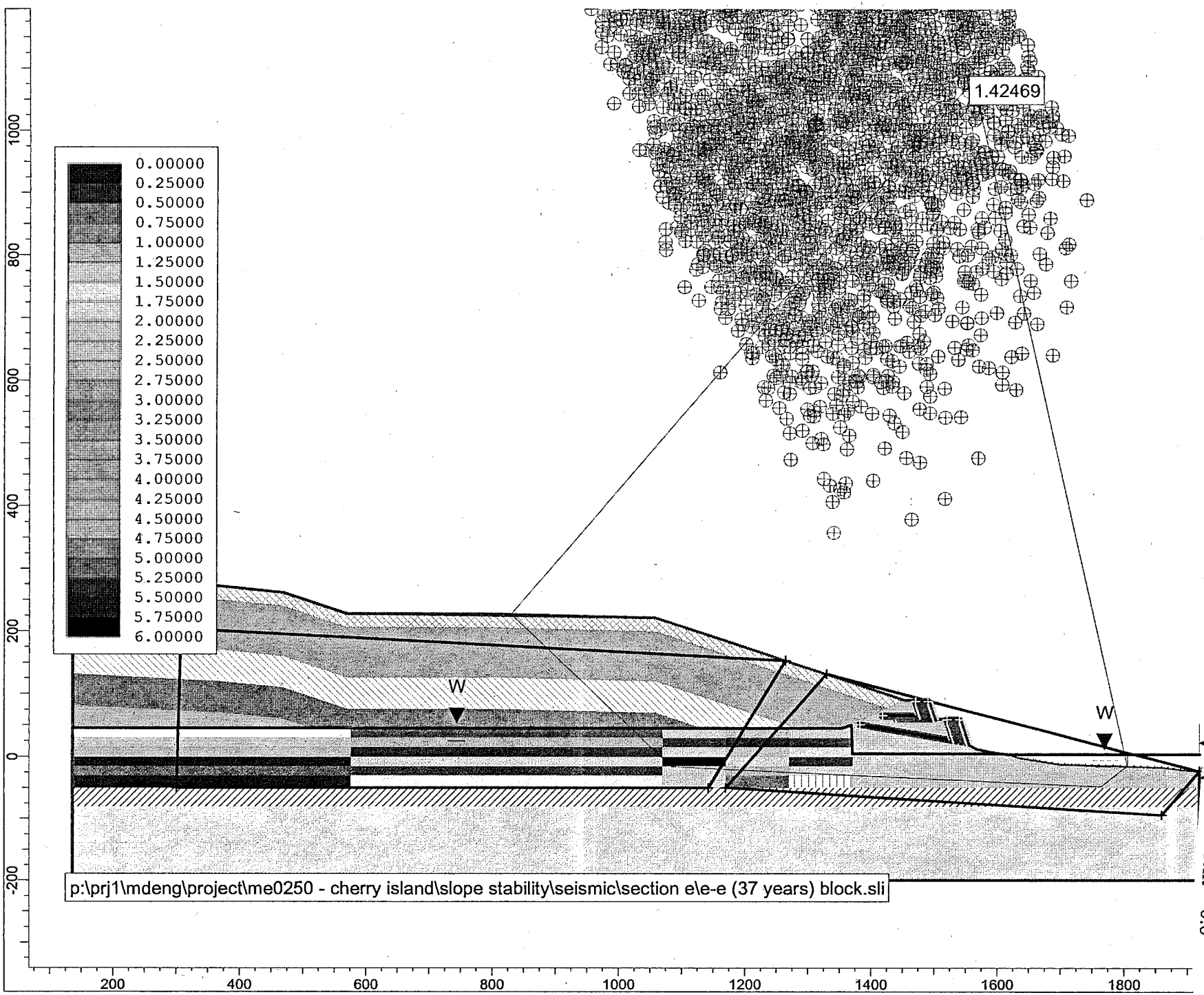
Evaluation of Yield Acceleration for Section E-E



Task	Initials	Date
Analysis Performed by:	SMW	3/31/03
Assumptions Checked by:	RDS	3/31/03
Geometry Stratigraphy Checked by:	DTM	4/1/03
Input Parameters Checked by:	DTM	4/1/03
Input Parameter Implementation Checked by:	DTM	4/1/03
Reasonableness of Analysis Checked by:	CDE	9/1/07
Analysis Backchecked by:	SMW	4/1/03

Section E-E (37 Year Analysis)
Static Slope Stability
Block Analysis
Seismic Coefficient = 0.0

E3/S-1



Section E-E (37 Year Analysis)
Static Slope Stability
Block Analysis
Seismic Coefficient = 0.0

Section E-E (37 Year Analysis)
Static Slope Stability
Block Analysis
Seismic Coefficient = 0.0

Slide Analysis Information

Document Name

File Name: e-e (37 years) block

Project Settings

Project Title: SLIDE - An Interactive Slope Stability Program
Failure Direction: Left to Right
Units of Measurement: Imperial Units
Pore Fluid Unit Weight: 62.4 lb/ft3
Groundwater Method: Water Surfaces
Data Output: Standard

Analysis Methods

Analysis Methods used:
Spencer

Number of slices: 50
Tolerance: 0.005
Maximum number of iterations: 50

Surface Options

Surface Type: Non-Circular Block Search
Number of Surfaces: 5000
Pseudo-Random Surfaces: Enabled
Convex Surfaces Only: Disabled
Left Projection Angle (Start Angle): 135
Left Projection Angle (End Angle): 160
Right Projection Angle (Start Angle): 30
Right Projection Angle (End Angle): 60

Loading

Seismic Load Coefficient (Horizontal): 0
Seismic Load Coefficient (Vertical): 0

Material Properties

Material: Potomac Formation
Strength Type: Undrained
Unit Weight: 120 lb/ft3
Cohesion Type: Function of Depth
Cohesion (Top): 4500 psf
Cohesion Change: 14.4 psf/ft
Cutoff: 10000 psf
Water Surface: None

Material: Waste (0 to 20)
Strength Type: Mohr-Coulomb
Unit Weight: 60 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (20 to 100)
Strength Type: Mohr-Coulomb
Unit Weight: 75 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (100 to 150)
Strength Type: Mohr-Coulomb
Unit Weight: 80 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (150 to 200)
Strength Type: Mohr-Coulomb
Unit Weight: 85 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (>200)
Strength Type: Mohr-Coulomb
Unit Weight: 90 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: final cover
Strength Type: Mohr-Coulomb
Unit Weight: 120 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

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Material: Drained PVD Area
Strength Type: Shear Normal function
Unit Weight: 85 lb/ft3
Water Surface: Water Table
Custom Hu value: 1

Material: d11
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1982 psf
Water Surface: None

Material: d12
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1772 psf
Water Surface: None

Material: d13
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1647 psf
Water Surface: None

Material: d14
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1609 psf
Water Surface: None

Material: d15
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1695 psf
Water Surface: None

Material: d16
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2419 psf
Water Surface: None

Material: d21
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2605 psf
Water Surface: None

Material: d22
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2226 psf
Water Surface: None

Material: d23
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1984 psf
Water Surface: None

Material: d24
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1881 psf
Water Surface: None

Material: d25
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1951 psf
Water Surface: None

Material: d26
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2910 psf
Water Surface: None

Material: d31
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 3237 psf
Water Surface: None

Material: d32
Strength Type: Undrained

Section E-E (37 Year Analysis)
Static Slope Stability
Block Analysis
Seismic Coefficient = 0.0

Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2580 psf
Water Surface: None

Material: d33
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2134 psf
Water Surface: None

Material: d34
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1944 psf
Water Surface: None

Material: d35
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2022 psf
Water Surface: None

Material: d36
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 3346 psf
Water Surface: None

Material: d41
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 3586 psf
Water Surface: None

Material: d42
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2615 psf
Water Surface: None

Material: d43
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2056 psf
Water Surface: None

Material: d44
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1933 psf
Water Surface: None

Material: d45
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2235 psf
Water Surface: None

Material: d46
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 3807 psf
Water Surface: None

Material: d51
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 4192 psf
Water Surface: None

Material: d52
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2833 psf
Water Surface: None

Material: d53
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2144 psf
Water Surface: None

Material: d54
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant

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Cohesion: 2031 psf
Water Surface: None

Material: d55
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2480 psf
Water Surface: None

Material: d56
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 4428 psf
Water Surface: None

Material: River Sediments
Strength Type: Strength=F(overburden)
Unit Weight: 85 lb/ft3
Tau/Sigma Ratio: 0.29
Water Surface: Water Table
Custom Hu value: 1

Material: Columbia Formation
Strength Type: Mohr-Coulomb
Unit Weight: 125 lb/ft3
Cohesion: 0 psf
Friction Angle: 40 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: MSE Wall Soil
Strength Type: Mohr-Coulomb
Unit Weight: 90 lb/ft3
Cohesion: 0 psf
Friction Angle: 29 degrees
Water Surface: Water Table
Custom Hu value: 1

Support Properties

Support: Geogrid
Support Type: GeoTextile
Force Application: Passive
Force Orientation: Bisector of Parallel and Tangent
Anchorage: Slope Face
Shear Strength Model: Linear
Strip Coverage: 100 percent
Tensile Strength: 5000 lb/ft
Pullout Strength Adhesion: 0 lb/ft2
Pullout Strength Friction Angle: 25 degrees

Support: Geogrid2
Support Type: GeoTextile
Force Application: Passive
Force Orientation: Bisector of Parallel and Tangent
Anchorage: Slope Face
Shear Strength Model: Linear
Strip Coverage: 100 percent
Tensile Strength: 21000 lb/ft
Pullout Strength Adhesion: 0 lb/ft2
Pullout Strength Friction Angle: 25 degrees

Global Minimums

Method: spencer
SF: 1.42469
Axis Location: 1558.82, 1081.27
Left Slip Surface Endpoint: 829.712, 227.033
Right Slip Surface Endpoint: 1804.75, -14.5581
Left Slope Intercept: 829.712 227.033
Right Slope Intercept: 1804.75 4

Method Statistics

Method: spencer
Number of Valid Surfaces: 4334
Number of Invalid Surfaces: 666
Error Codes:
Error Code -105 reported for 81 surfaces
Error Code -108 reported for 527 surfaces
Error Code -111 reported for 20 surfaces
Error Code -112 reported for 38 surfaces

Error Codes

The following errors were encountered during the computation:

-105 = More than two surface / slope intersections with no valid slip surface.

-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).

-111 = safety factor equation did not converge

-112 = The coefficient M-Alpha = cos(alpha)(1+tan(alpha)tan(phi)/F) < 0.2 for the final iteration

Section E-E (37 Year Analysis)
Static Slope Stability
Block Analysis
Seismic Coefficient = 0.0

of the safety factor calculation. This screens out some slip surfaces which may not be valid in the context of the analysis, in particular, deep seated slip surfaces with many high negative base angle slices in the passive zone.

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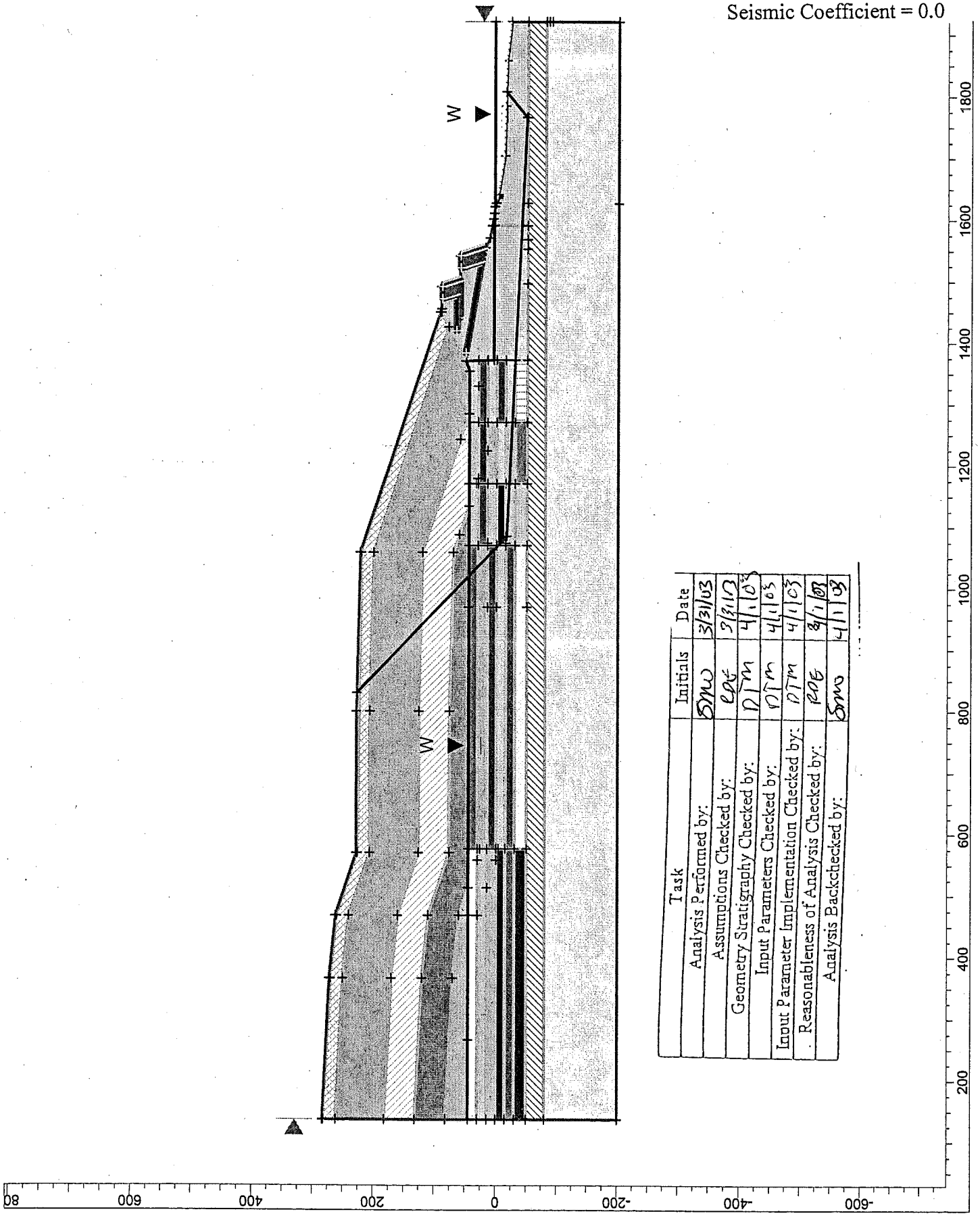
Section E-E (37 Year Analysis)
Dynamic Slope Stability
Block Analysis
Seismic Coefficient = 0.0



Task	Initials	Date
Analysis Performed by:	SMO	3/31/03
Assumptions Checked by:	EDE	2/8/03
Geometry Stratigraphy Checked by:	DTM	4/1/03
Input Parameters Checked by:	DTM	4/1/03
Input Parameter Implementation Checked by:	DTM	4/1/03
Reasonableness of Analysis Checked by:	EDE	4/1/03
Analysis Backchecked by:	SMO	4/1/03

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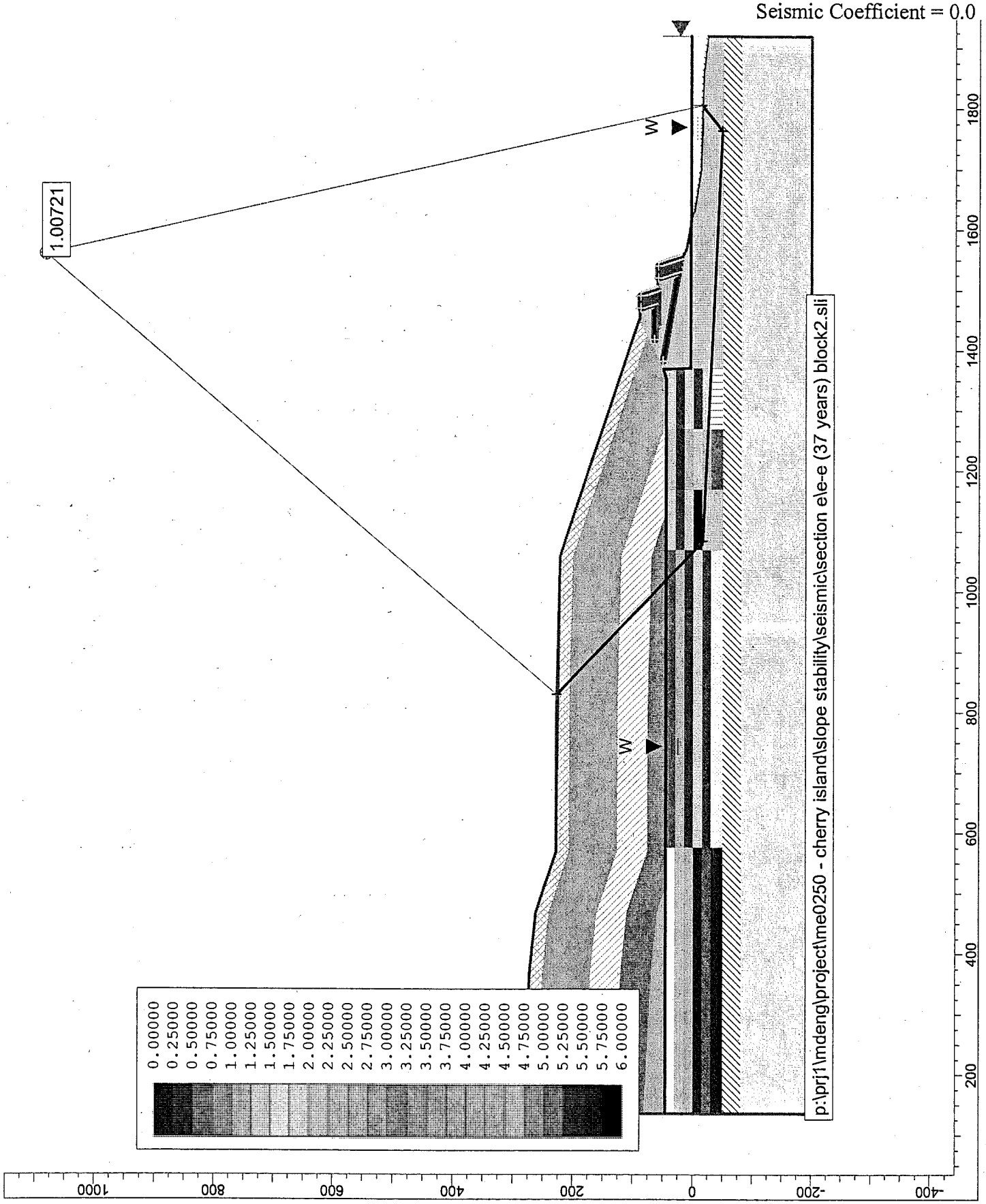
Section E-E (37 Year Analysis)
Dynamic Slope Stability
Block Analysis
Seismic Coefficient = 0.0



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Section E-E (37 Year Analysis)
Dynamic Slope Stability
Block Analysis
Seismic Coefficient = 0.0

Slide Analysis Information

Document Name

File Name: e-e (37 years) block2

Project Settings

Project Title: SLIDE - An Interactive Slope Stability Program
Failure Direction: Left to Right
Units of Measurement: Imperial Units
Pore Fluid Unit Weight: 62.4 lb/ft3
Groundwater Method: Water Surfaces
Data Output: Standard

Analysis Methods

Analysis Methods used:
Spencer

Number of slices: 50
Tolerance: 0.005
Maximum number of iterations: 50

Surface Options

Surface Type: Non-Circular Block Search
Number of Surfaces: 5000
Pseudo-Random Surfaces: Enabled
Convex Surfaces Only: Disabled
Left Projection Angle (Start Angle): 135
Left Projection Angle (End Angle): 160
Right Projection Angle (Start Angle): 30
Right Projection Angle (End Angle): 60

Loading

Seismic Load Coefficient (Horizontal): 0
Seismic Load Coefficient (Vertical): 0

Material Properties

Material: Potomac Formation
Strength Type: Undrained
Unit Weight: 120 lb/ft3
Cohesion Type: Function of Depth
Cohesion (Top): 4500 psf
Cohesion Change: 14.4 psf/ft
Cutoff: 10000 psf
Water Surface: None

Material: Waste (0 to 20)
Strength Type: Mohr-Coulomb
Unit Weight: 60 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (20 to 100)
Strength Type: Mohr-Coulomb
Unit Weight: 75 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (100 to 150)
Strength Type: Mohr-Coulomb
Unit Weight: 80 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (150 to 200)
Strength Type: Mohr-Coulomb
Unit Weight: 85 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (>200)
Strength Type: Mohr-Coulomb
Unit Weight: 90 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: final cover
Strength Type: Mohr-Coulomb
Unit Weight: 120 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

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Material: Undrained PVD Area
Strength Type: Strength=F(overburden)
Unit Weight: 85 lb/ft3
Tau/Sigma Ratio: 0.29
Water Surface: Water Table
Custom Hu value: 1

Material: d11
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1982 psf
Water Surface: None

Material: d12
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1772 psf
Water Surface: None

Material: d13
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1647 psf
Water Surface: None

Material: d14
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1609 psf
Water Surface: None

Material: d15
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1695 psf
Water Surface: None

Material: d16
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2419 psf
Water Surface: None

Material: d21
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2605 psf
Water Surface: None

Material: d22
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2226 psf
Water Surface: None

Material: d23
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1984 psf
Water Surface: None

Material: d24
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1881 psf
Water Surface: None

Material: d25
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1951 psf
Water Surface: None

Material: d26
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2910 psf
Water Surface: None

Material: d31
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 3237 psf
Water Surface: None

Material: d32

Section E-E (37 Year Analysis)
Dynamic Slope Stability
Block Analysis
Seismic Coefficient = 0.0

Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2580 psf
Water Surface: None

Material: d33
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2134 psf
Water Surface: None

Material: d34
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1944 psf
Water Surface: None

Material: d35
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2022 psf
Water Surface: None

Material: d36
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 3346 psf
Water Surface: None

Material: d41
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 3586 psf
Water Surface: None

Material: d42
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2615 psf
Water Surface: None

Material: d43
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2056 psf
Water Surface: None

Material: d44
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1933 psf
Water Surface: None

Material: d45
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2235 psf
Water Surface: None

Material: d46
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 3807 psf
Water Surface: None

Material: d51
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 4192 psf
Water Surface: None

Material: d52
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2833 psf
Water Surface: None

Material: d53
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2144 psf
Water Surface: None

Material: d54
Strength Type: Undrained
Unit Weight: 85 lb/ft3

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Cohesion Type: Constant
Cohesion: 2031 psf
Water Surface: None

Material: d55
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2480 psf
Water Surface: None

Material: d56
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 4428 psf
Water Surface: None

Material: River Sediments
Strength Type: Strength=F(overburden)
Unit Weight: 85 lb/ft3
Tau/Sigma Ratio: 0.29
Water Surface: Water Table
Custom Hu value: 1

Material: Columbia Formation
Strength Type: Mohr-Coulomb
Unit Weight: 125 lb/ft3
Cohesion: 0 psf
Friction Angle: 40 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: MSE Wall Soil
Strength Type: Mohr-Coulomb
Unit Weight: 90 lb/ft3
Cohesion: 0 psf
Friction Angle: 29 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Drained PVD Area
Strength Type: Shear Normal function
Unit Weight: 85 lb/ft3
Water Surface: Water Table
Custom Hu value: 1

Support Properties

Support: Geogrid
Support Type: GeoTextile
Force Application: Passive
Force Orientation: Bisector of Parallel and Tangent
Anchorage: Slope Face
Shear Strength Model: Linear
Strip Coverage: 100 percent
Tensile Strength: 5000 lb/ft
Pullout Strength Adhesion: 0 lb/ft2
Pullout Strength Friction Angle: 25 degrees

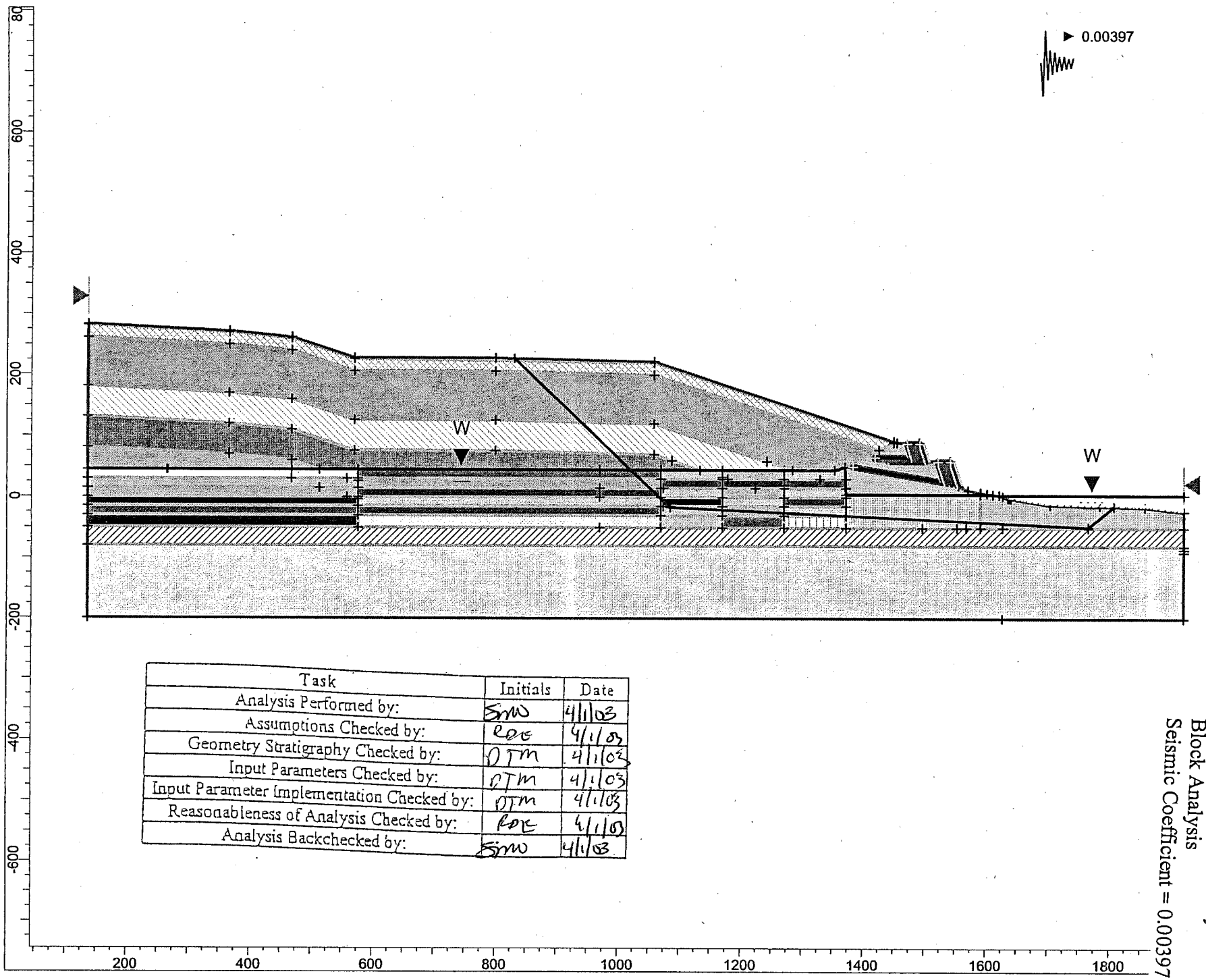
Support: Geogrid2
Support Type: GeoTextile
Force Application: Passive
Force Orientation: Bisector of Parallel and Tangent
Anchorage: Slope Face
Shear Strength Model: Linear
Strip Coverage: 100 percent
Tensile Strength: 21000 lb/ft
Pullout Strength Adhesion: 0 lb/ft2
Pullout Strength Friction Angle: 25 degrees

Global Minimums

Method: spencer
SF: 1.00721
Axis Location: 1558.82, 1081.28
Left Slip Surface Endpoint: 829.712, 227.033
Right Slip Surface Endpoint: 1804.75, -14.5582
Left Slope Intercept: 829.712 227.033
Right Slope Intercept: 1804.75 4

Method Statistics

Method: spencer
Number of Valid Surfaces: 1
Number of Invalid Surfaces: 0



Task	Initials	Date
Analysis Performed by:	SMW	4/1/03
Assumptions Checked by:	RDE	4/1/03
Geometry Stratigraphy Checked by:	DTM	4/1/03
Input Parameters Checked by:	DTM	4/1/03
Input Parameter Implementation Checked by:	DTM	4/1/03
Reasonableness of Analysis Checked by:	RDE	4/1/03
Analysis Backchecked by:	SMW	4/1/03

Section E-E (37 Year Analysis)
Dynamic Slope Stability
Block Analysis
Seismic Coefficient = 0.00397

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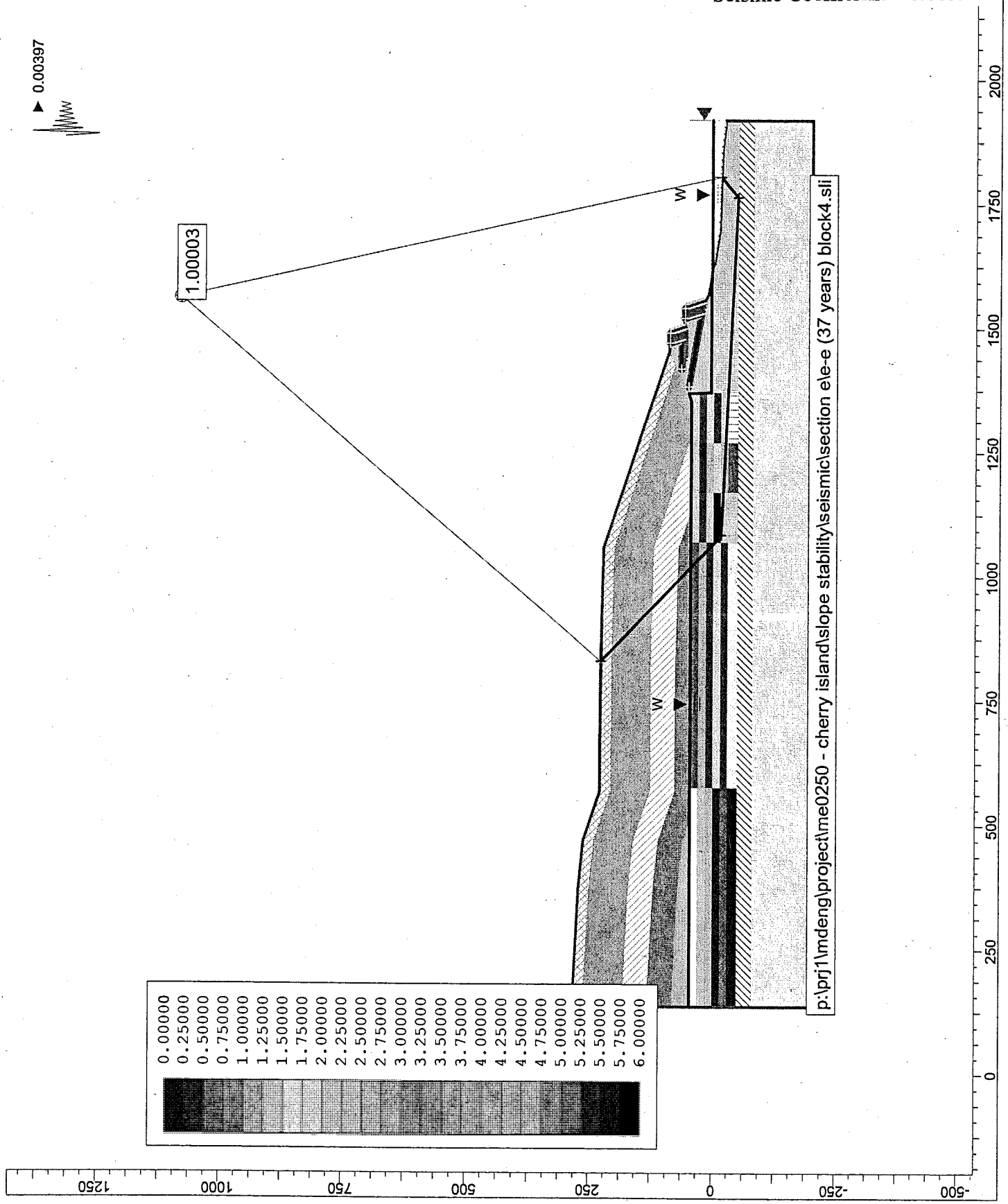
Section E-E (37 Year Analysis)
Dynamic Slope Stability
Block Analysis
Seismic Coefficient = 0.00397



E37S-11

Section E-E (37 Year Analysis)
Dynamic Slope Stability
Block Analysis
Seismic Coefficient = 0.00397

Slide Analysis Information

Document Name

File Name: e-e (37 years) block4

Project Settings

Project Title: SLIDE - An Interactive Slope Stability Program
Failure Direction: Left to Right
Units of Measurement: Imperial Units
Pore Fluid Unit Weight: 62.4 lb/ft3
Groundwater Method: Water Surfaces
Data Output: Standard

Analysis Methods

Analysis Methods used:
Spencer

Number of slices: 50
Tolerance: 0.005
Maximum number of iterations: 50

Surface Options

Surface Type: Non-Circular Block Search
Number of Surfaces: 5000
Pseudo-Random Surfaces: Enabled
Convex Surfaces Only: Disabled
Left Projection Angle (Start Angle): 135
Left Projection Angle (End Angle): 160
Right Projection Angle (Start Angle): 30
Right Projection Angle (End Angle): 60

Loading

Seismic Load Coefficient (Horizontal): 0.00397
Seismic Load Coefficient (Vertical): 0

Material Properties

Material: Potomac Formation
Strength Type: Undrained
Unit Weight: 120 lb/ft3
Cohesion Type: Function of Depth
Cohesion (Top): 4500 psf
Cohesion Change: 14.4 psf/ft
Cutoff: 10000 psf
Water Surface: None

Material: Waste (0 to 20)
Strength Type: Mohr-Coulomb
Unit Weight: 60 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (20 to 100)
Strength Type: Mohr-Coulomb
Unit Weight: 75 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (100 to 150)
Strength Type: Mohr-Coulomb
Unit Weight: 80 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (150 to 200)
Strength Type: Mohr-Coulomb
Unit Weight: 85 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (>200)
Strength Type: Mohr-Coulomb
Unit Weight: 90 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: final cover
Strength Type: Mohr-Coulomb
Unit Weight: 120 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

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Material: Undrained PVD Area
Strength Type: Strength=F(overburden)
Unit Weight: 85 lb/ft3
Tau/Sigma Ratio: 0.29
Water Surface: Water Table
Custom Hu value: 1

Material: d11
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1982 psf
Water Surface: None

Material: d12
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1772 psf
Water Surface: None

Material: d13
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1647 psf
Water Surface: None

Material: d14
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1609 psf
Water Surface: None

Material: d15
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1695 psf
Water Surface: None

Material: d16
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2419 psf
Water Surface: None

Material: d21
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2605 psf
Water Surface: None

Material: d22
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2226 psf
Water Surface: None

Material: d23
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1984 psf
Water Surface: None

Material: d24
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1881 psf
Water Surface: None

Material: d25
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1951 psf
Water Surface: None

Material: d26
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2910 psf
Water Surface: None

Material: d31
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 3237 psf
Water Surface: None

Material: d32

Section E-E (37 Year Analysis)
Dynamic Slope Stability
Block Analysis
Seismic Coefficient = 0.00397

Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2580 psf
Water Surface: None

Material: d33
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2134 psf
Water Surface: None

Material: d34
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1944 psf
Water Surface: None

Material: d35
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2022 psf
Water Surface: None

Material: d36
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 3346 psf
Water Surface: None

Material: d41
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 3586 psf
Water Surface: None

Material: d42
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2615 psf
Water Surface: None

Material: d43
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2056 psf
Water Surface: None

Material: d44
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1933 psf
Water Surface: None

Material: d45
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2235 psf
Water Surface: None

Material: d46
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 3807 psf
Water Surface: None

Material: d51
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 4192 psf
Water Surface: None

Material: d52
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2833 psf
Water Surface: None

Material: d53
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2144 psf
Water Surface: None

Material: d54
Strength Type: Undrained
Unit Weight: 85 lb/ft3

E3/5.13

Cohesion Type: Constant
Cohesion: 2031 psf
Water Surface: None

Material: d55
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2480 psf
Water Surface: None

Material: d56
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 4428 psf
Water Surface: None

Material: River Sediments
Strength Type: Strength=F(overburden)
Unit Weight: 85 lb/ft3
Tau/Sigma Ratio: 0.29
Water Surface: Water Table
Custom Hu value: 1

Material: Columbia Formation
Strength Type: Mohr-Coulomb
Unit Weight: 125 lb/ft3
Cohesion: 0 psf
Friction Angle: 40 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: MSE Wall Soil
Strength Type: Mohr-Coulomb
Unit Weight: 90 lb/ft3
Cohesion: 0 psf
Friction Angle: 29 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Drained PVD Area
Strength Type: Shear Normal function
Unit Weight: 85 lb/ft3
Water Surface: Water Table
Custom Hu value: 1

Support Properties

Support: Geogrid
Support Type: GeoTextile
Force Application: Passive
Force Orientation: Bisector of Parallel and Tangent
Anchorage: Slope Face
Shear Strength Model: Linear
Strip Coverage: 100 percent
Tensile Strength: 5000 lb/ft
Pullout Strength Adhesion: 0 lb/ft2
Pullout Strength Friction Angle: 25 degrees

Support: Geogrid2
Support Type: GeoTextile
Force Application: Passive
Force Orientation: Bisector of Parallel and Tangent
Anchorage: Slope Face
Shear Strength Model: Linear
Strip Coverage: 100 percent
Tensile Strength: 21000 lb/ft
Pullout Strength Adhesion: 0 lb/ft2
Pullout Strength Friction Angle: 25 degrees

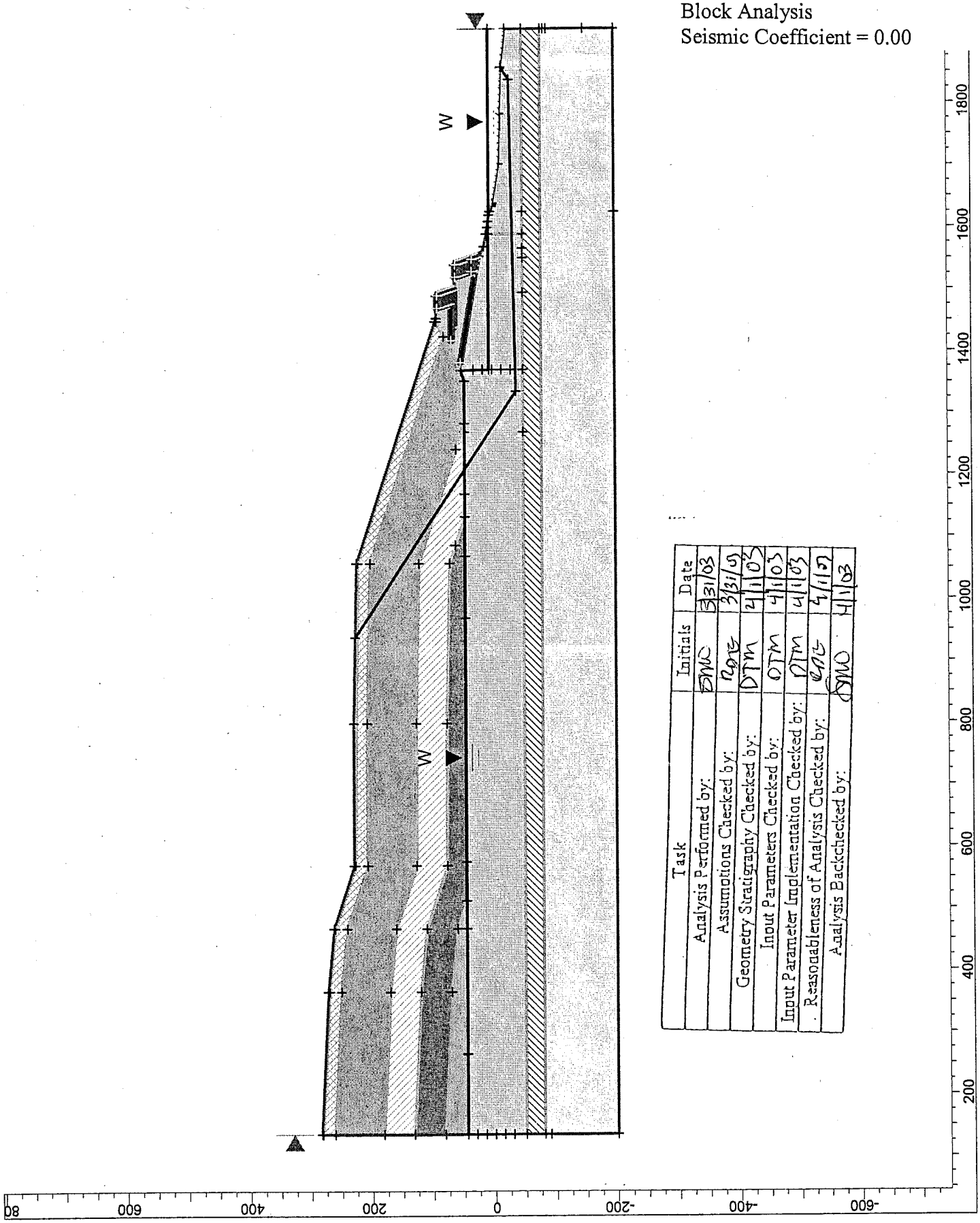
Global Minimums

Method: spencer
SF: 1.00003
Axis Location: 1558.82, 1081.28
Left Slip Surface Endpoint: 829.712, 227.033
Right Slip Surface Endpoint: 1804.75, -14.5582
Left Slope Intercept: 829.712 227.033
Right Slope Intercept: 1804.75 4

Method Statistics

Method: spencer
Number of Valid Surfaces: 1
Number of Invalid Surfaces: 0

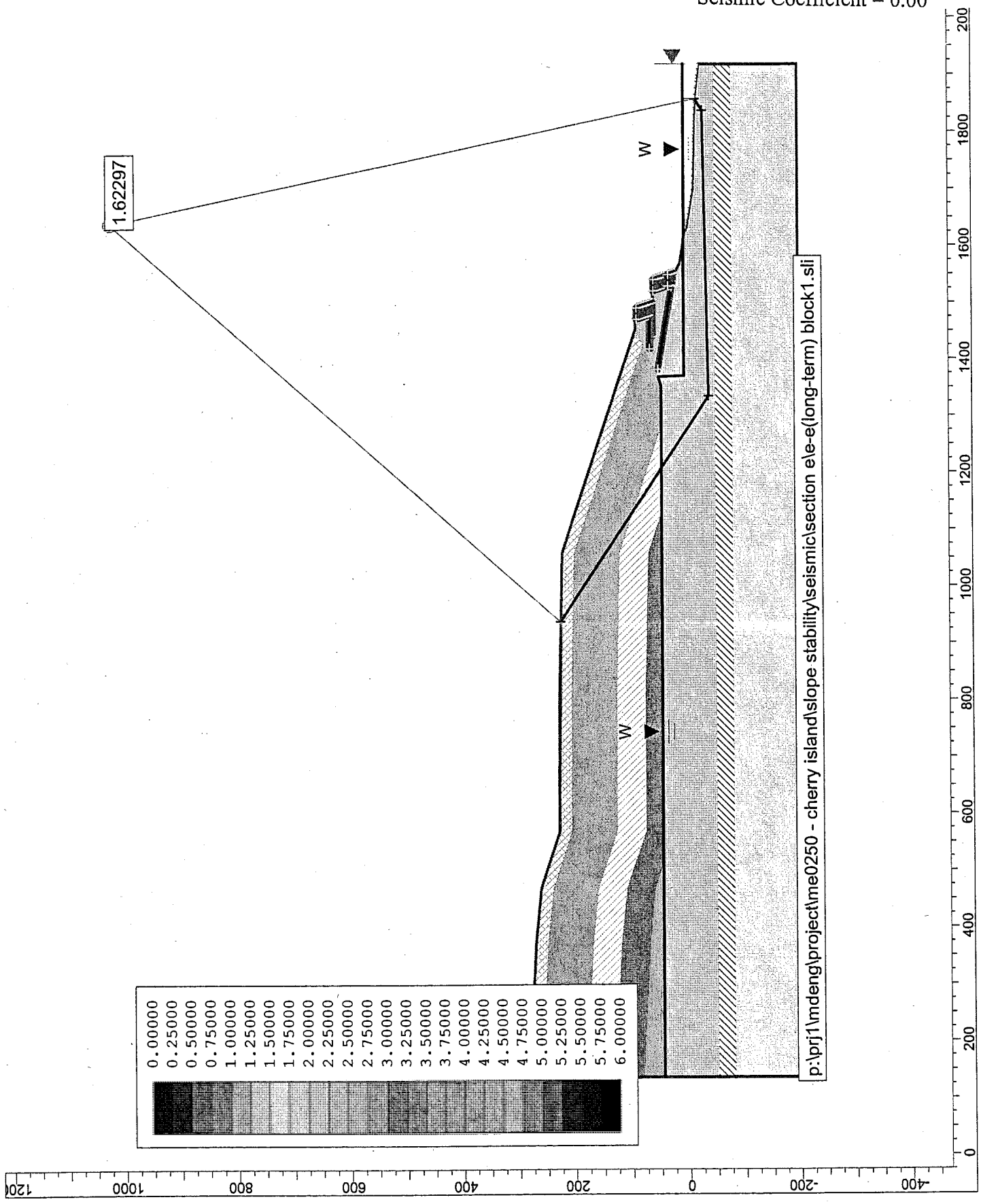
Section E-E (Long-Term Analysis)
Static Slope Stability
Block Analysis
Seismic Coefficient = 0.00



Task	Initials	Date
Analysis Performed by:	DMC	3/31/03
Assumptions Checked by:	RDS	3/31/03
Geometry Stratigraphy Checked by:	DTM	4/1/03
Input Parameters Checked by:	DTM	4/1/03
Input Parameter Implementation Checked by:	DTM	4/1/03
Reasonableness of Analysis Checked by:	CAS	4/1/03
Analysis Backchecked by:	DMC	4/1/03

E-LTS-1

Section E-E (Long-Term Analysis)
Static Slope Stability
Block Analysis
Seismic Coefficient = 0.00



ELTS-2

Section E-E (Long-Term Analysis)
Static Slope Stability
Block Analysis
Seismic Coefficient = 0.00

Slide Analysis Information

Document Name

File Name: e-e(long-term) block1

Project Settings

Project Title: SLIDE - An Interactive Slope Stability Program
Failure Direction: Left to Right
Units of Measurement: Imperial Units
Pore Fluid Unit Weight: 62.4 lb/ft3
Groundwater Method: Water Surfaces
Data Output: Standard

Analysis Methods

Analysis Methods used:
Spencer

Number of slices: 50
Tolerance: 0.005
Maximum number of iterations: 50

Surface Options

Surface Type: Non-Circular Block Search
Number of Surfaces: 5000
Pseudo-Random Surfaces: Enabled
Convex Surfaces Only: Disabled
Left Projection Angle (Start Angle): 135
Left Projection Angle (End Angle): 160
Right Projection Angle (Start Angle): 30
Right Projection Angle (End Angle): 60

Loading

Seismic Load Coefficient (Horizontal): 0
Seismic Load Coefficient (Vertical): 0

Material Properties

Material: Potomac Formation
Strength Type: Undrained
Unit Weight: 120 lb/ft3
Cohesion Type: Function of Depth
Cohesion (Top): 4500 psf
Cohesion Change: 14.4 psf/ft
Cutoff: 10000 psf
Water Surface: None

Material: Waste (0 to 20)
Strength Type: Mohr-Coulomb
Unit Weight: 60 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (20 to 100)
Strength Type: Mohr-Coulomb
Unit Weight: 75 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (100 to 150)
Strength Type: Mohr-Coulomb
Unit Weight: 80 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (150 to 200)
Strength Type: Mohr-Coulomb
Unit Weight: 85 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (>200)
Strength Type: Mohr-Coulomb
Unit Weight: 90 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: final cover
Strength Type: Mohr-Coulomb
Unit Weight: 120 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

ECT 3

Material: Columbia Formation
Strength Type: Mohr-Coulomb
Unit Weight: 125 lb/ft3
Cohesion: 0 psf
Friction Angle: 40 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: MSE Wall Soil
Strength Type: Mohr-Coulomb
Unit Weight: 90 lb/ft3
Cohesion: 0 psf
Friction Angle: 29 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Drained PVD Area
Strength Type: Shear Normal function
Unit Weight: 85 lb/ft3
Water Surface: Water Table
Custom Hu value: 1

Support Properties

Support: Geogrid
Support Type: GeoTextile
Force Application: Passive
Force Orientation: Bisector of Parallel and Tangent
Anchorage: Slope Face
Shear Strength Model: Linear
Strip Coverage: 100 percent
Tensile Strength: 5000 lb/ft
Pullout Strength Adhesion: 0 lb/ft2
Pullout Strength Friction Angle: 25 degrees

Support: Geogrid2
Support Type: GeoTextile
Force Application: Passive
Force Orientation: Bisector of Parallel and Tangent
Anchorage: Slope Face
Shear Strength Model: Linear
Strip Coverage: 100 percent
Tensile Strength: 21000 lb/ft
Pullout Strength Adhesion: 0 lb/ft2
Pullout Strength Friction Angle: 25 degrees

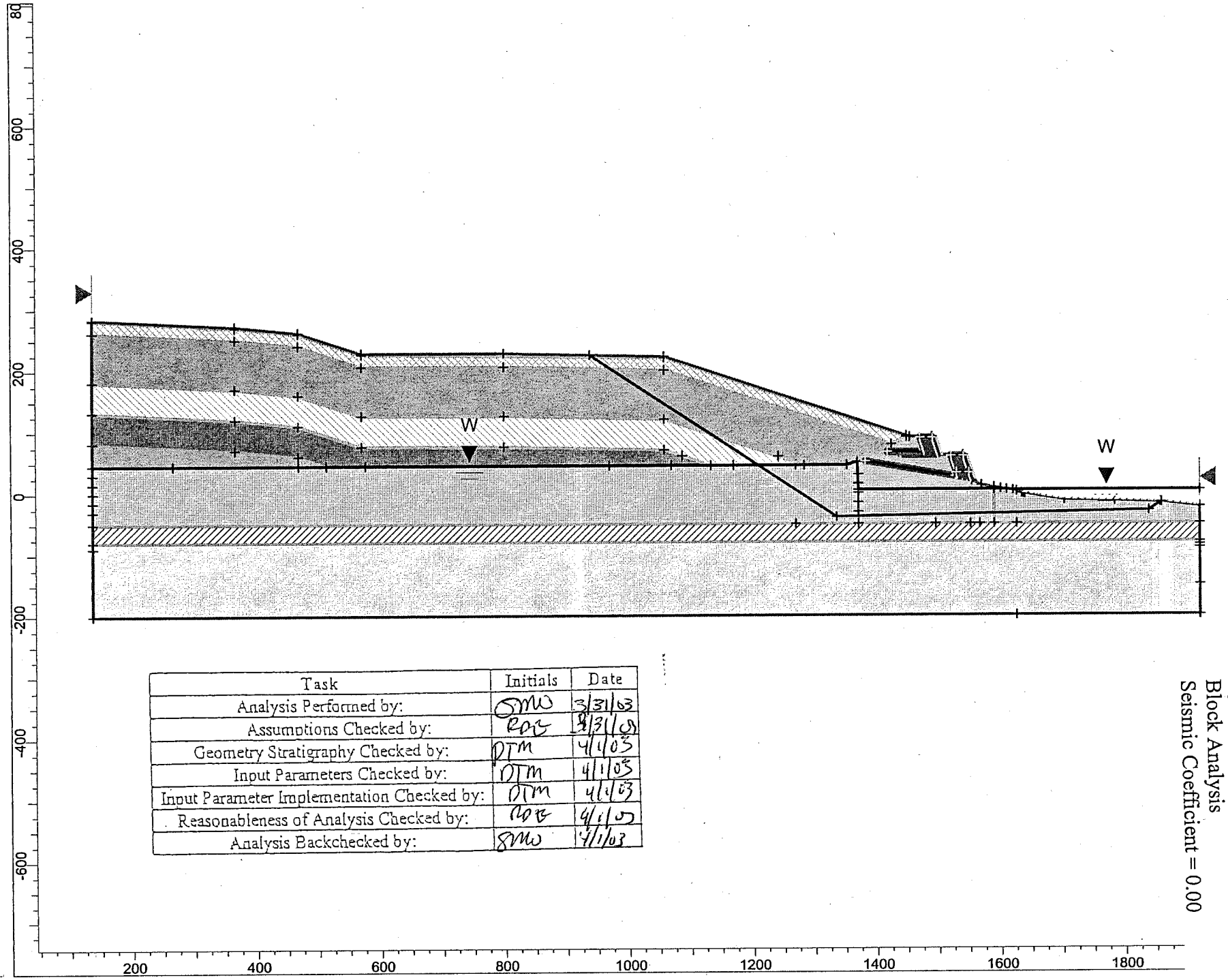
Global Minimums

Method: spencer
SF: 1.62297
Axis Location: 1638.37, 1023.18
Left Slip Surface Endpoint: 937.999, 224.643
Right Slip Surface Endpoint: 1856.98, -16.2415
Left Slope Intercept: 937.999 224.643
Right Slope Intercept: 1856.98 4

Method Statistics

Method: spencer
Number of Valid Surfaces: 1
Number of Invalid Surfaces: 0

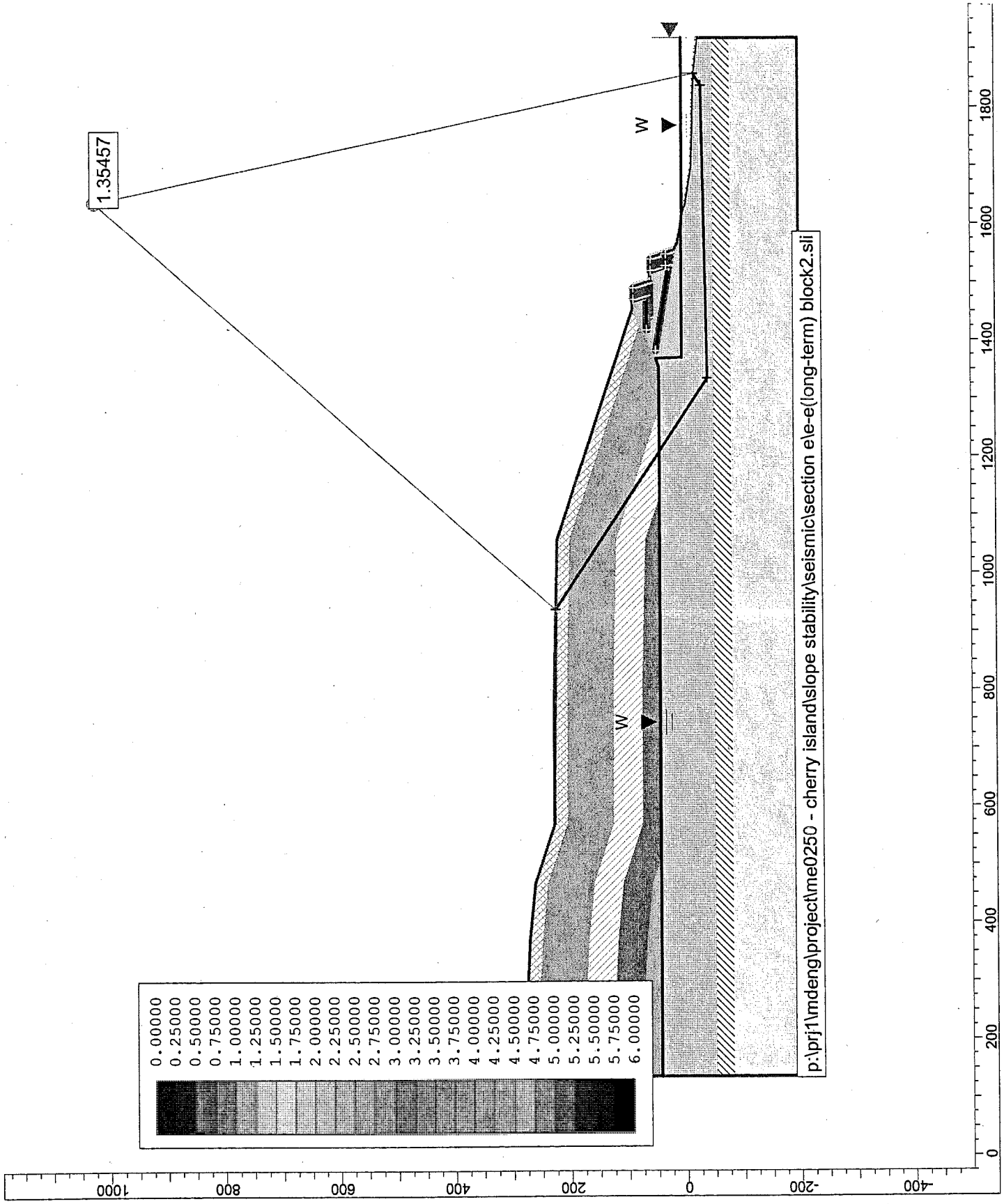
Section E-E (Long-Term Analysis)
Dynamic Slope Stability
Block Analysis
Seismic Coefficient = 0.00



Task	Initials	Date
Analysis Performed by:	SMW	3/31/03
Assumptions Checked by:	RDE	3/31/03
Geometry Stratigraphy Checked by:	DTM	4/1/03
Input Parameters Checked by:	DTM	4/1/03
Input Parameter Implementation Checked by:	DTM	4/1/03
Reasonableness of Analysis Checked by:	RDE	4/1/03
Analysis Backchecked by:	SMW	4/1/03

ELTS-4

Section E-E (Long-Term Analysis)
Dynamic Slope Stability
Block Analysis
Seismic Coefficient = 0.00



ELTS-5

Section E-E (Long-Term Analysis)
Dynamic Slope Stability
Block Analysis
Seismic Coefficient = 0.00

Slide Analysis Information

Document Name

File Name: e-e(long-term) block2

Project Settings

Project Title: SLIDE - An Interactive Slope Stability Program
Failure Direction: Left to Right
Units of Measurement: Imperial Units
Pore Fluid Unit Weight: 62.4 lb/ft3
Groundwater Method: Water Surfaces
Data Output: Standard

Analysis Methods

Analysis Methods used:
Spencer

Number of slices: 50
Tolerance: 0.005
Maximum number of iterations: 50

Surface Options

Surface Type: Non-Circular Block Search
Number of Surfaces: 5000
Pseudo-Random Surfaces: Enabled
Convex Surfaces Only: Disabled
Left Projection Angle (Start Angle): 135
Left Projection Angle (End Angle): 160
Right Projection Angle (Start Angle): 30
Right Projection Angle (End Angle): 60

Loading

Seismic Load Coefficient (Horizontal): 0
Seismic Load Coefficient (Vertical): 0

Material Properties

Material: Potomac Formation
Strength Type: Undrained
Unit Weight: 120 lb/ft3
Cohesion Type: Function of Depth
Cohesion (Top): 4500 psf
Cohesion Change: 14.4 psf/ft
Cutoff: 10000 psf
Water Surface: None

Material: Waste (0 to 20)
Strength Type: Mohr-Coulomb
Unit Weight: 60 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (20 to 100)
Strength Type: Mohr-Coulomb
Unit Weight: 75 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (100 to 150)
Strength Type: Mohr-Coulomb
Unit Weight: 80 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (150 to 200)
Strength Type: Mohr-Coulomb
Unit Weight: 85 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (>200)
Strength Type: Mohr-Coulomb
Unit Weight: 90 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: final cover
Strength Type: Mohr-Coulomb
Unit Weight: 120 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

E LTS 6

Material: Undrained PVD Area
Strength Type: Strength=F(overburden)
Unit Weight: 85 lb/ft3
Tau/Sigma Ratio: 0.29
Water Surface: Water Table
Custom Hu value: 1

Material: Columbia Formation
Strength Type: Mohr-Coulomb
Unit Weight: 125 lb/ft3
Cohesion: 0 psf
Friction Angle: 40 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: MSE Wall Soil
Strength Type: Mohr-Coulomb
Unit Weight: 90 lb/ft3
Cohesion: 0 psf
Friction Angle: 29 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Drained PVD Area
Strength Type: Shear Normal function
Unit Weight: 85 lb/ft3
Water Surface: Water Table
Custom Hu value: 1

Support Properties

Support: Geogrid
Support Type: GeoTextile
Force Application: Passive
Force Orientation: Bisector of Parallel and Tangent
Anchorage: Slope Face
Shear Strength Model: Linear
Strip Coverage: 100 percent
Tensile Strength: 5000 lb/ft
Pullout Strength Adhesion: 0 lb/ft2
Pullout Strength Friction Angle: 25 degrees

Support: Geogrid2
Support Type: GeoTextile
Force Application: Passive
Force Orientation: Bisector of Parallel and Tangent
Anchorage: Slope Face
Shear Strength Model: Linear
Strip Coverage: 100 percent
Tensile Strength: 21000 lb/ft
Pullout Strength Adhesion: 0 lb/ft2
Pullout Strength Friction Angle: 25 degrees

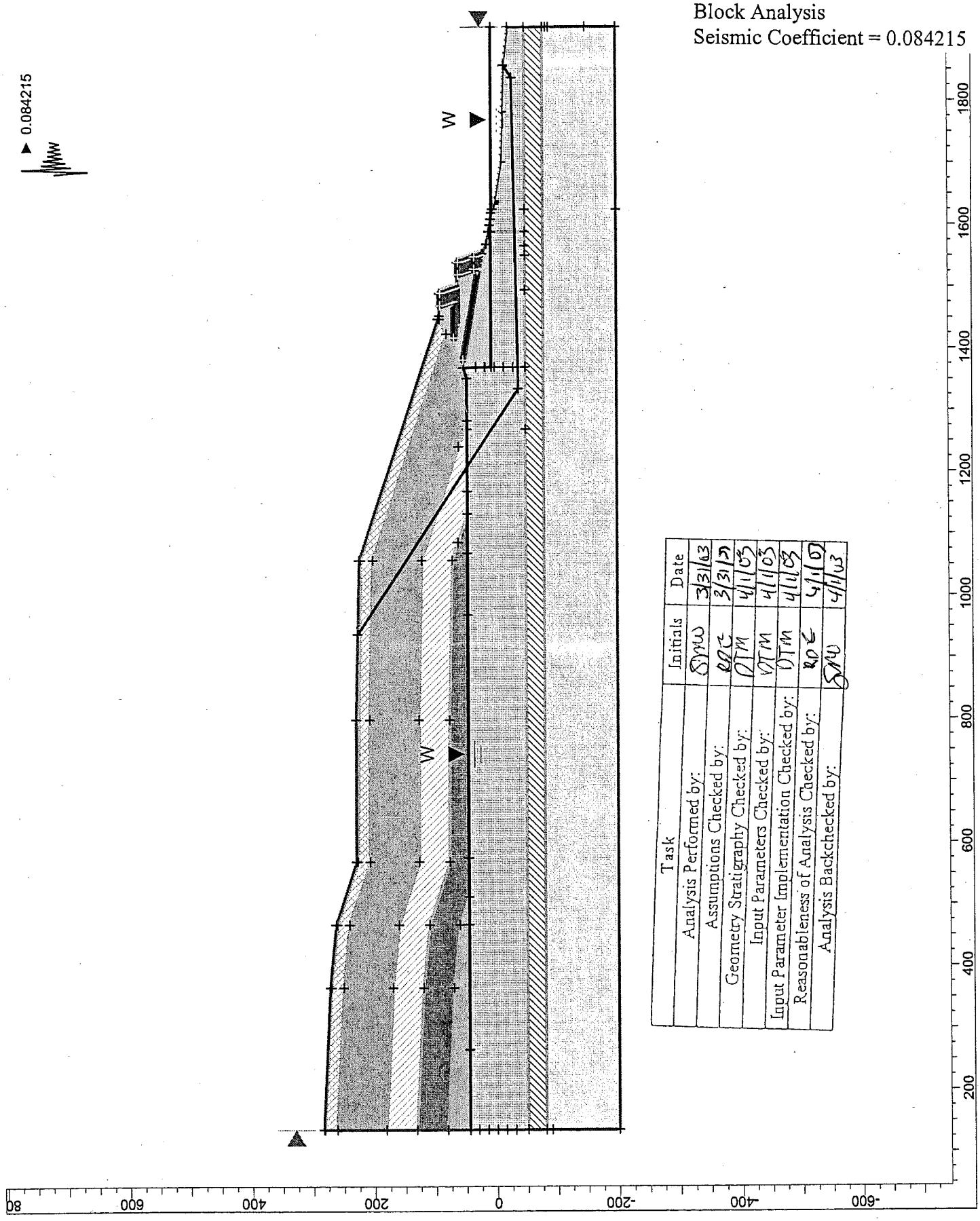
Global Minimums

Method: spencer
SF: 1.35457
Axis Location: 1638.37, 1023.18
Left Slip Surface Endpoint: 937.999, 224.643
Right Slip Surface Endpoint: 1856.98, -16.2415
Left Slope Intercept: 937.999 224.643
Right Slope Intercept: 1856.98 4

Method Statistics

Method: spencer
Number of Valid Surfaces: 1
Number of Invalid Surfaces: 0

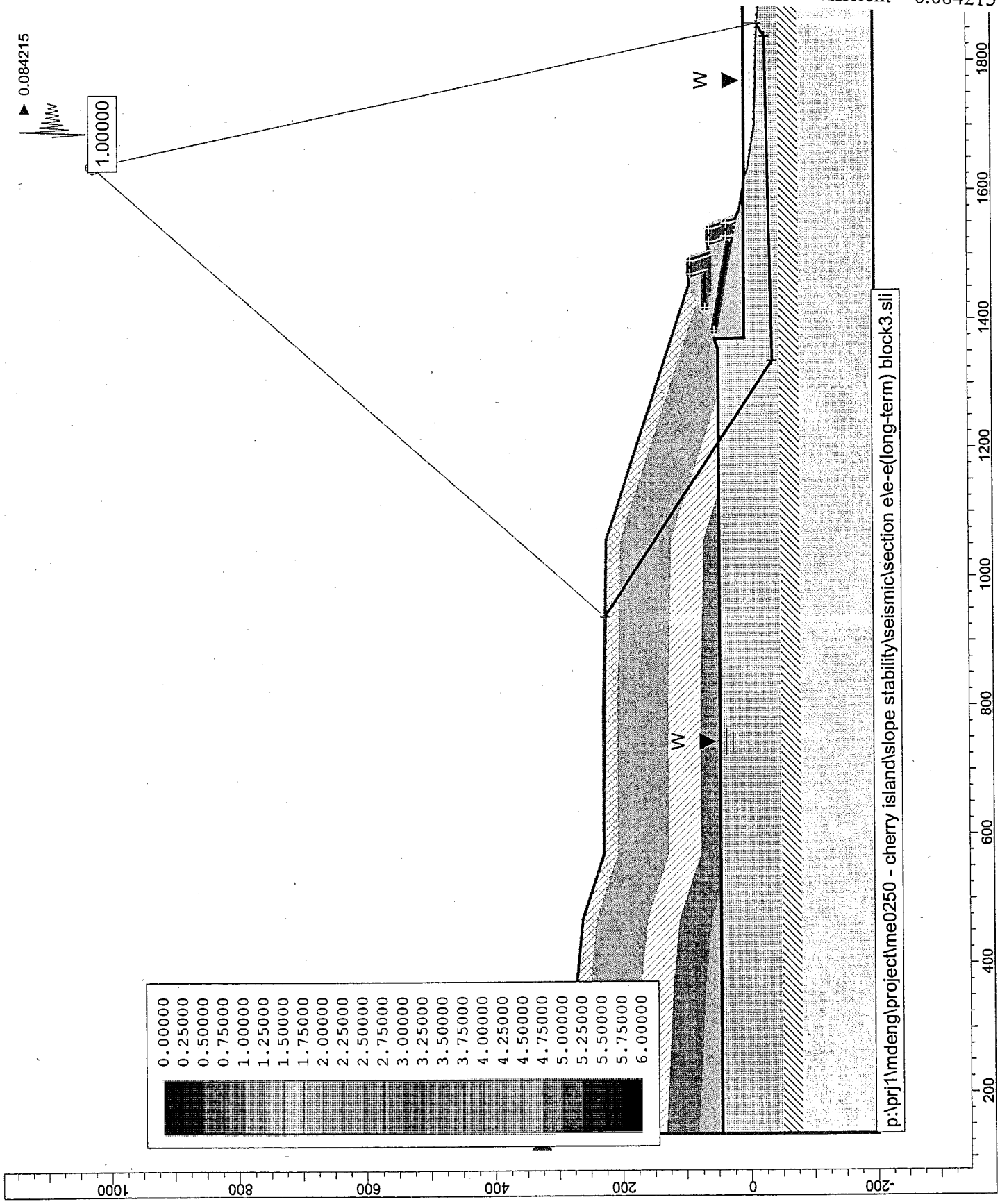
Section E-E (Long-Term Analysis)
Dynamic Slope Stability
Block Analysis
Seismic Coefficient = 0.084215



Task	Initials	Date
Analysis Performed by:	SMW	3/31/03
Assumptions Checked by:	RAC	3/31/03
Geometry Stratigraphy Checked by:	DTM	4/1/03
Input Parameters Checked by:	DTM	4/1/03
Input Parameter Implementation Checked by:	DTM	4/1/03
Reasonableness of Analysis Checked by:	RAC	4/1/03
Analysis Backchecked by:	SMW	4/1/03

ELTS-7

Section E-E (Long-Term Analysis)
Dynamic Slope Stability
Block Analysis
Seismic Coefficient = 0.084215



ELTS-8

Section E-E (Long-Term Analysis)
Dynamic Slope Stability
Block Analysis
Seismic Coefficient = 0.084215

Slide Analysis Information

Document Name

File Name: e-e(long-term) block3

Project Settings

Project Title: SLIDE - An Interactive Slope Stability Program
Failure Direction: Left to Right
Units of Measurement: Imperial Units
Pore Fluid Unit Weight: 62.4 lb/ft3
Groundwater Method: Water Surfaces
Data Output: Standard

Analysis Methods

Analysis Methods used:
Spencer

Number of slices: 50
Tolerance: 0.005
Maximum number of iterations: 50

Surface Options

Surface Type: Non-Circular Block Search
Number of Surfaces: 5000
Pseudo-Random Surfaces: Enabled
Convex Surfaces Only: Disabled
Left Projection Angle (Start Angle): 135
Left Projection Angle (End Angle): 160
Right Projection Angle (Start Angle): 30
Right Projection Angle (End Angle): 60

Loading

Seismic Load Coefficient (Horizontal): 0.084215
Seismic Load Coefficient (Vertical): 0

Material Properties

Material: Potomac Formation
Strength Type: Undrained
Unit Weight: 120 lb/ft3
Cohesion Type: Function of Depth
Cohesion (Top): 4500 psf
Cohesion Change: 14.4 psf/ft
Cutoff: 10000 psf
Water Surface: None

Material: Waste (0 to 20)
Strength Type: Mohr-Coulomb
Unit Weight: 60 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (20 to 100)
Strength Type: Mohr-Coulomb
Unit Weight: 75 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (100 to 150)
Strength Type: Mohr-Coulomb
Unit Weight: 80 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (150 to 200)
Strength Type: Mohr-Coulomb
Unit Weight: 85 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (>200)
Strength Type: Mohr-Coulomb
Unit Weight: 90 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: final cover
Strength Type: Mohr-Coulomb
Unit Weight: 120 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

E-LTS-9

Material: Undrained PVD Area
Strength Type: Strength=F(overburden)
Unit Weight: 85 lb/ft3
Tau/Sigma Ratio: 0.29
Water Surface: Water Table
Custom Hu value: 1

Material: Columbia Formation
Strength Type: Mohr-Coulomb
Unit Weight: 125 lb/ft3
Cohesion: 0 psf
Friction Angle: 40 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: MSE Wall Soil
Strength Type: Mohr-Coulomb
Unit Weight: 90 lb/ft3
Cohesion: 0 psf
Friction Angle: 29 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Drained PVD Area
Strength Type: Shear Normal function
Unit Weight: 85 lb/ft3
Water Surface: Water Table
Custom Hu value: 1

Support Properties

Support: Geogrid
Support Type: GeoTextile
Force Application: Passive
Force Orientation: Bisector of Parallel and Tangent
Anchorage: Slope Face
Shear Strength Model: Linear
Strip Coverage: 100 percent
Tensile Strength: 5000 lb/ft
Pullout Strength Adhesion: 0 lb/ft2
Pullout Strength Friction Angle: 25 degrees

Support: Geogrid2
Support Type: GeoTextile
Force Application: Passive
Force Orientation: Bisector of Parallel and Tangent
Anchorage: Slope Face
Shear Strength Model: Linear
Strip Coverage: 100 percent
Tensile Strength: 21000 lb/ft
Pullout Strength Adhesion: 0 lb/ft2
Pullout Strength Friction Angle: 25 degrees

Global Minimums

Method: spencer
SF: 1
Axis Location: 1638.37, 1023.18
Left Slip Surface Endpoint: 937.999, 224.643
Right Slip Surface Endpoint: 1856.98, -16.2415
Left Slope Intercept: 937.999 224.643
Right Slope Intercept: 1856.98 4

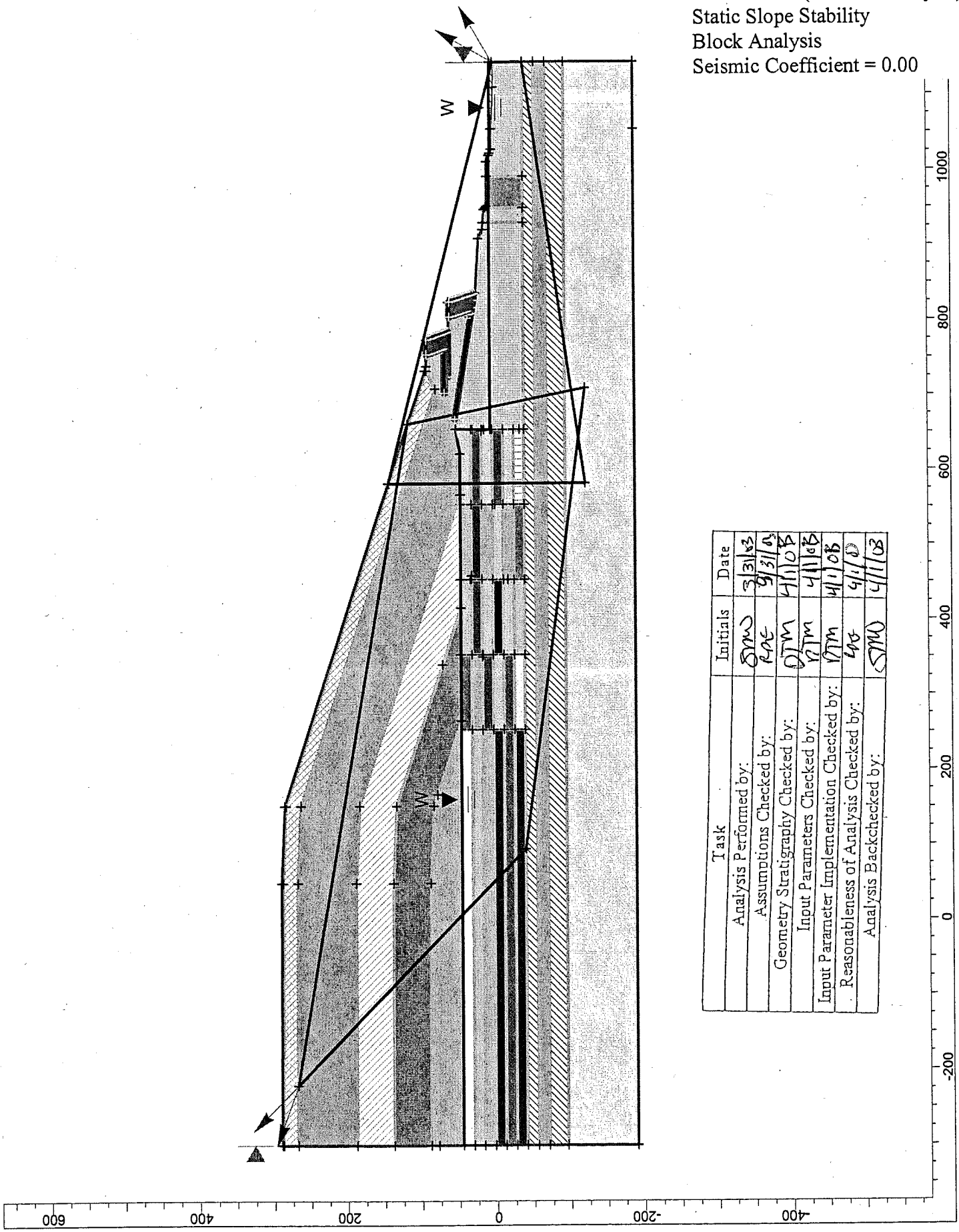
Method Statistics

Method: spencer
Number of Valid Surfaces: 1
Number of Invalid Surfaces: 0

ATTACHMENT C

Evaluation of Yield Acceleration for Section H-H

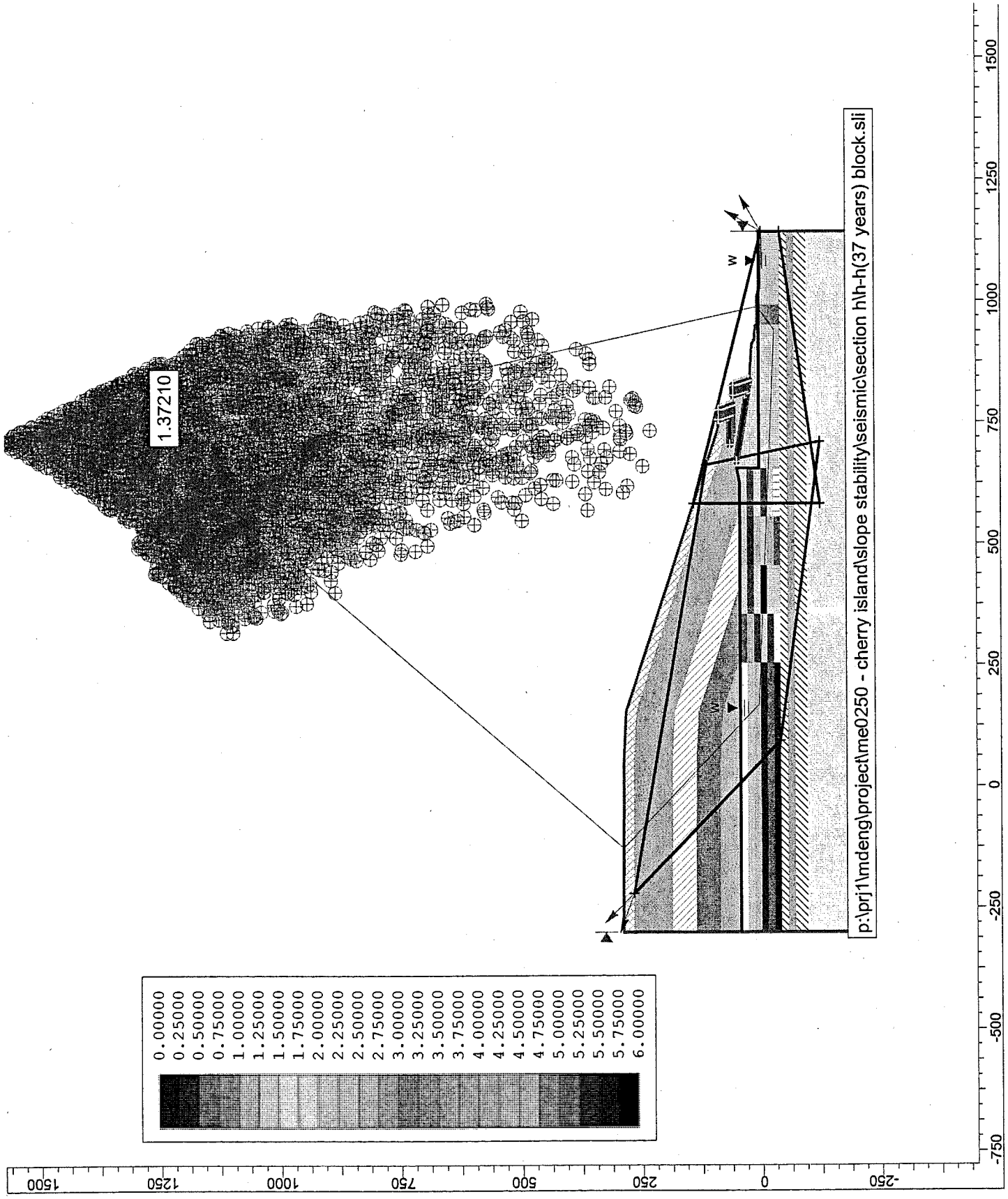
Section H-H (37 Year Analysis)
Static Slope Stability
Block Analysis
Seismic Coefficient = 0.00



Task	Initials	Date
Analysis Performed by:	SMW	3/31/03
Assumptions Checked by:	RAE	3/31/03
Geometry Stratigraphy Checked by:	DJM	4/1/03
Input Parameters Checked by:	RJM	4/1/03
Input Parameter Implementation Checked by:	RJM	4/1/03
Reasonableness of Analysis Checked by:	GG	4/1/03
Analysis Backchecked by:	SMW	4/1/03

H37S-1

Section H-H (37 Year Analysis)
Static Slope Stability
Block Analysis
Seismic Coefficient = 0.00



H375-2

Section H-H (37 Year Analysis)
Static Slope Stability
Block Analysis
Seismic Coefficient = 0.00

Slide Analysis Information

Document Name

File Name: h-h(37 years) block

Project Settings

Project Title: SLIDE - An Interactive Slope Stability Program
Failure Direction: Left to Right
Units of Measurement: Imperial Units
Pore Fluid Unit Weight: 62.4 lb/ft3
Groundwater Method: Water Surfaces
Data Output: Standard

Analysis Methods

Analysis Methods used:
Spencer

Number of slices: 50
Tolerance: 0.005
Maximum number of iterations: 50

Surface Options

Surface Type: Non-Circular Block Search
Number of Surfaces: 5000
Pseudo-Random Surfaces: Enabled
Convex Surfaces Only: Disabled
Left Projection Angle (Start Angle): 135
Left Projection Angle (End Angle): 160
Right Projection Angle (Start Angle): 30
Right Projection Angle (End Angle): 60

Loading

Seismic Load Coefficient (Horizontal): 0
Seismic Load Coefficient (Vertical): 0

Material Properties

Material: Potomac Formation
Strength Type: Undrained
Unit Weight: 120 lb/ft3
Cohesion Type: Function of Depth
Cohesion (Top): 4500 psf
Cohesion Change: 14.4 psf/ft
Cutoff: 10000 psf
Water Surface: None

Material: Waste (0 to 20)
Strength Type: Mohr-Coulomb
Unit Weight: 60 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (20 to 100)
Strength Type: Mohr-Coulomb
Unit Weight: 75 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (100 to 150)
Strength Type: Mohr-Coulomb
Unit Weight: 80 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (150 to 200)
Strength Type: Mohr-Coulomb
Unit Weight: 85 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (>200)
Strength Type: Mohr-Coulomb
Unit Weight: 90 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: final cover
Strength Type: Mohr-Coulomb
Unit Weight: 120 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

H375.3

Material: Drained PVD Area
Strength Type: Shear Normal function
Unit Weight: 85 lb/ft3
Water Surface: Water Table
Custom Hu value: 1

Material: d11
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2003 psf
Water Surface: None

Material: d12
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1813 psf
Water Surface: None

Material: d13
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1695 psf
Water Surface: None

Material: d14
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1663 psf
Water Surface: None

Material: d15
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1756 psf
Water Surface: None

Material: d16
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2405 psf
Water Surface: None

Material: d21
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2647 psf
Water Surface: None

Material: d22
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2327 psf
Water Surface: None

Material: d23
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2113 psf
Water Surface: None

Material: d24
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2025 psf
Water Surface: None

Material: d25
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2103 psf
Water Surface: None

Material: d26
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2937 psf
Water Surface: None

Material: d31
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 3295 psf
Water Surface: None

Material: d32
Strength Type: Undrained

Section H-H (37 Year Analysis)
Static Slope Stability
Block Analysis
Seismic Coefficient = 0.00

Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2718 psf
Water Surface: None

Material: d33
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2302 psf
Water Surface: None

Material: d34
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2120 psf
Water Surface: None

Material: d35
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2205 psf
Water Surface: None

Material: d36
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 3391 psf
Water Surface: None

Material: d41
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 3660 psf
Water Surface: None

Material: d42
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2775 psf
Water Surface: None

Material: d43
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2232 psf
Water Surface: None

Material: d44
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2132 psf
Water Surface: None

Material: d45
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2506 psf
Water Surface: None

Material: d46
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 3917 psf
Water Surface: None

Material: d51
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 4273 psf
Water Surface: None

Material: d52
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 3002 psf
Water Surface: None

Material: d53
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2324 psf
Water Surface: None

Material: d54
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant

H375.4

Cohesion: 2238 psf
Water Surface: None

Material: d55
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2751 psf
Water Surface: None

Material: d56
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 4535 psf
Water Surface: None

Material: River Sediments
Strength Type: Strength=F(overburden)
Unit Weight: 85 lb/ft3
Tau/Sigma Ratio: 0.29
Water Surface: Water Table
Custom Hu value: 1

Material: Columbia Formation
Strength Type: Mohr-Coulomb
Unit Weight: 125 lb/ft3
Cohesion: 0 psf
Friction Angle: 40 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: MSE Wall Soil
Strength Type: Mohr-Coulomb
Unit Weight: 90 lb/ft3
Cohesion: 0 psf
Friction Angle: 29 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Wetlands
Strength Type: Strength=F(overburden)
Unit Weight: 85 lb/ft3
Tau/Sigma Ratio: 0.29
Water Surface: Water Table
Custom Hu value: 1

Material: Clay Layer
Strength Type: Undrained
Unit Weight: 120 lb/ft3
Cohesion Type: Constant
Cohesion: 4000 psf
Water Surface: None

Support Properties

Support: Geogrid
Support Type: GeoTextile
Force Application: Passive
Force Orientation: Bisector of Parallel and Tangent
Anchorage: Slope Face
Shear Strength Model: Linear
Strip Coverage: 100 percent
Tensile Strength: 5000 lb/ft
Pullout Strength Adhesion: 0 lb/ft2
Pullout Strength Friction Angle: 25 degrees

Support: Geogrid2
Support Type: GeoTextile
Force Application: Passive
Force Orientation: Bisector of Parallel and Tangent
Anchorage: Slope Face
Shear Strength Model: Linear
Strip Coverage: 100 percent
Tensile Strength: 21000 lb/ft
Pullout Strength Adhesion: 0 lb/ft2
Pullout Strength Friction Angle: 25 degrees

Global Minimums

Method: spencer
SF: 1.3721
Axis Location: 711.41, 1262.57
Left Slip Surface Endpoint: -126.99, 289.653
Right Slip Surface Endpoint: 986.703, 8.1

Method Statistics

Method: spencer
Number of Valid Surfaces: 3688
Number of Invalid Surfaces: 1312
Error Codes:
Error Code -105 reported for 186 surfaces
Error Code -108 reported for 942 surfaces
Error Code -111 reported for 122 surfaces
Error Code -112 reported for 62 surfaces

Error Codes

Section H-H (37 Year Analysis)
Static Slope Stability
Block Analysis
Seismic Coefficient = 0.00

The following errors were encountered during the computation:

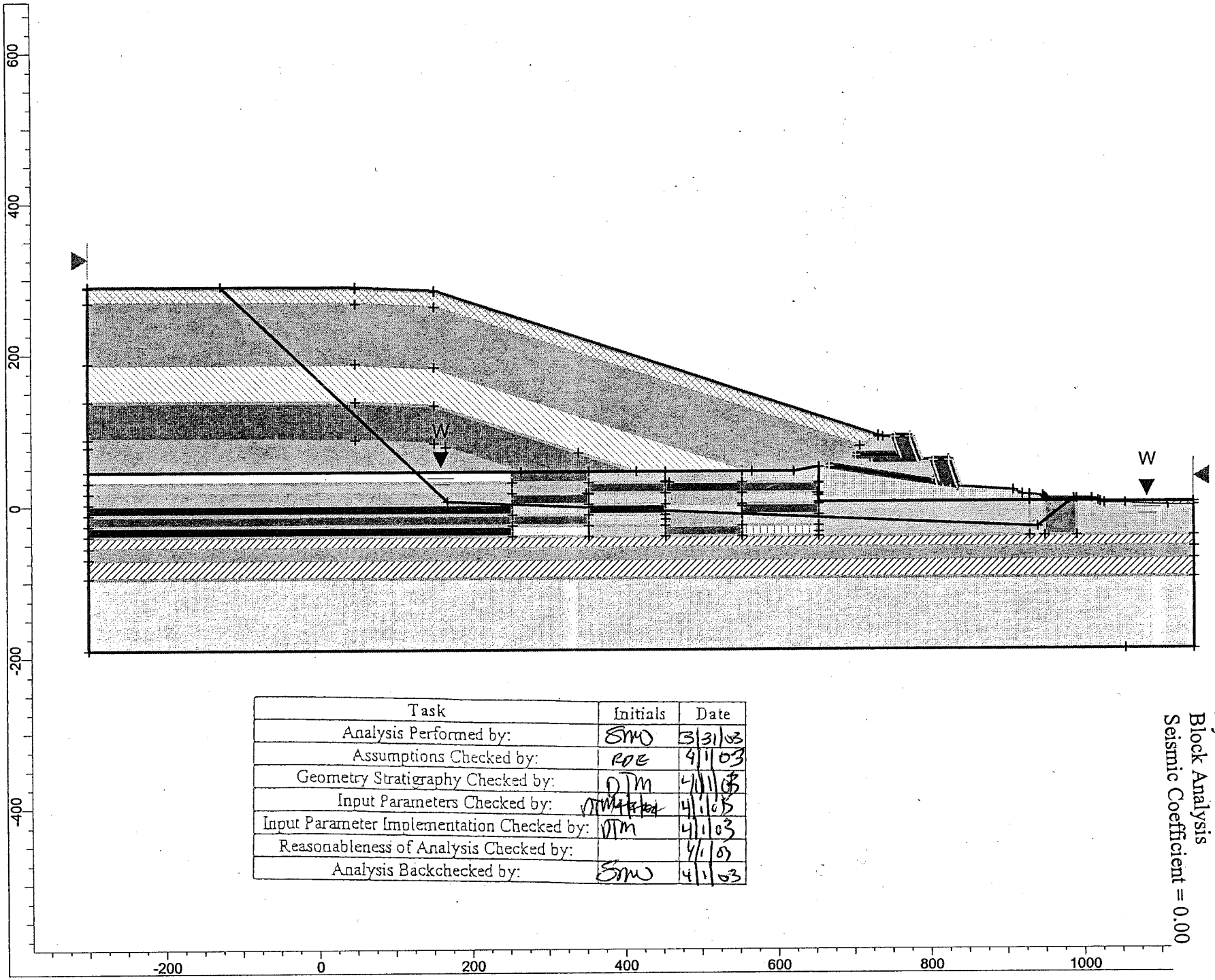
-105 = More than two surface / slope intersections with no valid slip surface.

-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).

-111 = safety factor equation did not converge

-112 = The coefficient M-Alpha = cos(alpha)(1+tan(alpha)tan(phi)/F) < 0.2 for the final iteration of the safety factor calculation. This screens out some slip surfaces which may not be valid in the context of the analysis, in particular, deep seated slip surfaces with many high negative base angle slices in the passive zone.

H375.5



Task	Initials	Date
Analysis Performed by:	SMO	3/31/03
Assumptions Checked by:	RDE	4/1/03
Geometry Stratigraphy Checked by:	DTM	4/1/03
Input Parameters Checked by:	DTM	4/1/03
Input Parameter Implementation Checked by:	DTM	4/1/03
Reasonableness of Analysis Checked by:		4/1/03
Analysis Backchecked by:	SMO	4/1/03

Section H-H (37 Year Analysis)
Dynamic Slope Stability
Block Analysis
Seismic Coefficient = 0.00

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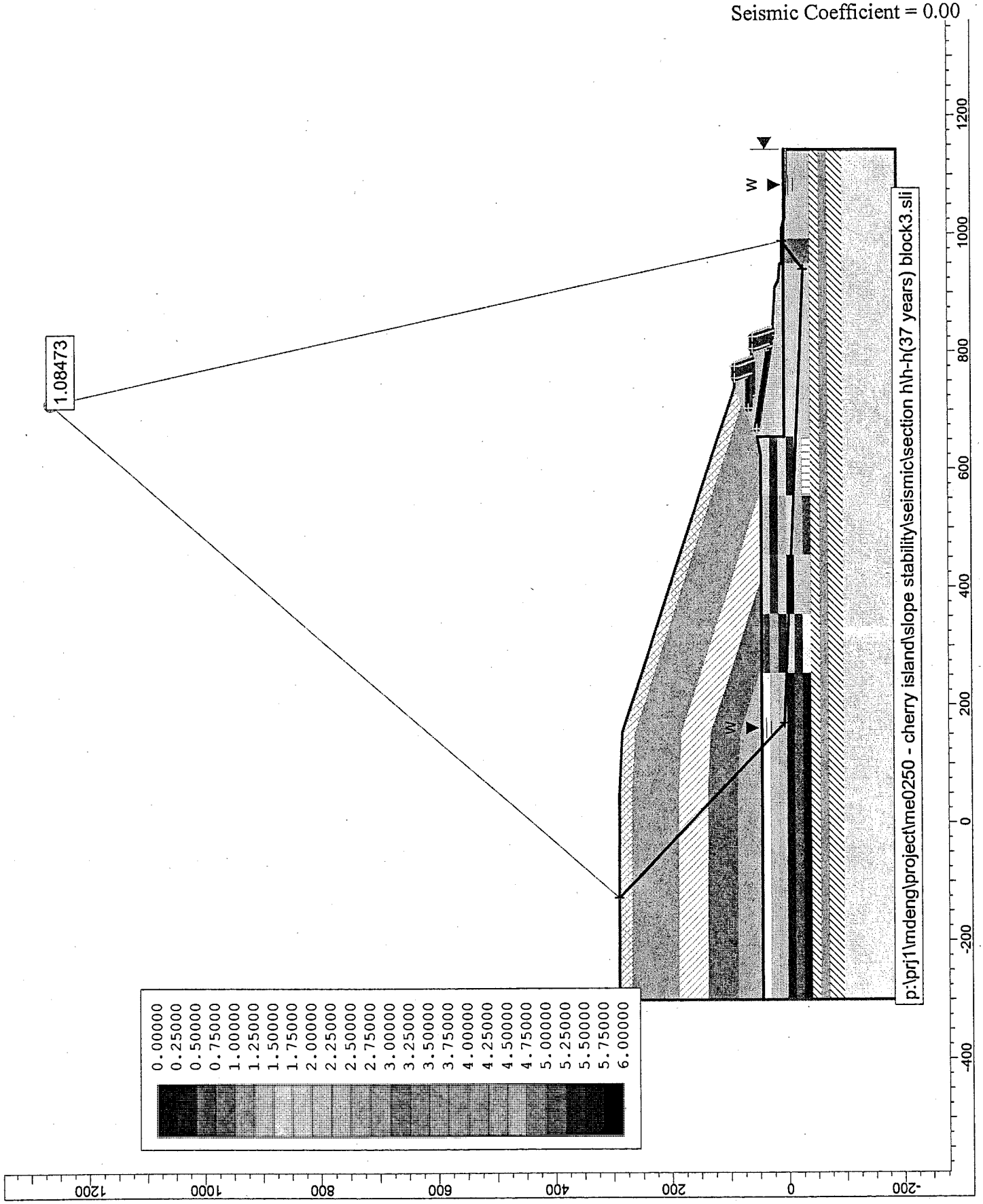
Section H-H (37 Year Analysis)
Dynamic Slope Stability
Block Analysis
Seismic Coefficient = 0.00



H375-7

Section H-H (37 Year Analysis)
Dynamic Slope Stability
Block Analysis
Seismic Coefficient = 0.00

Slide Analysis Information

Document Name

File Name: h-h(37 years) block3

Project Settings

Project Title: SLIDE - An Interactive Slope Stability Program
Failure Direction: Left to Right
Units of Measurement: Imperial Units
Pore Fluid Unit Weight: 62.4 lb/ft3
Groundwater Method: Water Surfaces
Data Output: Standard

Analysis Methods

Analysis Methods used:
Spencer

Number of slices: 50
Tolerance: 0.005
Maximum number of iterations: 50

Surface Options

Surface Type: Non-Circular Block Search
Number of Surfaces: 5000
Pseudo-Random Surfaces: Enabled
Convex Surfaces Only: Disabled
Left Projection Angle (Start Angle): 135
Left Projection Angle (End Angle): 160
Right Projection Angle (Start Angle): 30
Right Projection Angle (End Angle): 60

Loading

Seismic Load Coefficient (Horizontal): 0
Seismic Load Coefficient (Vertical): 0

Material Properties

Material: Potomac Formation
Strength Type: Undrained
Unit Weight: 120 lb/ft3
Cohesion Type: Function of Depth
Cohesion (Top): 4500 psf
Cohesion Change: 14.4 psf/ft
Cutoff: 10000 psf
Water Surface: None

Material: Waste (0 to 20)
Strength Type: Mohr-Coulomb
Unit Weight: 60 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (20 to 100)
Strength Type: Mohr-Coulomb
Unit Weight: 75 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (100 to 150)
Strength Type: Mohr-Coulomb
Unit Weight: 80 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (150 to 200)
Strength Type: Mohr-Coulomb
Unit Weight: 85 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (>200)
Strength Type: Mohr-Coulomb
Unit Weight: 90 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: final cover
Strength Type: Mohr-Coulomb
Unit Weight: 120 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

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Material: Undrained PVD Area
Strength Type: Strength=F(overburden)
Unit Weight: 85 lb/ft3
Tau/Sigma Ratio: 0.29
Water Surface: Water Table
Custom Hu value: 1

Material: d11
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2003 psf
Water Surface: None

Material: d12
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1813 psf
Water Surface: None

Material: d13
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1695 psf
Water Surface: None

Material: d14
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1663 psf
Water Surface: None

Material: d15
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1756 psf
Water Surface: None

Material: d16
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2405 psf
Water Surface: None

Material: d21
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2647 psf
Water Surface: None

Material: d22
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2327 psf
Water Surface: None

Material: d23
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2113 psf
Water Surface: None

Material: d24
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2025 psf
Water Surface: None

Material: d25
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2103 psf
Water Surface: None

Material: d26
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2937 psf
Water Surface: None

Material: d31
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 3295 psf
Water Surface: None

Material: d32

Section H-H (37 Year Analysis)
Dynamic Slope Stability
Block Analysis
Seismic Coefficient = 0.00

Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2718 psf
Water Surface: None

Material: d33
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2302 psf
Water Surface: None

Material: d34
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2120 psf
Water Surface: None

Material: d35
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2205 psf
Water Surface: None

Material: d36
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 3391 psf
Water Surface: None

Material: d41
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 3660 psf
Water Surface: None

Material: d42
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2775 psf
Water Surface: None

Material: d43
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2232 psf
Water Surface: None

Material: d44
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2132 psf
Water Surface: None

Material: d45
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2506 psf
Water Surface: None

Material: d46
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 3917 psf
Water Surface: None

Material: d51
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 4273 psf
Water Surface: None

Material: d52
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 3002 psf
Water Surface: None

Material: d53
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2324 psf
Water Surface: None

Material: d54
Strength Type: Undrained
Unit Weight: 85 lb/ft3

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Cohesion Type: Constant
Cohesion: 2238 psf
Water Surface: None

Material: d55
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2751 psf
Water Surface: None

Material: d56
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 4535 psf
Water Surface: None

Material: River Sediments
Strength Type: Strength=F(overburden)
Unit Weight: 85 lb/ft3
Tau/Sigma Ratio: 0.29
Water Surface: Water Table
Custom Hu value: 1

Material: Columbia Formation
Strength Type: Mohr-Coulomb
Unit Weight: 125 lb/ft3
Cohesion: 0 psf
Friction Angle: 40 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: MSE Wall Soil
Strength Type: Mohr-Coulomb
Unit Weight: 90 lb/ft3
Cohesion: 0 psf
Friction Angle: 29 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Wetlands
Strength Type: Strength=F(overburden)
Unit Weight: 85 lb/ft3
Tau/Sigma Ratio: 0.29
Water Surface: Water Table
Custom Hu value: 1

Material: Clay Layer
Strength Type: Undrained
Unit Weight: 120 lb/ft3
Cohesion Type: Constant
Cohesion: 4000 psf
Water Surface: None

Material: Drained PVD Area
Strength Type: Shear Normal function
Unit Weight: 85 lb/ft3
Water Surface: Water Table
Custom Hu value: 1

Support Properties

Support: Geogrid
Support Type: GeoTextile
Force Application: Passive
Force Orientation: Bisector of Parallel and Tangent
Anchorage: Slope Face
Shear Strength Model: Linear
Strip Coverage: 100 percent
Tensile Strength: 5000 lb/ft
Pullout Strength Adhesion: 0 lb/ft2
Pullout Strength Friction Angle: 25 degrees

Support: Geogrid2
Support Type: GeoTextile
Force Application: Passive
Force Orientation: Bisector of Parallel and Tangent
Anchorage: Slope Face
Shear Strength Model: Linear
Strip Coverage: 100 percent
Tensile Strength: 21000 lb/ft
Pullout Strength Adhesion: 0 lb/ft2
Pullout Strength Friction Angle: 25 degrees

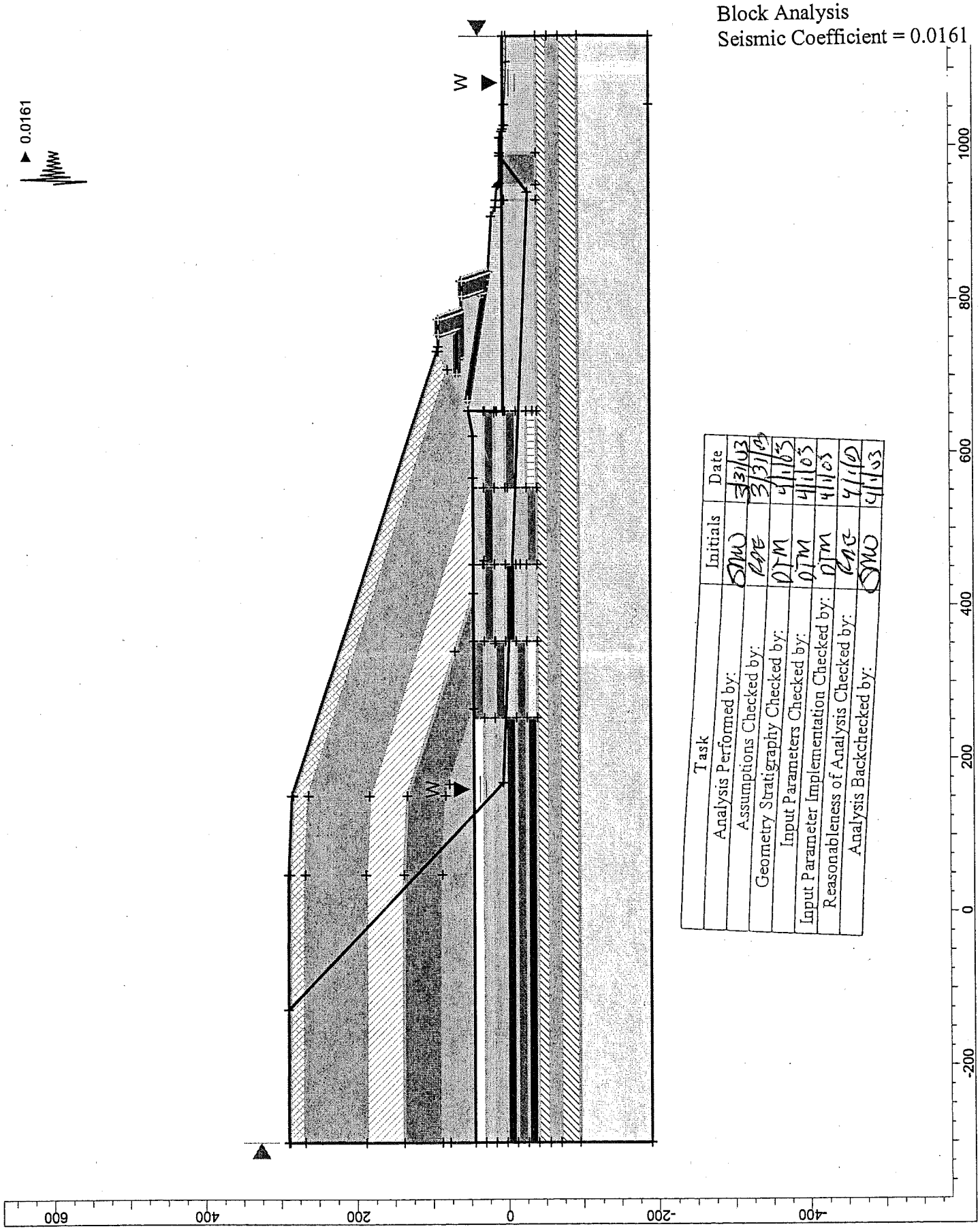
Global Minimums

Method: spencer
SF: 1.08473
Axis Location: 711.41, 1262.57
Left Slip Surface Endpoint: -126.99, 289.653
Right Slip Surface Endpoint: 986.703, 8.1

Method Statistics

Method: spencer
Number of Valid Surfaces: 1
Number of Invalid Surfaces: 0

Section H-H (37 Year Analysis)
Dynamic Slope Stability
Block Analysis
Seismic Coefficient = 0.0161



Task	Initials	Date
Analysis Performed by:	SMW	3/31/03
Assumptions Checked by:	RAE	3/31/03
Geometry Stratigraphy Checked by:	DTM	4/1/03
Input Parameters Checked by:	DTM	4/1/03
Input Parameter Implementation Checked by:	DTM	4/1/03
Reasonableness of Analysis Checked by:	RAE	4/1/03
Analysis Backchecked by:	SMW	4/1/03

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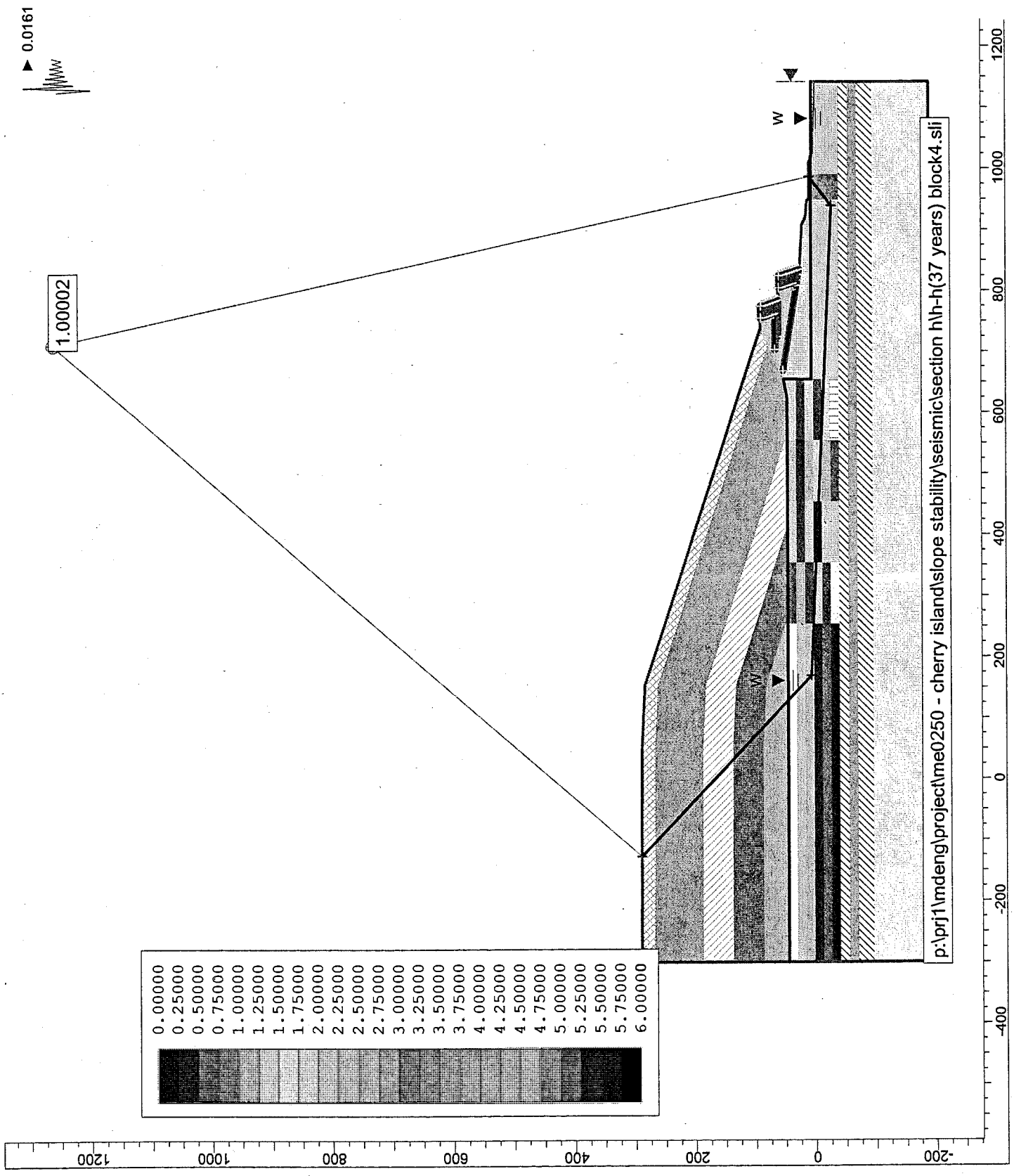
Section H-H (37 Year Analysis)
Dynamic Slope Stability
Block Analysis
Seismic Coefficient = 0.0161



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Section H-H (37 Year Analysis)
Dynamic Slope Stability
Block Analysis
Seismic Coefficient = 0.0161

Slide Analysis Information

Document Name

File Name: h-h(37 years) block4

Project Settings

Project Title: SLIDE - An Interactive Slope Stability Program
Failure Direction: Left to Right
Units of Measurement: Imperial Units
Pore Fluid Unit Weight: 62.4 lb/ft3
Groundwater Method: Water Surfaces
Data Output: Standard

Analysis Methods

Analysis Methods used:
Spencer

Number of slices: 50
Tolerance: 0.005
Maximum number of iterations: 50

Surface Options

Surface Type: Non-Circular Block Search
Number of Surfaces: 5000
Pseudo-Random Surfaces: Enabled
Convex Surfaces Only: Disabled
Left Projection Angle (Start Angle): 135
Left Projection Angle (End Angle): 160
Right Projection Angle (Start Angle): 30
Right Projection Angle (End Angle): 60

Loading

Seismic Load Coefficient (Horizontal): 0.0161
Seismic Load Coefficient (Vertical): 0

Material Properties

Material: Potomac Formation
Strength Type: Undrained
Unit Weight: 120 lb/ft3
Cohesion Type: Function of Depth
Cohesion (Top): 4500 psf
Cohesion Change: 14.4 psf/ft
Cutoff: 10000 psf
Water Surface: None

Material: Waste (0 to 20)
Strength Type: Mohr-Coulomb
Unit Weight: 60 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (20 to 100)
Strength Type: Mohr-Coulomb
Unit Weight: 75 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (100 to 150)
Strength Type: Mohr-Coulomb
Unit Weight: 80 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (150 to 200)
Strength Type: Mohr-Coulomb
Unit Weight: 85 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (>200)
Strength Type: Mohr-Coulomb
Unit Weight: 90 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: final cover
Strength Type: Mohr-Coulomb
Unit Weight: 120 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

H375-12

Material: Undrained PVD Area
Strength Type: Strength=F(overburden)
Unit Weight: 85 lb/ft3
Tau/Sigma Ratio: 0.29
Water Surface: Water Table
Custom Hu value: 1

Material: d11
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2003 psf
Water Surface: None

Material: d12
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1813 psf
Water Surface: None

Material: d13
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1695 psf
Water Surface: None

Material: d14
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1663 psf
Water Surface: None

Material: d15
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 1756 psf
Water Surface: None

Material: d16
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2405 psf
Water Surface: None

Material: d21
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2647 psf
Water Surface: None

Material: d22
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2327 psf
Water Surface: None

Material: d23
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2113 psf
Water Surface: None

Material: d24
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2025 psf
Water Surface: None

Material: d25
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2103 psf
Water Surface: None

Material: d26
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2937 psf
Water Surface: None

Material: d31
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 3295 psf
Water Surface: None

Material: d32

Section H-H (37 Year Analysis)
Dynamic Slope Stability
Block Analysis
Seismic Coefficient = 0.0161

Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2718 psf
Water Surface: None

Material: d33
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2302 psf
Water Surface: None

Material: d34
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2120 psf
Water Surface: None

Material: d35
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2205 psf
Water Surface: None

Material: d36
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 3391 psf
Water Surface: None

Material: d41
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 3660 psf
Water Surface: None

Material: d42
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2775 psf
Water Surface: None

Material: d43
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2232 psf
Water Surface: None

Material: d44
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2132 psf
Water Surface: None

Material: d45
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2506 psf
Water Surface: None

Material: d46
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 3917 psf
Water Surface: None

Material: d51
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 4273 psf
Water Surface: None

Material: d52
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 3002 psf
Water Surface: None

Material: d53
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2324 psf
Water Surface: None

Material: d54
Strength Type: Undrained
Unit Weight: 85 lb/ft3

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Cohesion Type: Constant
Cohesion: 2238 psf
Water Surface: None

Material: d55
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 2751 psf
Water Surface: None

Material: d56
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 4535 psf
Water Surface: None

Material: River Sediments
Strength Type: Strength=F(overburden)
Unit Weight: 85 lb/ft3
Tau/Sigma Ratio: 0.29
Water Surface: Water Table
Custom Hu value: 1

Material: Columbia Formation
Strength Type: Mohr-Coulomb
Unit Weight: 125 lb/ft3
Cohesion: 0 psf
Friction Angle: 40 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: MSE Wall Soil
Strength Type: Mohr-Coulomb
Unit Weight: 90 lb/ft3
Cohesion: 0 psf
Friction Angle: 29 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Wetlands
Strength Type: Strength=F(overburden)
Unit Weight: 85 lb/ft3
Tau/Sigma Ratio: 0.29
Water Surface: Water Table
Custom Hu value: 1

Material: Clay Layer
Strength Type: Undrained
Unit Weight: 120 lb/ft3
Cohesion Type: Constant
Cohesion: 4000 psf
Water Surface: None

Material: Drained PVD Area
Strength Type: Shear Normal function
Unit Weight: 85 lb/ft3
Water Surface: Water Table
Custom Hu value: 1

Support Properties

Support: Geogrid
Support Type: GeoTextile
Force Application: Passive
Force Orientation: Bisector of Parallel and Tangent
Anchorage: Slope Face
Shear Strength Model: Linear
Strip Coverage: 100 percent
Tensile Strength: 5000 lb/ft
Pullout Strength Adhesion: 0 lb/ft2
Pullout Strength Friction Angle: 25 degrees

Support: Geogrid2
Support Type: GeoTextile
Force Application: Passive
Force Orientation: Bisector of Parallel and Tangent
Anchorage: Slope Face
Shear Strength Model: Linear
Strip Coverage: 100 percent
Tensile Strength: 21000 lb/ft
Pullout Strength Adhesion: 0 lb/ft2
Pullout Strength Friction Angle: 25 degrees

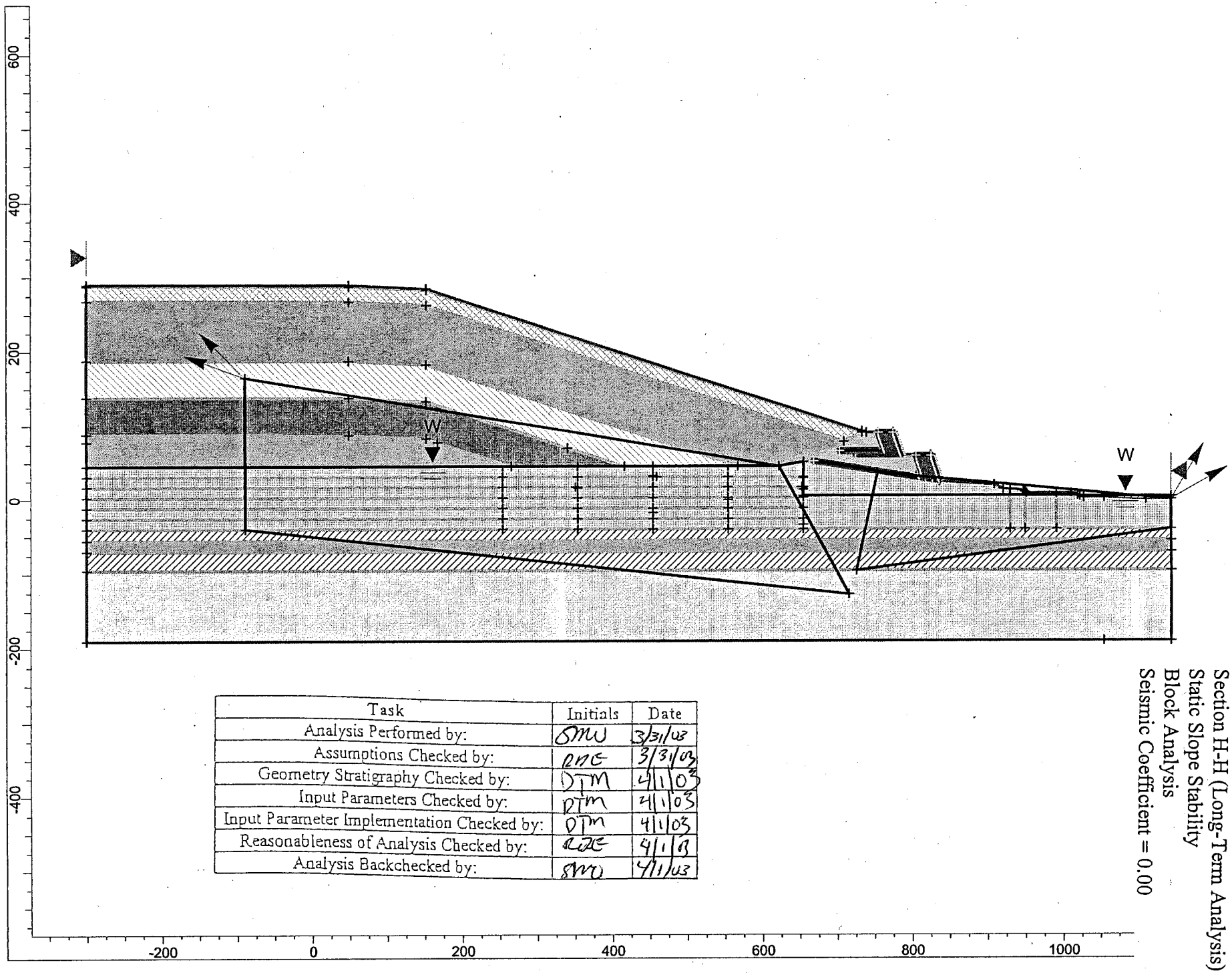
Global Minimums

Method: spencer
SF: 1.00002
Axis Location: 711.41, 1262.57
Left Slip Surface Endpoint: -126.99, 289.653
Right Slip Surface Endpoint: 986.703, 8.1

Method Statistics

Method: spencer
Number of Valid Surfaces: 1
Number of Invalid Surfaces: 0

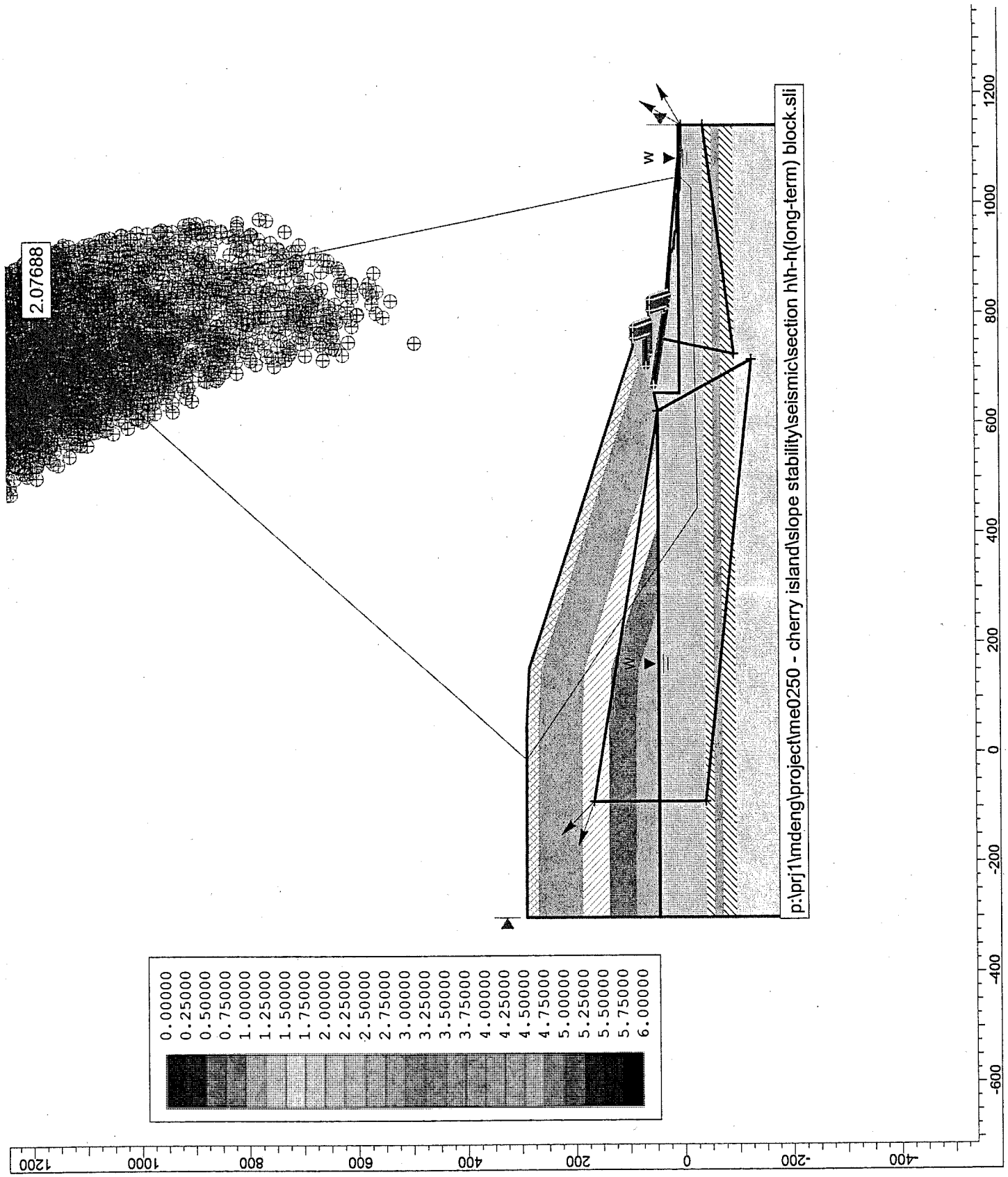
Section H-H (Long-Term Analysis)
Static Slope Stability
Block Analysis
Seismic Coefficient = 0.00



Task	Initials	Date
Analysis Performed by:	SMW	3/31/03
Assumptions Checked by:	RMC	3/31/03
Geometry Stratigraphy Checked by:	DTM	4/1/03
Input Parameters Checked by:	DTM	4/1/03
Input Parameter Implementation Checked by:	DTM	4/1/03
Reasonableness of Analysis Checked by:	RMC	4/1/03
Analysis Backchecked by:	SMW	4/1/03

HCT3-1

Section H-H (Long-Term Analysis)
Static Slope Stability
Block Analysis
Seismic Coefficient = 0.00



HLTS-2

Section H-H (Long-Term Analysis)
Static Slope Stability
Block Analysis
Seismic Coefficient = 0.00

Slide Analysis Information

Document Name

File Name: h-h(long-term) block

Project Settings

Project Title: SLIDE - An Interactive Slope Stability Program
Failure Direction: Left to Right
Units of Measurement: Imperial Units
Pore Fluid Unit Weight: 62.4 lb/ft3
Groundwater Method: Water Surfaces
Data Output: Standard

Analysis Methods

Analysis Methods used:
Spencer

Number of slices: 50
Tolerance: 0.005
Maximum number of iterations: 50

Surface Options

Surface Type: Non-Circular Block Search
Number of Surfaces: 5000
Pseudo-Random Surfaces: Enabled
Convex Surfaces Only: Disabled
Left Projection Angle (Start Angle): 135
Left Projection Angle (End Angle): 160
Right Projection Angle (Start Angle): 30
Right Projection Angle (End Angle): 60

Loading

Seismic Load Coefficient (Horizontal): 0
Seismic Load Coefficient (Vertical): 0

Material Properties

Material: Potomac Formation
Strength Type: Mohr-Coulomb
Unit Weight: 120 lb/ft3
Cohesion: 0 psf
Friction Angle: 21 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (0 to 20)
Strength Type: Mohr-Coulomb
Unit Weight: 60 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (20 to 100)
Strength Type: Mohr-Coulomb
Unit Weight: 75 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (100 to 150)
Strength Type: Mohr-Coulomb
Unit Weight: 80 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (150 to 200)
Strength Type: Mohr-Coulomb
Unit Weight: 85 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (>200)
Strength Type: Mohr-Coulomb
Unit Weight: 90 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: final cover
Strength Type: Mohr-Coulomb
Unit Weight: 120 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

HLTS-3

Material: Drained Dredge
Strength Type: Shear Normal function
Unit Weight: 85 lb/ft3
Water Surface: Water Table
Custom Hu value: 1

Material: Columbia Formation
Strength Type: Mohr-Coulomb
Unit Weight: 125 lb/ft3
Cohesion: 0 psf
Friction Angle: 40 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: MSE Wall Soil
Strength Type: Mohr-Coulomb
Unit Weight: 90 lb/ft3
Cohesion: 0 psf
Friction Angle: 29 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Clay Layer
Strength Type: Undrained
Unit Weight: 120 lb/ft3
Cohesion Type: Constant
Cohesion: 4000 psf
Water Surface: None

Support Properties

Support: Geogrid
Support Type: GeoTextile
Force Application: Passive
Force Orientation: Bisector of Parallel and Tangent
Anchorage: Slope Face
Shear Strength Model: Linear
Strip Coverage: 100 percent
Tensile Strength: 5000 lb/ft
Pullout Strength Adhesion: 0 lb/ft2
Pullout Strength Friction Angle: 25 degrees

Support: Geogrid2
Support Type: GeoTextile
Force Application: Passive
Force Orientation: Bisector of Parallel and Tangent
Anchorage: Slope Face
Shear Strength Model: Linear
Strip Coverage: 100 percent
Tensile Strength: 21000 lb/ft
Pullout Strength Adhesion: 0 lb/ft2
Pullout Strength Friction Angle: 25 degrees

Global Minimums

Method: spencer
SF: 2.07688
Axis Location: 805.471, 1207.05
Left Slip Surface Endpoint: -12.4972, 289.424
Right Slip Surface Endpoint: 1048.79, 2.1
Left Slope Intercept: -12.4972 289.424
Right Slope Intercept: 1048.79 4

Method Statistics

Method: spencer
Number of Valid Surfaces: 2869
Number of Invalid Surfaces: 2131
Error Codes:
Error Code -105 reported for 2 surfaces
Error Code -108 reported for 663 surfaces
Error Code -109 reported for 1439 surfaces
Error Code -111 reported for 11 surfaces
Error Code -112 reported for 16 surfaces

Error Codes

The following errors were encountered during the computation:

-105 = More than two surface / slope intersections with no valid slip surface.

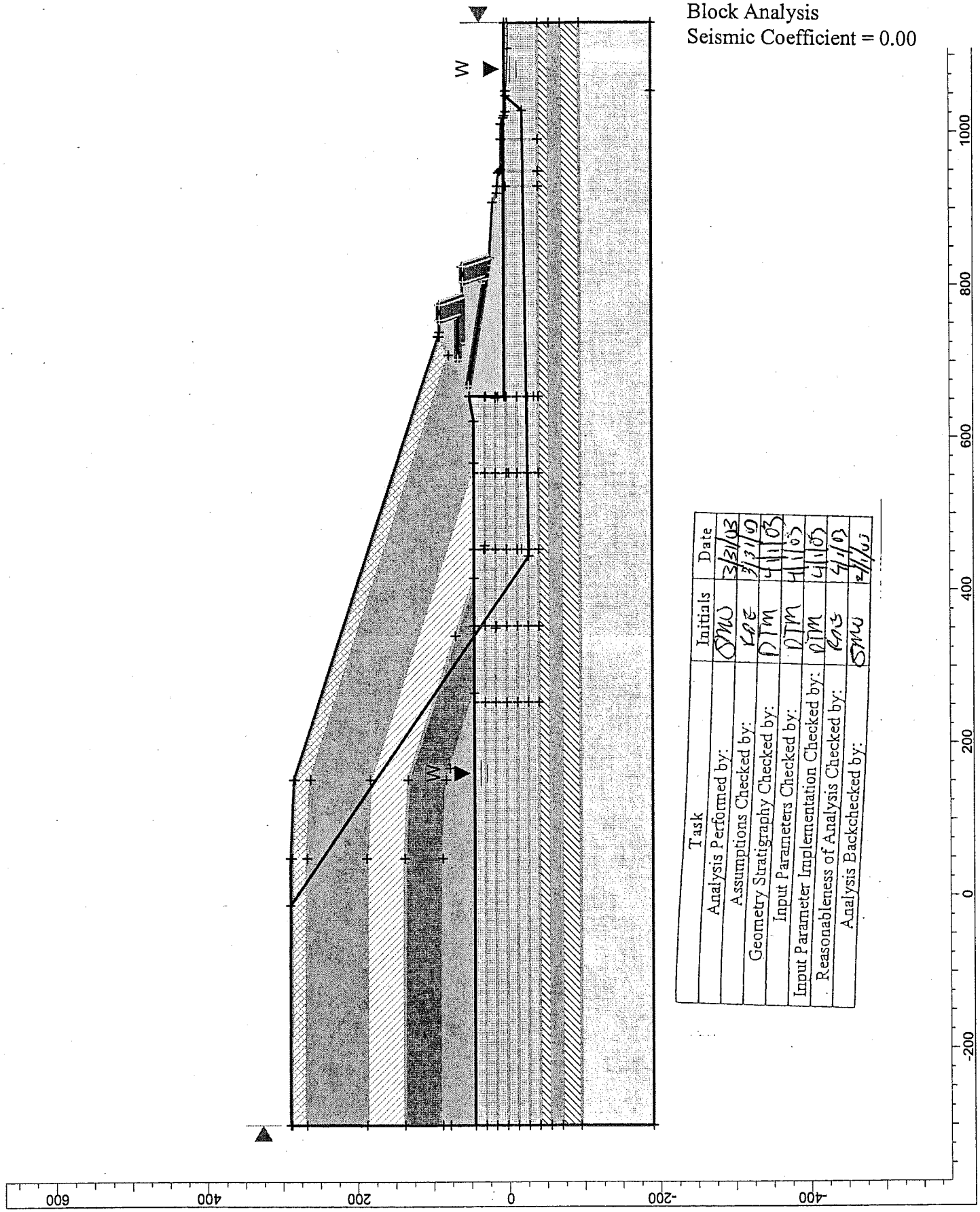
-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).

-109 = Soiltype for slice base not located. This error should occur very rarely, if at all. It may occur if a very low number of slices is combined with certain soil geometries, such that the midpoint of a slice base is actually outside the soil region,even though the slip surface is wholly within the soil region.

-111 = safety factor equation did not converge

-112 = The coefficient M-Alpha = cos(alpha)(1+tan(alpha)tan(phi)/F) < 0.2 for the final iteration of the safety factor calculation. This screens out some slip surfaces which may not be valid in the context of the analysis, in particular, deep seated slip surfaces with many high negative base angle slices in the passive zone.

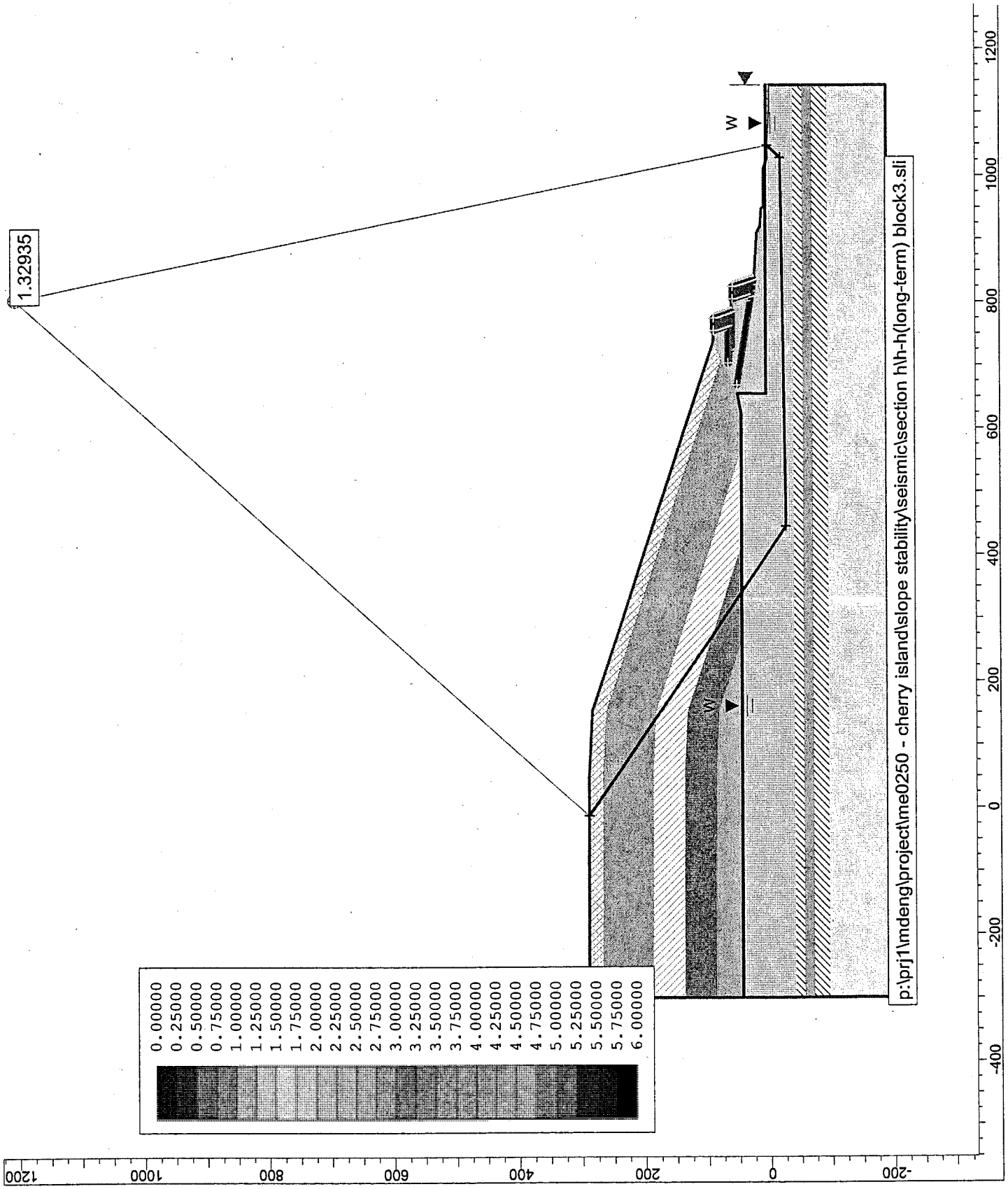
Section H-H (Long-Term Analysis)
Dynamic Slope Stability
Block Analysis
Seismic Coefficient = 0.00



Task	Initials	Date
Analysis Performed by:	SMO	3/31/03
Assumptions Checked by:	KAE	3/31/03
Geometry Stratigraphy Checked by:	DTM	4/1/03
Input Parameters Checked by:	DTM	4/1/03
Input Parameter Implementation Checked by:	DTM	4/1/03
Reasonableness of Analysis Checked by:	KAE	4/1/03
Analysis Backchecked by:	SMO	4/1/03

HLTS-4

Section H-H (Long-Term Analysis)
Dynamic Slope Stability
Block Analysis
Seismic Coefficient = 0.00



HLTS-5

Section H-H (Long-Term Analysis)
Dynamic Slope Stability
Block Analysis
Seismic Coefficient = 0.00

Slide Analysis Information

Document Name

File Name: h-h(long-term) block3

Project Settings

Project Title: SLIDE - An Interactive Slope Stability Program
Failure Direction: Left to Right
Units of Measurement: Imperial Units
Pore Fluid Unit Weight: 62.4 lb/ft3
Groundwater Method: Water Surfaces
Data Output: Standard

Analysis Methods

Analysis Methods used:
Spencer

Number of slices: 50
Tolerance: 0.005
Maximum number of iterations: 50

Surface Options

Surface Type: Non-Circular Block Search
Number of Surfaces: 5000
Pseudo-Random Surfaces: Enabled
Convex Surfaces Only: Disabled
Left Projection Angle (Start Angle): 135
Left Projection Angle (End Angle): 160
Right Projection Angle (Start Angle): 30
Right Projection Angle (End Angle): 60

Loading

Seismic Load Coefficient (Horizontal): 0
Seismic Load Coefficient (Vertical): 0

Material Properties

Material: Potomac Formation
Strength Type: Undrained
Unit Weight: 120 lb/ft3
Cohesion Type: Function of Depth
Cohesion (Top): 4500 psf
Cohesion Change: 14.4 psf/ft
Cutoff: 10000 psf
Water Surface: None

Material: Waste (0 to 20)
Strength Type: Mohr-Coulomb
Unit Weight: 60 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (20 to 100)
Strength Type: Mohr-Coulomb
Unit Weight: 75 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (100 to 150)
Strength Type: Mohr-Coulomb
Unit Weight: 80 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (150 to 200)
Strength Type: Mohr-Coulomb
Unit Weight: 85 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (>200)
Strength Type: Mohr-Coulomb
Unit Weight: 90 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: final cover
Strength Type: Mohr-Coulomb
Unit Weight: 120 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

HLT5-6

Material: Undrained PVD Area
Strength Type: Strength=F(overburden)
Unit Weight: 85 lb/ft3
Tau/Sigma Ratio: 0.29
Water Surface: Water Table
Custom Hu value: 1

Material: Columbia Formation
Strength Type: Mohr-Coulomb
Unit Weight: 125 lb/ft3
Cohesion: 0 psf
Friction Angle: 40 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: MSE Wall Soil
Strength Type: Mohr-Coulomb
Unit Weight: 90 lb/ft3
Cohesion: 0 psf
Friction Angle: 29 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Clay Layer
Strength Type: Undrained
Unit Weight: 120 lb/ft3
Cohesion Type: Constant
Cohesion: 4000 psf
Water Surface: None

Material: Drained PVD Area
Strength Type: Shear Normal function
Unit Weight: 85 lb/ft3
Water Surface: Water Table
Custom Hu value: 1

Support Properties

Support: Geogrid
Support Type: GeoTextile
Force Application: Passive
Force Orientation: Bisector of Parallel and Tangent
Anchorage: Slope Face
Shear Strength Model: Linear
Strip Coverage: 100 percent
Tensile Strength: 5000 lb/ft
Pullout Strength Adhesion: 0 lb/ft2
Pullout Strength Friction Angle: 25 degrees

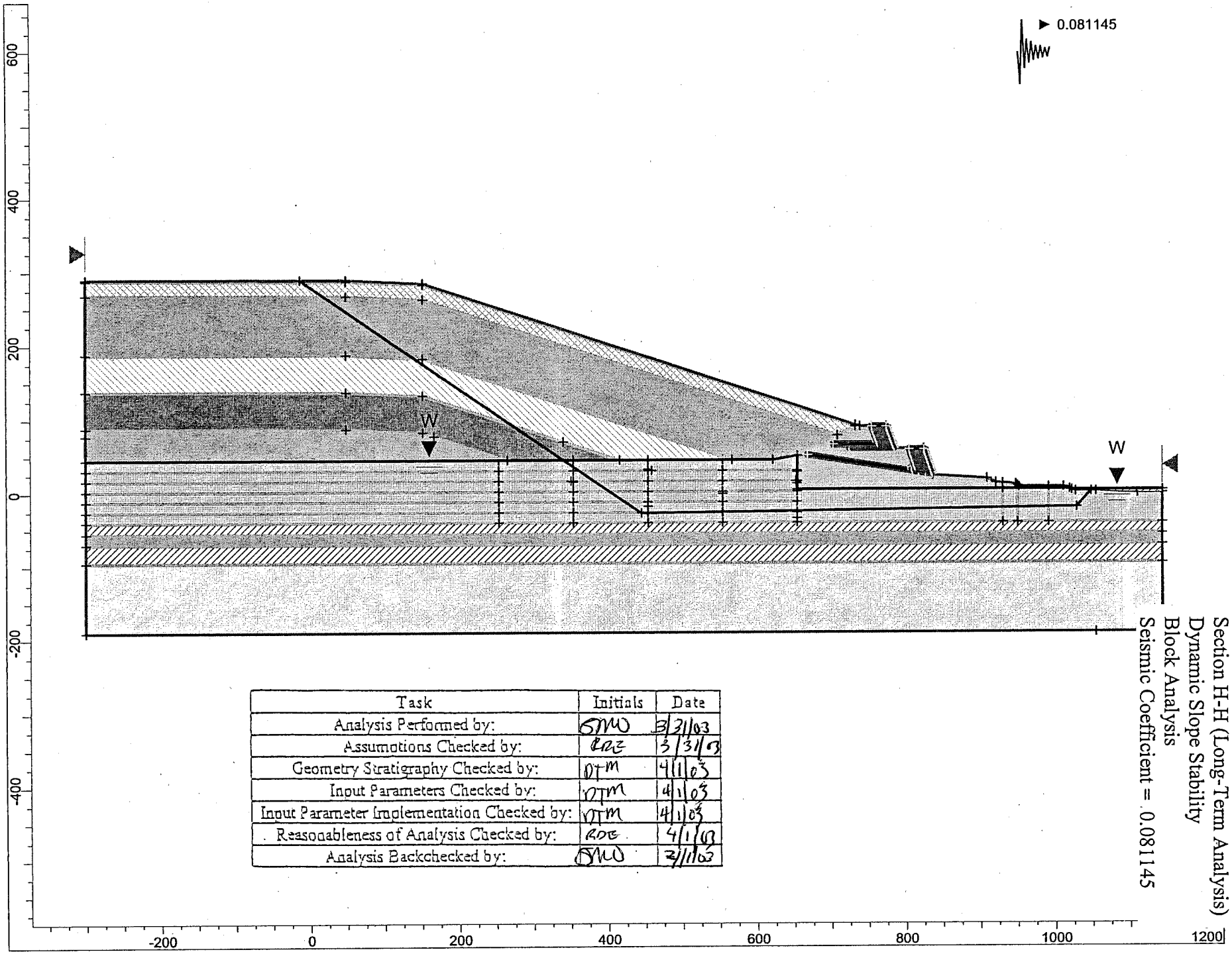
Support: Geogrid2
Support Type: GeoTextile
Force Application: Passive
Force Orientation: Bisector of Parallel and Tangent
Anchorage: Slope Face
Shear Strength Model: Linear
Strip Coverage: 100 percent
Tensile Strength: 21000 lb/ft
Pullout Strength Adhesion: 0 lb/ft2
Pullout Strength Friction Angle: 25 degrees

Global Minimums

Method: spencer
SF: 1.32935
Axis Location: 804.613, 1205.34
Left Slip Surface Endpoint: -12.497, 289.424
Right Slip Surface Endpoint: 1047.08, 2.1
Left Slope Intercept: -12.497 289.424
Right Slope Intercept: 1047.08 4

Method Statistics

Method: spencer
Number of Valid Surfaces: 1
Number of Invalid Surfaces: 0

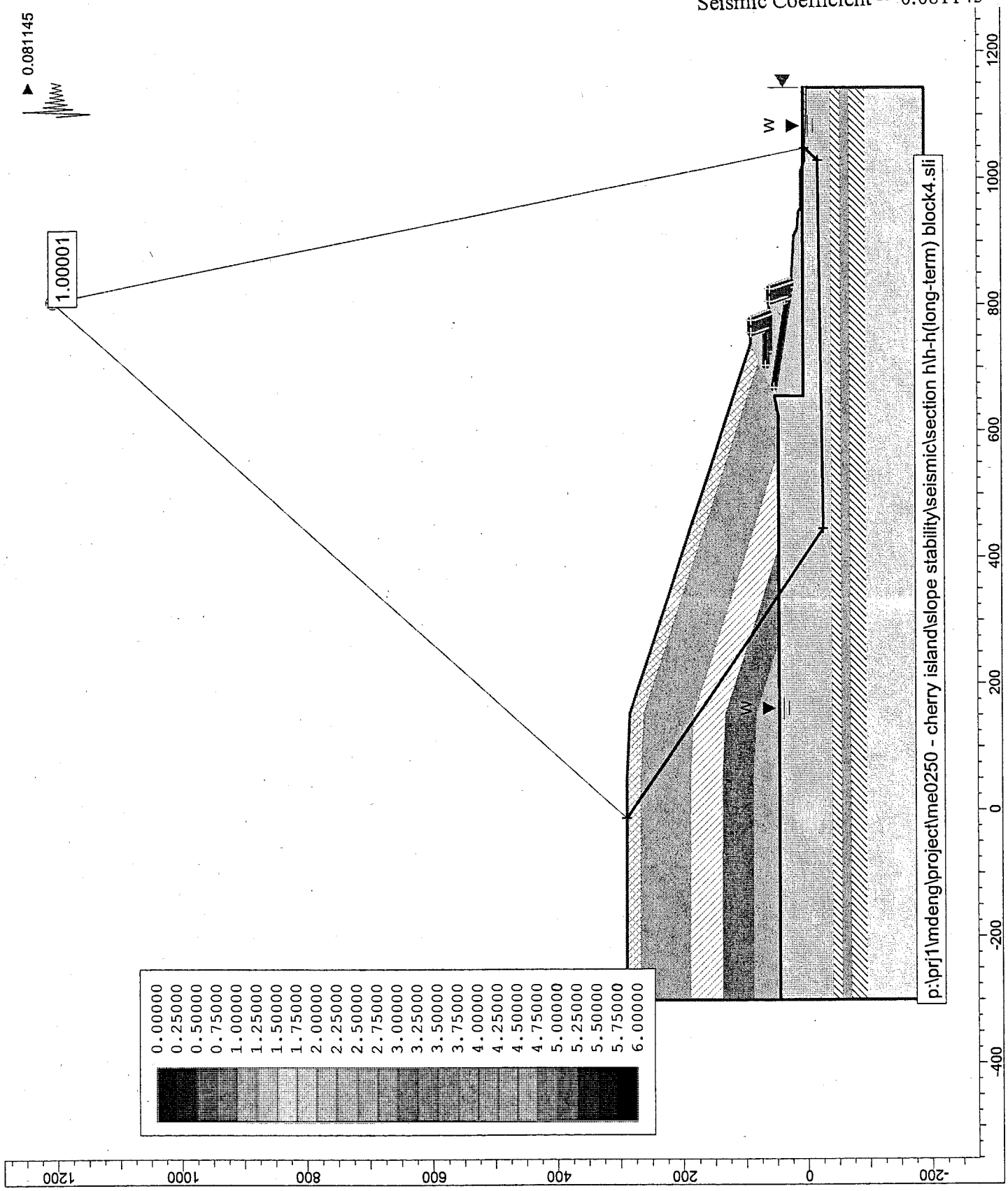


Task	Initials	Date
Analysis Performed by:	SMW	3/31/03
Assumptions Checked by:	RDE	3/31/03
Geometry Stratigraphy Checked by:	DTM	4/1/03
Input Parameters Checked by:	DTM	4/1/03
Input Parameter Implementation Checked by:	DTM	4/1/03
Reasonableness of Analysis Checked by:	RDE	4/1/03
Analysis Backchecked by:	SMW	3/1/03

Section H-H (Long-Term Analysis)
Dynamic Slope Stability
Block Analysis
Seismic Coefficient = 0.081145

HLTS-7

Section H-H (Long-Term Analysis)
Dynamic Slope Stability
Block Analysis
Seismic Coefficient = 0.081145



HLTS-8

Section H-H (Long-Term Analysis)
Dynamic Slope Stability
Block Analysis
Seismic Coefficient = 0.081145

Slide Analysis Information

Document Name

File Name: h-h(long-term) block4

Project Settings

Project Title: SLIDE - An Interactive Slope Stability Program
Failure Direction: Left to Right
Units of Measurement: Imperial Units
Pore Fluid Unit Weight: 62.4 lb/ft3
Groundwater Method: Water Surfaces
Data Output: Standard

Analysis Methods

Analysis Methods used:
Spencer

Number of slices: 50
Tolerance: 0.005
Maximum number of iterations: 50

Surface Options

Surface Type: Non-Circular Block Search
Number of Surfaces: 5000
Pseudo-Random Surfaces: Enabled
Convex Surfaces Only: Disabled
Left Projection Angle (Start Angle): 135
Left Projection Angle (End Angle): 160
Right Projection Angle (Start Angle): 30
Right Projection Angle (End Angle): 60

Loading

Seismic Load Coefficient (Horizontal): 0.081145
Seismic Load Coefficient (Vertical): 0

Material Properties

Material: Potomac Formation
Strength Type: Undrained
Unit Weight: 120 lb/ft3
Cohesion Type: Function of Depth
Cohesion (Top): 4500 psf
Cohesion Change: 14.4 psf/ft
Cutoff: 10000 psf
Water Surface: None

Material: Waste (0 to 20)
Strength Type: Mohr-Coulomb
Unit Weight: 60 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (20 to 100)
Strength Type: Mohr-Coulomb
Unit Weight: 75 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (100 to 150)
Strength Type: Mohr-Coulomb
Unit Weight: 80 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (150 to 200)
Strength Type: Mohr-Coulomb
Unit Weight: 85 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Waste (>200)
Strength Type: Mohr-Coulomb
Unit Weight: 90 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: final cover
Strength Type: Mohr-Coulomb
Unit Weight: 120 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

HLTS-9

Material: Undrained PVD Area
Strength Type: Strength=F(overburden)
Unit Weight: 85 lb/ft3
Tau/Sigma Ratio: 0.29
Water Surface: Water Table
Custom Hu value: 1

Material: Columbia Formation
Strength Type: Mohr-Coulomb
Unit Weight: 125 lb/ft3
Cohesion: 0 psf
Friction Angle: 40 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: MSE Wall Soil
Strength Type: Mohr-Coulomb
Unit Weight: 90 lb/ft3
Cohesion: 0 psf
Friction Angle: 29 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Clay Layer
Strength Type: Undrained
Unit Weight: 120 lb/ft3
Cohesion Type: Constant
Cohesion: 4000 psf
Water Surface: None

Material: Drained PVD Area
Strength Type: Shear Normal function
Unit Weight: 85 lb/ft3
Water Surface: Water Table
Custom Hu value: 1

Support Properties

Support: Geogrid
Support Type: GeoTextile
Force Application: Passive
Force Orientation: Bisector of Parallel and Tangent
Anchorage: Slope Face
Shear Strength Model: Linear
Strip Coverage: 100 percent
Tensile Strength: 5000 lb/ft
Pullout Strength Adhesion: 0 lb/ft2
Pullout Strength Friction Angle: 25 degrees

Support: Geogrid2
Support Type: GeoTextile
Force Application: Passive
Force Orientation: Bisector of Parallel and Tangent
Anchorage: Slope Face
Shear Strength Model: Linear
Strip Coverage: 100 percent
Tensile Strength: 21000 lb/ft
Pullout Strength Adhesion: 0 lb/ft2
Pullout Strength Friction Angle: 25 degrees

Global Minimums

Method: spencer
SF: 1.00001
Axis Location: 804.613, 1205.34
Left Slip Surface Endpoint: -12.497, 289.424
Right Slip Surface Endpoint: 1047.08, 2.1
Left Slope Intercept: -12.497 289.424
Right Slope Intercept: 1047.08 4

Method Statistics

Method: spencer
Number of Valid Surfaces: 1
Number of Invalid Surfaces: 0

Appendix VIb-D.4

Mechanically Stabilized Earth Berm Construction Analysis

GEOSYNTEC CONSULTANTS

COMPUTATION COVER SHEET

Client: DSWA **Project:** Cherry Island **Project/Proposal #:** ME0250 **Task #:** 2.2.5

TITLE OF COMPUTATIONS Mechanically Stabilized Earth Berm Construction Stability Analysis

COMPUTATIONS BY:

Signature

DATE 03/31/03

Printed Name and Title S. Opdyke, Staff Engineer

ASSUMPTIONS AND PROCEDURES CHECKED BY:
(Peer Reviewer)

Signature

DATE 04/01/03

Printed Name and Title David Espinoza, Senior Engineer

COMPUTATIONS CHECKED BY:

Signature

DATE 04/01/03

Printed Name and Title David Espinoza, Senior Engineer

COMPUTATIONS BACKCHECKED BY:
(Originator)

Signature

DATE 04/01/03

Printed Name and Title S. Opdyke, Staff Engineer

APPROVED BY:
(PM or Designate)

Signature

DATE 04/01/03

Printed Name and Title David Espinoza, Senior Engineer

APPROVAL NOTES:

REVISIONS (Number and initial all revisions)

NO.	SHEET	DATE	BY	CHECKED BY	APPROVAL

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4. LOADING CONDITIONS 2

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Written by: Shana Opdyke Date: 03/31/03 Reviewed by: R.D. Espinoza Date: 04/01/03

Client: DSWA Project: Cherry Island Project/Proposal No.: ME0250 Task No.: 2.2.5

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(continued)

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Figure 2 Cross Section E-E
Figure 3 Example of Idealized Cross Section in SLIDE
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ATTACHMENTS

Attachment A Soil Stratigraphy
Attachment B Stability Analysis Results for Construction of Section E-E

Written by: Shana Opdyke Date: 03/31/03 Reviewed by: R.D. Espinoza Date: 04/01/03

Client: DSWA Project: Cherry Island Project/Proposal No.: ME0250 Task No.: 2.2.5

MECHANICALLY STABILIZED EARTH BERM CONSTRUCTION STABILITY ANALYSIS

1. INTRODUCTION

The purpose of this analysis to evaluate the local stability of the proposed perimeter mechanically stabilized earth (MSE) berm at the Cherry Island Landfill (CIL). The analysis focuses on the stability of the MSE berm during construction. Overall stability of the proposed landfill expansion is addressed in a separate calculation package, "Landfill Stability Analysis (Static) - Phases III to V", (see Appendix VIb-D.2).

In the proposed landfill expansion, the maximum elevation in Phases III to V is increased to approximately 290 ft-msl, whereas the maximum elevations in Phases I and II are essentially unchanged except at the boundary with Phases III to V. To allow expansion of the landfill to the proposed elevations, both construction of a MSE berm and installation of prefabricated vertical drains (PVD) around the perimeter of Phases III, IV, and V (outside the existing waste footprint) are required.

2. SECTIONS FOR ANALYSIS

A total of eight (8) sections located in Phases III through V were selected for static stability analysis and are evaluated in the calculation package entitled "Landfill Stability Analysis (Static) - Phases III to V", (see Appendix VIb-D.2). The locations of the cross sections are shown in Figure 1. Each of the cross sections have been selected to take into consideration unique features of the landfill geometry (e.g., maximum height, bench location), foundation stratigraphy (thickness of dredge/alluvium, thickness of the Potomac Formation) and other surface features such as distance to the river and wetlands. Due to the proximity to the Delaware River, the minimal area of PVD placement, and maximum MSE berm height of 70 ft, section E-E is the most critical sections during construction and thus is analyzed in this calculation package.

Existing ground surface information is obtained from aerial topography performed in October, 2002. The ground surface information in the Christina and Delaware rivers was obtained from 2002-bathymetric information provided by the United States Army Corps of Engineers. Both the Delaware and Christina Rivers contain navigable shipping channels. However, dredge operations only affects approximately 25 ft outside the limits of the navigation

channels. As the limits of the navigation channels are located approximately 800 ft away from the shoreline, dredging operations will not affect the stability of the MSE berm.

3. STABILITY CRITERIA

The slope stability analysis is performed to verify that the MSE berm configuration has an adequate factor of safety against failure under static loading conditions. According to technical manual published by the USEPA entitled, "Solid Waste Disposal Facility Criteria" [USEPA, 1993], the minimum recommended factor of safety against slope stability failure for temporary conditions is 1.25.

4. LOADING CONDITIONS

The main static load applied to the soft dredge/alluvial deposits is the gravity load exerted by the MSE berm. As the MSE berm is constructed, the additional load generates excess pore pressures in the saturated dredge/alluvium. Successful construction of the MSE berm without causing overall stability problems depends upon the ability of this soft material to gain additional strength (i.e., dissipate pore pressures) as the load is placed. Excess pore pressure in the saturated dredge/alluvium under the proposed MSE berm will dissipate via radial drainage to the PVDs, and then to the Columbia Formation and drainage layer placed at the ground surface. The dredge's ability to dissipate the excess pore pressures generated during loading is directly proportional to the material's permeability and inversely proportional to the square of the PVD spacing. Because the PVD spacing could vary from 4 ft. to 8 ft., assuming that the permeability at the site is approximately homogeneous, the strength gain rate of the 4 ft. PVD spacing will be 4 times faster than that provided by the 8 ft. PVD.

Based on the above discussion, the rate of construction is an important part of this stability analysis. Generally, the MSE berm will be constructed in increments of ten feet. Subsequent lifts will be placed only after approximately 90 percent of the excess pore pressure generated in the dredge/alluvium during placement of the previous lift has been dissipated. Based on the radial consolidation theory, the time required to dissipate 90 percent of the excessive pore pressure for a 4-ft PVD spacing is approximately five months. A pilot test program to study the influence of PVD spacing is currently being undertaken at the CIL site. Based on preliminary results from the pilot test and analytical results using radial consolidation theory, GeoSyntec estimates that it will take approximately four to five months to dissipate 90 percent of the excess pore pressure for a 4-ft spacing. This preliminary information indicates that a ten foot lift could be constructed every four to five months. However, the actual construction rate will be

determined after complete results from the pilot test have been obtained and analyzed. In addition, the final PVD spacing will be selected based not only on its ability to allow construction of the MSE berm but also on the ability of the PVD area to act drained during waste placement (see calculation package entitled "Landfill Stability Analyses (Static) – Phases III to V," Appendix VIb-D.2).

5. STRATIGRAPHY AND MATERIAL PARAMETERS

5.1 General

As shown Figure 2, below the waste and MSE berm the stratigraphy at the CIL site includes dredge, alluvium, the Columbia Formation and the Potomac Formation. On the river side of the berm, the soil above the Columbia Formation is assumed to be alluvium. Properties for each cross section are based upon the information collected in the Geotechnical Characterization Report (GCR) [GeoSyntec 2003]. The boundary between the dredge/alluvium and the Columbia Formation is based on the stratigraphy presented in the GCR (Figures A.1 to A.4 in Attachment A). As a supplement to this information, the boundary between the Columbia and Potomac Formations, based on the information provided by Terraqua [1982], is provided in Figures A.5 to A.9 in Attachment A. The remainder of this section addresses the parameters of these soil types used in the stability analysis. A table at the end of this section summarizes the soil parameters used in the analysis.

5.2 Waste

GeoSyntec performed field investigations and laboratory testing in March and April 2002 to characterize the waste at the CIL site. Based on the results of the field investigation and subsequent laboratory testing, the MSW was found to have an average density ranging from 60 lbs/ft^3 (in the upper 20 feet) to 75 lbs/ft^3 (20 ft below the waste surface). Higher densities (i.e., 80 to 100 lbs/ft^3) were found for saturated waste. In the analysis, the unit weight adopted is 60 lbs/ft^3 for moist waste and 100 lbs/ft^3 for saturated waste.

Nine laboratory shear strength tests performed on saturated waste at different rates indicate that, except for one test, waste at CIL exhibits a friction angle ranging from 34° to 40°, with an average of 36° and a cohesion ranging from 0 psf to 165 psf. A friction angle of 33° and no cohesion was conservatively used in the analysis. Further discussion on these results can be found in Appendix O of the GCR.

5.3 Dredge/Alluvium

5.3.1 General

GeoSyntec conducted field investigations in March and April 2002 to evaluate the subsurface soil conditions at the site. A brief summary of the findings related to the dredge and alluvium, is presented herein; additional details can be found in the GCR. The dredge consists primarily of sandy silty clay to clayey silt and varies in thickness from 30 to 40 feet. The alluvium is comprised of clayey silts and silty clays with varying amounts of sand and organic matter and silty sands. Because of the similar characteristics of the dredge spoils and the alluvium; these layers are combined as one soil type in the analysis. Although there is no soil data along the riverbed of the Delaware and Christina rivers, the river sediments are likely to have similar soil characteristics as the alluvium.

The average total unit weight for the dredge/alluvium is 85 pcf, while the average saturated unit weight is 97 pcf. The shear strength in the dredge/alluvium depends upon the degree of pore pressure dissipation. In this analysis, the dredge/alluvium strength parameters are considered to be either (i) existing partially consolidated undrained parameters, (ii) consolidated undrained parameters; and (iii) drained parameters. A discussion of the strength parameters follows.

5.3.2 Existing Partially Consolidated Undrained Parameters

This soil type corresponds to the dredge/alluvium beneath the existing waste (see Figures 2a and 2b). The strength of existing dredge/alluvium is conservatively estimated based on CPT data presented in the GCR. The dredge/alluvium zone was divided into six layers. This stratigraphic division was performed to be consistent with the one used in the "Landfill Stability Analyses (Static) – Phases III to V" calculation package presented in Appendix VIb-D.2. The first two layers had cohesion of 200 psf, the third and fourth layer of 400 psf, the fifth of 600 psf and the bottom layer of 800 psf.

5.3.3 Consolidated Undrained Parameters

The consolidated undrained shear strength (S_u) is calculated as a function of the maximum vertical effective stress using the following linear relationship:

$$\frac{S_u}{\sigma_v'} = 0.29 \qquad (1)$$

where σ'_v is the effective vertical stress. The value of 0.29 is in agreement with previous and recent laboratory and field investigation results summarized in the GCR. This condition is applicable to the dredge/alluvium assuming that PVD area is undrained. Because of the PVD spacing, in this analysis, 50 percent of the total available area is considered undrained (see section below).

5.3.4 Drained Parameters

A series of PVD will be installed underneath and beyond the MSE berm. The PVDs will be installed from the ground surface to the Columbia Formation. This area is outside the existing waste footprint. The PVDs will be installed to enhance the dredge's ability to drain and accelerate the dissipation of excess pore pressures generated during berm construction and subsequent waste placement. The rapid dissipation of excess pore pressures in the dredge/alluvium by means of the PVDs, allows a portion of the dredge/alluvium to be modeled assuming drained conditions during MSE berm construction. Based on radial consolidation, an area approximately 1.5 ft around the PVD can be assumed drained. This area corresponds to approximately 50 percent of the total area of the PVD area. An assessment of dredge/alluvium drained conditions is presented in Appendix VIb-D.5. In order to model the influence of the PVDs, the dredge/alluvium is divided into several 10-ft vertical columns of alternating drained/undrained parameters.

The dredge/alluvium drained shear strength is modeled as an envelope based on effective strength parameters obtained from laboratory testing as follows [GeoSyntec, 2003]:

Effective Normal Stress (psf)	Shear Stress (psf)	Effective Friction Angle (Degrees)
0 – 1,000	0 – 1,000	45
1,000 – 3,000	1,000 – 2,678	40
> 3,000	–	34

5.4 Columbia Formation

The Columbia Formation, which is encountered under the dredge/alluvium, consists of poorly sorted, fine-to-coarse sand and gravel with silty sand, silty clay, and clayey silt lenses of varying thicknesses. An effective a friction angle of 40 degrees with no cohesion is used to model the strength of this layer. The unit weight for this formation is 125 pcf. Detailed

discussion on the selection of these parameters can be found in the GCR. At locations where silty clay lenses were significantly thick (i.e., greater than 5 ft), the lens undrained strength parameters were obtained form the field investigation data closest to the analyzed cross section.

5.5 Potomac Formation

The Potomac Formation, which underlies the Columbia Formation, consists of a brownish red (often described as varicolored), stiff to hard, heavily over consolidated, clayey silt to silty clay, with traces of fine sand. Layers of sand are often found in this formation. Based on the information collected in the GCR, the thickness of the Potomac Formation varies from approximately 120 ft along the Delaware River, to approximately 5 ft along the western boundary of the CIL site. The strength parameter of the Potomac Formation is conservatively described for undrained analysis as:

$$S_u = 4{,}500 \text{ psf} + 14.4\,d \qquad (2)$$

where S_u is the undrained shear strength (psf) and d is depth measured from the top of the Potomac Formation.

5.6 Reinforced Soil

The backfill of the MSE berm will include features to promote drainage (e.g., geocomposite drainage chimney, and a backdrain). Non-traditional and cost-effective materials such as dredge and fly ash will be considered for construction. The unit weight of the MSE berm is assumed to be 90 pcf with a friction angle of 29 degrees (i.e., ϕ_{MSE}= of 29°). The unit weight of the lower 10 ft of the MSE berm is assumed to be 120 pcf with a friction angle of 35 degrees (i.e., ϕ_{MSE}= of 35°). For design purposes, both a high strength geogrid of 5,000 lbs/lf, and a high strength geotextile of 21,000 lb/lf are considered. The interface friction angle (δ) between the backfill and the reinforcement was assumed equal to:

$$\tan(\delta) = 0.85 \tan \phi_{MSE} \qquad (3)$$

The width of the MSE berm was iteratively calculated to provide an adequate factor of safety for during waste placement (see "Landfill Stability Analyses (Static) – Phases III to V", Appendix VIb-D.2). Also, the reinforcement pattern (i.e., vertical spacing and reinforcement length) was calculated through an iterative process, described in Section 7.

5.7 Summary of Properties

A summary table of the soil parameters used in this analysis is provided below. The soil numbers in the table correspond to the soil numbers used in the stability analysis.

Material	Label(1)	Condition	Cohesion (psf)	Friction Angle (degrees)	Unit Weight (pcf)	Unit Weight Saturated (pcf)
Waste	Waste (0 to 20)	Drained	0	33	60	100
Dredge/Alluvium	River Sediments, Wetlands, Undrained PVD Area	Consolidated undrained	0.29 σ_v	-	85	97
	Drained PVD Area	Drained	0	34(4)		
	d11,d12, d13, d14	Partially consolidated undrained	200 to 800(2)	-		
Columbia	Columbia Formation	Drained	0	40	125	125
Potomac Formation	Potomac Formation	Undrained	4,500(3)	-	120	120
MSE Berm	MSE Wall Soil	Drained	0	29	90	90
	Structural Fill	Drained	0	35	120	120

(1) Labels used in SLIDE analysis (see Figure 3)
(2) Partially consolidated undrained strength for the existing dredge/alluvium parameters are estimated based on CPT data as reported in GCR.
(3) Minimum undrained strength is 4,500 psf and increases with depth.
(4) Dredge drained parameters is an envelope with a slope of 34 degrees for effective stresses greater than 3,000 psf.

6. WATER TABLE

The current liquid level in the dredge/alluvium is dictated by the elevation of the Delaware, and Christina rivers, liquids in the waste, and the water level at the time of dredge placement. The liquid level in the dredge/alluvium was selected as follows:

- *Under the landfill*: Because dredge is placed fully saturated, the water level can be assumed at the dredge ground surface. For the stability analysis, for undrained conditions, the factors of safety are calculated using total unit weights. Hence, the location of the water level does not influence the calculation of the factors of safety except for the calculation of unit weight.

- *In the PVD area*: Because the PVDs connect the dredge/alluvium with the Columbia Formation, the water level of the dredge/alluvium is influenced by the groundwater elevation of the Columbia Formation. In this area, the water level is assumed to be at elevation 5 ft-msl, which corresponds to measured values of the groundwater elevation of the Columbia Formation around the perimeter berm. This value is 2-ft higher than the average river level.

- *Outside the PVD area (river side and wetland areas)*: The water level in this area is assumed to be influenced by the river elevation. The average river level is approximately 3 ft-msl. In this area the water level is assumed to be at elevation 5 ft-msl. The water level in wetland areas is assumed to be at the ground surface. For the stability analysis, for undrained conditions, the factors of safety are calculated using total unit weights. Hence, the location of the river elevation does not influence the calculation of the factors of safety.

The piezometric level in the Columbia and Potomac Formations is assumed to be equal to the assumed liquid levels in the dredge/alluvium. This assumption is conservative, particularly under the landfill, where the piezometric level in the Columbia and Potomac Formations is likely to be less than the water level in the dredge/alluvium. Higher piezometric levels results in lower effective stresses with corresponding lower shear strength.

7. METHOD OF ANALYSIS

7.1 Introduction

The stability of the selected cross sections was evaluated based on limit equilibrium theory using the methods of slices. The computer program SLIDE [Rocscience, 2002] was used to perform the analyses. SLIDE is a 2D slope stability program that evaluates the factor of safety of circular and non-circular failure surfaces in soils. The procedure consisted of analyzing numerous potential failure surfaces to find the critical failure surface that renders the minimum factor of safety for the slope. Circular and non-circular failure surfaces can be analyzed. For circular and non-circular failure surfaces, the Spencer method [Spencer, 1967] is used. In the Spencer method both force and moment equilibrium are satisfied in each slice, the slope of the inter slice forces is assumed constant and parallel to each other.

During the analysis, the search boundaries were varied to ensure that the most critical surface was captured during the search. Numerous potential failure surfaces were analyzed to find the critical failure surface that result in the minimum factor of safety for the slope. For the slope stability cases analyzed in this calculation, both non-circular and circular failure surfaces were considered.

7.2 Implementation

The ground surfaces of the selected cross sections were obtained using AutoCADD sections in an x,y coordinate system, and subsequently entered into SLIDE. The sections used for the "Landfill Stability Analysis (Static) – Phases III to V" (see Appendix VIb-D.2) were also used to evaluate local stability of the MSE berm during construction. However, the sections were reduced to extend only 200 feet into the landfill from the back of the MSE berm. The bottom of existing waste, assumed to be at elevation 40 ft-msl, is based upon record drawings for Phases III, IV and V and settlements recorded at settlement plates. The horizontal extent of existing waste was obtained from existing limits of waste. The dredge/alluvium strata were divided into six layers. In order to minimize errors, a specific labeling system was developed for the various materials. Figure 3 shows an example of an idealized cross section implemented in SLIDE along with layer divisions and the labeling system used for all analyses. Consistent labeling systems and material boundaries allowed material properties to be imported and exported between files. For example, materials in a file containing a circular analysis of Section E-E during the first stage of construction were exported to a new file for a circular analysis of Section E-E during the second stage of construction. Through this exportation the materials were automatically the same for both files.

The same analysis parameters were used for the circular failure mode in all sections. Parameters for the circular search for the Spencer analysis method include using fifty (50) slices, a tolerance of 0.005, fifty (50) maximum iterations, and for each slip center, 75 regularly spaced circles were analyzed. These parameters were selected such that the analysis was performed accurately and expediently.

For the circular search, a search grid with 20 horizontal increments and 20 vertical increments was used to find the minimum factor of safety (Figure 4). This grid defined a total of 441 (i.e., 21 x 21) slip centers. Hence, the total number of slip surfaces was 33,075 (i.e., 75 x 441). SLIDE provides both the minimum factor of safety and a factor of safety contour map for the computation. In some cases, when the contour lines that contain the minimum factor of safety were not fully closed, the search grid was expanded horizontally or vertically and the

analysis performed again. This iterative process ensured that a global minimum factor of safety (i.e., the true minimum factor of safety), not a local one, was calculated.

All sections were extended horizontally in both directions to ensure that the critical failure surface was not constrained by geometry. If a critical failure surface was found near the right or left boundary, the boundary was extended, and the analysis performed again. This ensured that the analysis identified the minimum factor of safety without being limited by geometry.

7.3 Modeling of Sequential Construction

As discussed earlier, the MSE berm geometry was selected to provide adequate factors of safety for the landfill (see calculation package entitled "Landfill Stability Analysis (Static) – Phases III to V," Appendix VIb-D.2). Because the rate of MSE berm construction will be significantly faster that that of waste placement, drained conditions cannot be assumed for the entire layer in the analysis. For the construction of the MSE berm, 50 percent of the area close to each PVD is assumed drained, whereas for the remaining 50 percent undrained shear strength parameters for the dredge/alluvium in the PVD area is conservatively assumed. A detailed description of the shear strength parameters is presented in the calculation Package entitled: "Assessment of Dredge/Alluvium Drained Conditions", Appendix VI.b-D.5.

The rate of construction depends on the rate of pore pressure dissipation and hence the rate of strength gain of the dredge/alluvium. Pore pressures have to dissipate before construction can proceed vertically. Pore pressure was considered dissipated when 90 percent of the excess pore pressure generated during construction of a given lift has been dissipated.

Construction was modeled in SLIDE as a series of ten foot lifts of soil. For example, section E-E contains a MSE berm that is approximately 70 ft in height. This section was modeled in though a series of 7 analyses, as shown in Attachment B. For example, the file E-E Construction 1 is a representation of a single 10 ft lift of soil placed over existing ground. Likewise, the file E-E Construction 2 is an analysis of a single 10 ft lift of soil placed over the previous 10 ft. lift.

8. STABILITY RESULTS

Stability analyses were performed for the selected cross section for temporary construction conditions. As shown in Attachment B, the MSE berm can be constructed in stages with a factor of safety greater than 1.25.

9. CONCLUSION

The analysis presented in this calculation package shows that the MSE berm can be built in ten foot increments providing that at least 90 percent of the excess pore pressure generated during placement of the previous lift has been dissipated before construction the next lift. The analysis presented herein is conservative because pore pressure will dissipate during construction, therefore, the dredge/alluvium with PVDs will not be fully undrained.

10. REFERENCES

Duncan, J.M., Smith, R.W., Brandon, T.L., Wong, K.S. CONSOL (Version 2.0): A Computer Program for 1-D Analysis of Layered Soil Masses. Virginia Polytechnic Institute and State University, 1988.

GeoSyntec Consultants, "*Geotechnical Characterization Report*", prepared for Delaware Solid Waste Authority Cherry Island Landfill Expansion Project, February 2003.

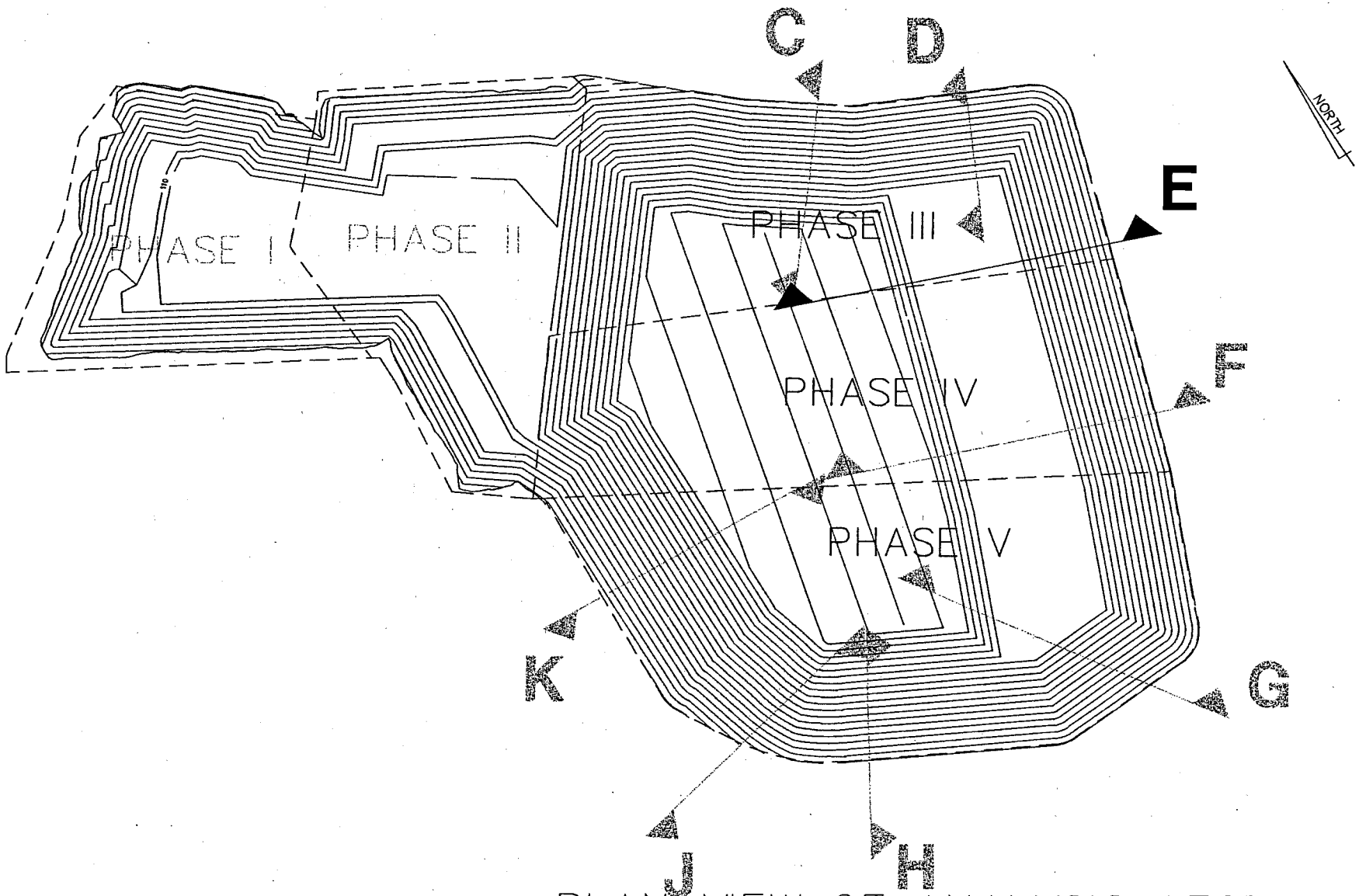
Rocscience, Slide, 2002: A 2D Slope Stability Analysis for Soil and Rock Slopes.", Rocscience, Toronto.

Spencer (1967). "*A method of analysis of the stability of embankments assuming parallel inter-slice forces.*" Geotechnique, London, England, 17(1), 11-26.

Terraqua Resources/Duffield (1984) *"Site Suitability Report, Hydrogeological And Geotechnical Evaluation Of The Cherry Island Site."* Vol. 1 (Report) & Vol. 2 (Oversize Drawings), January.

USEPA (1993). "*Solid Waste Disposal Facility Criteria,"* Document No. EPA 530-R-93-017, United States Environmental Protection Agency, November, 1993.

Figures



PLAN VIEW OF ANALYSIS SECTIONS

450 225 0 450

SCALE: 1" = 450'

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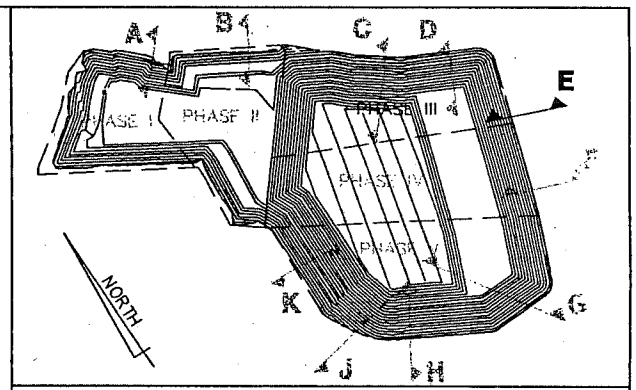
COLUMBIA, MARYLAND

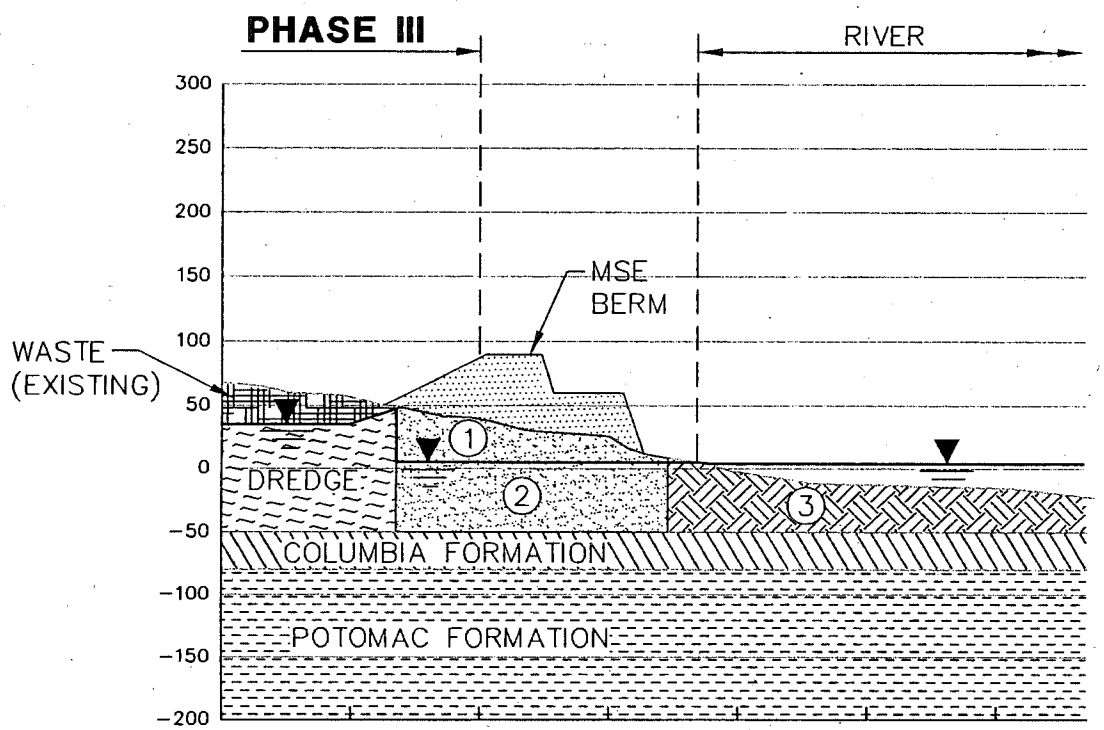
FIGURE NO.	1
PROJECT NO.	ME0250
DOCUMENT NO.	
FILE NO.	0250F609-2

SECTION E

STA 50+00



KEY MAP



① = UNDRAINED PVD AREA

② = DRAINED PVD AREA

③ = RIVER SEDIMENTS

150 75 0 150

SCALE: 1" = 150'

GEOSYNTEC CONSULTANTS

COLUMBIA, MARYLAND

FIGURE NO.	2
PROJECT NO.	ME0250
DOCUMENT NO.	
FILE NO.	0250F609

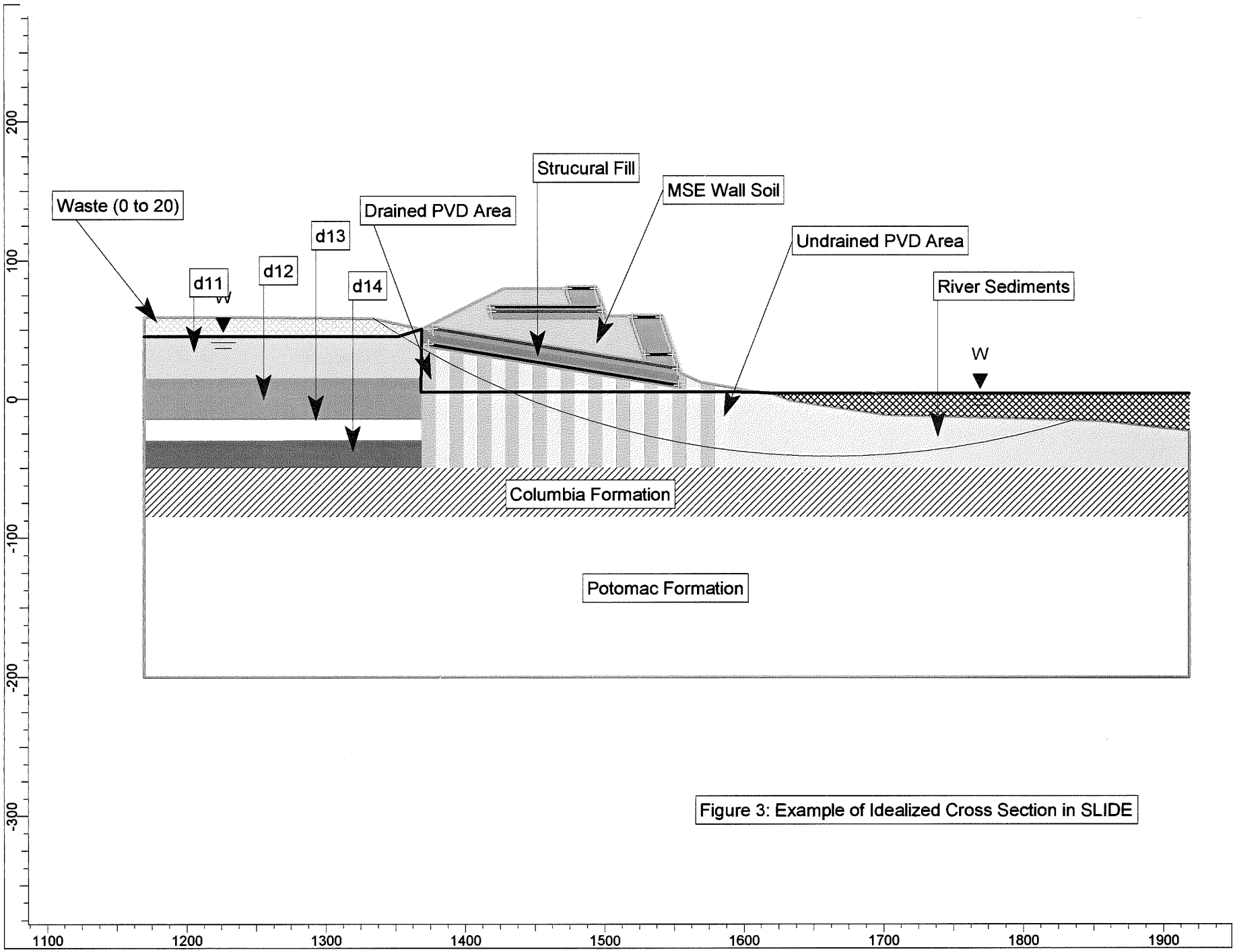


Figure 3: Example of Idealized Cross Section in SLIDE

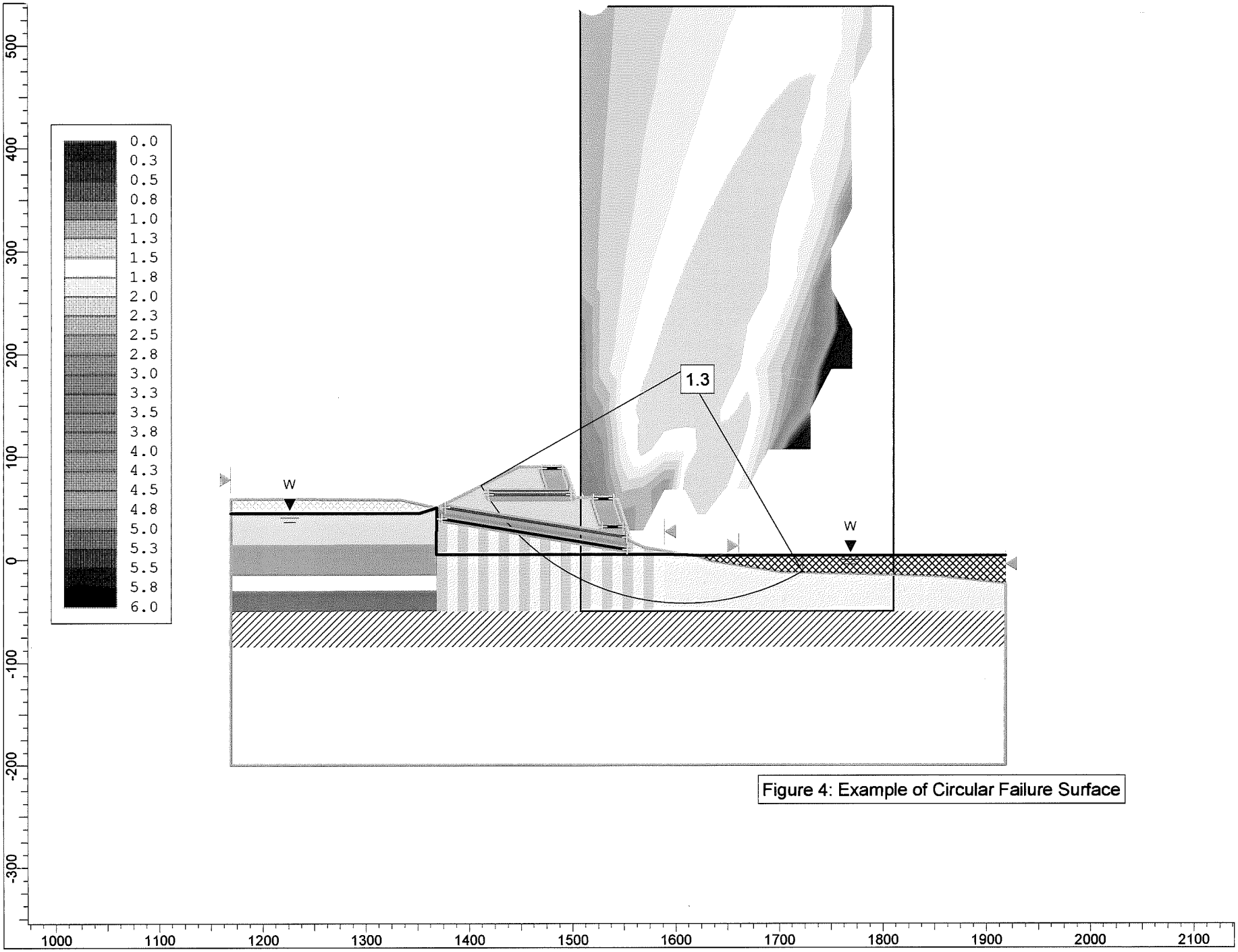
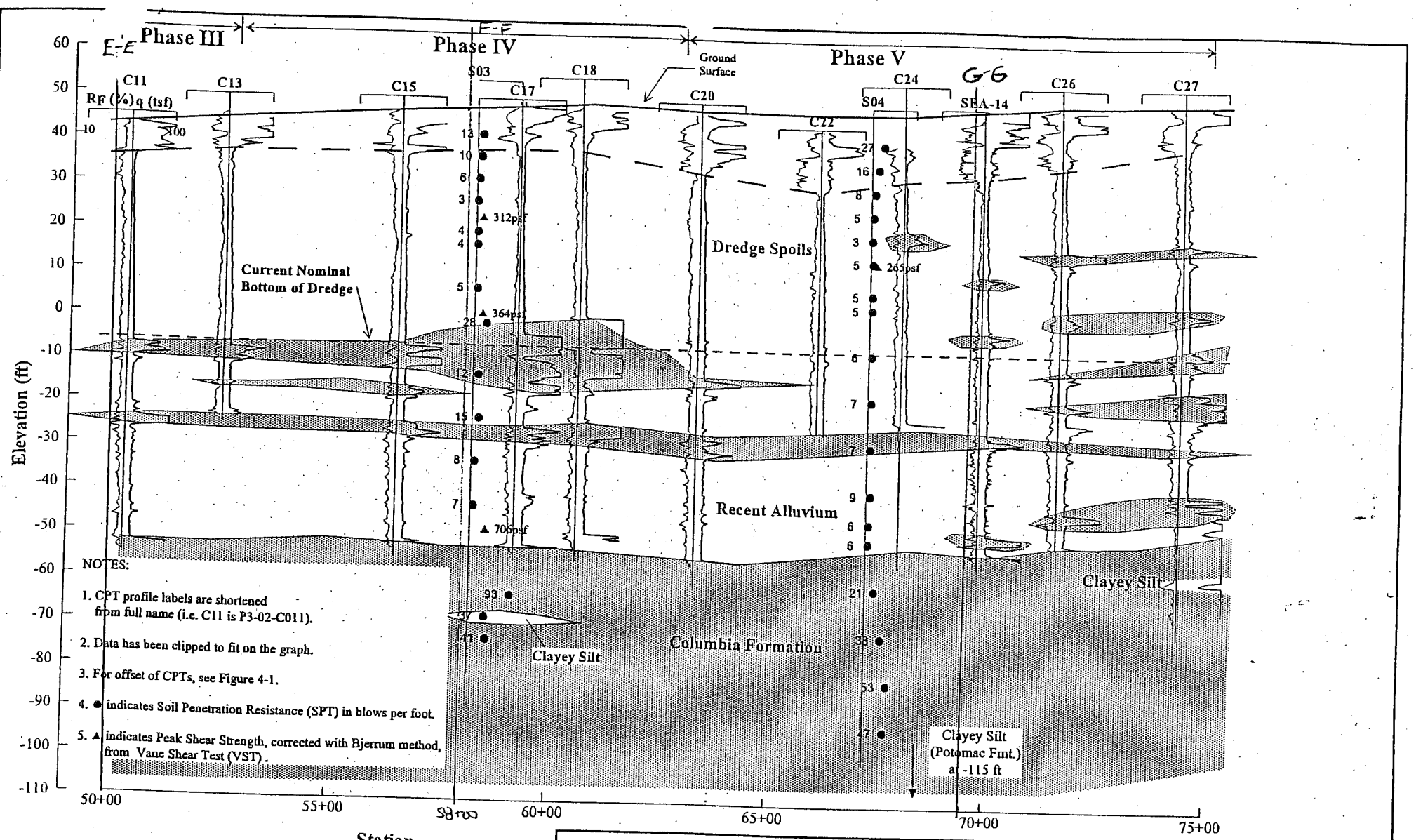


Figure 4: Example of Circular Failure Surface

Attachment A

Soil Stratigraphy



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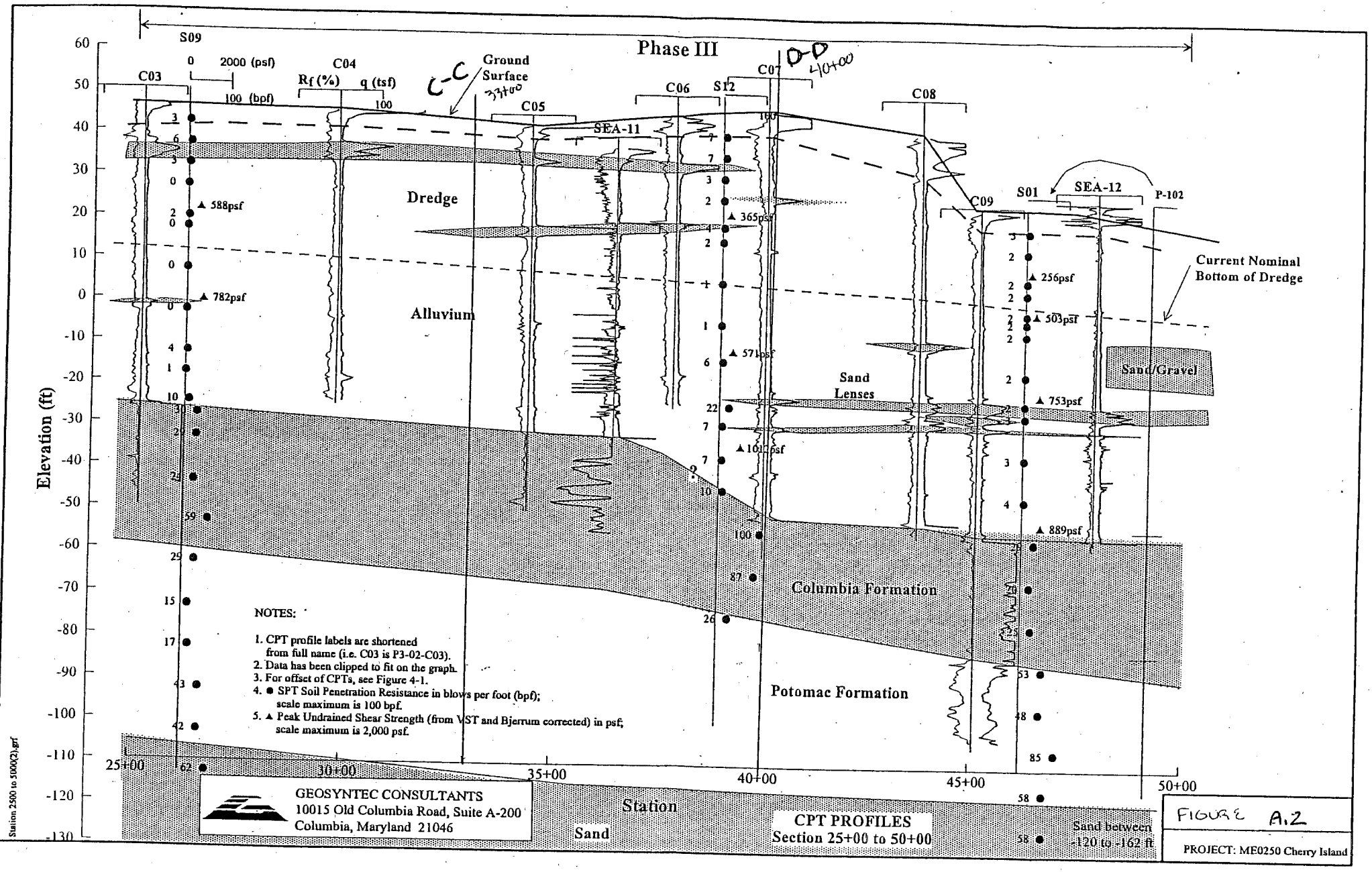
10015 Old Columbia Road, Suite A-200
Columbia, Maryland 21046

CPT PROFILES
Station 50+00 to 75+00
(Along Dike)

FIGURE A.1

PROJECT: ME0250 Cherry Island

Station 5000 to 7500ba(2).grf


Phase III
S09
C03
C04
C05
C06
S12
C07
C08
C09
S01
SEA-11
SEA-12
P-102
0
2000 (psf)
100 (bpf)
Rf (%)
q (tsf)
100
Ground Surface
C-C
33+00
D-D
40+00
Dredge
Alluvium
Sand Lenses
Sand/Gravel
Columbia Formation
Potomac Formation
Current Nominal Bottom of Dredge
588psf
782psf
365psf
571psf
1012psf
256psf
503psf
753psf
889psf
Elevation (ft)
Station
25+00
30+00
35+00
40+00
45+00
50+00
Sand
Sand between -120 to -162 ft
NOTES:
1. CPT profile labels are shortened from full name (i.e. C03 is P3-02-C03).
2. Data has been clipped to fit on the graph.
3. For offset of CPTs, see Figure 4-1.
4. ● SPT Soil Penetration Resistance in blows per foot (bpf); scale maximum is 100 bpf.
5. ▲ Peak Undrained Shear Strength (from VST and Bjerrum corrected) in psf; scale maximum is 2,000 psf.
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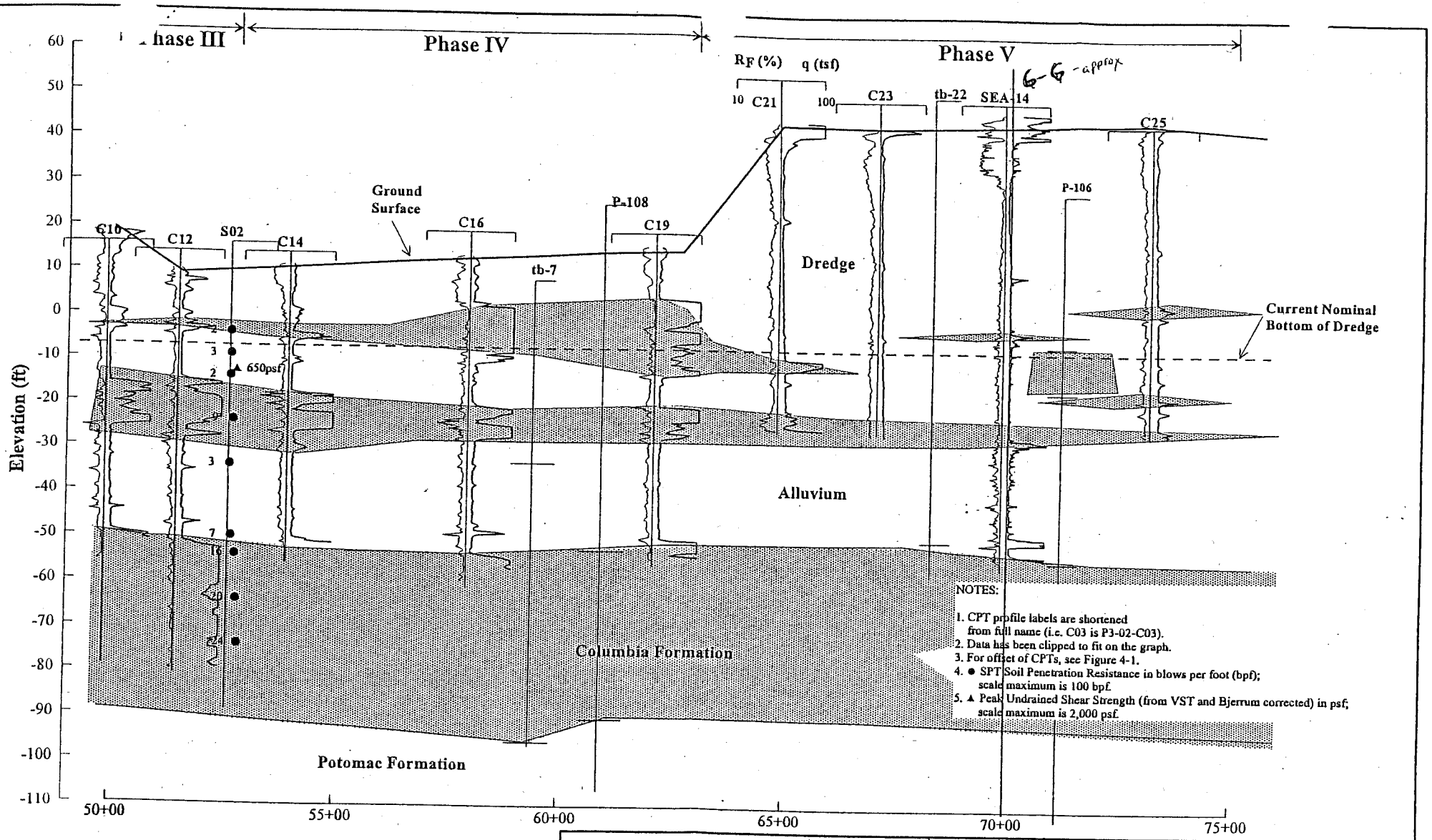
Columbia, Maryland 21046
CPT PROFILES
Section 25+00 to 50+00
FIGURE A.2
PROJECT: ME0250 Cherry Island
Station 2500 to 5000(2).grf



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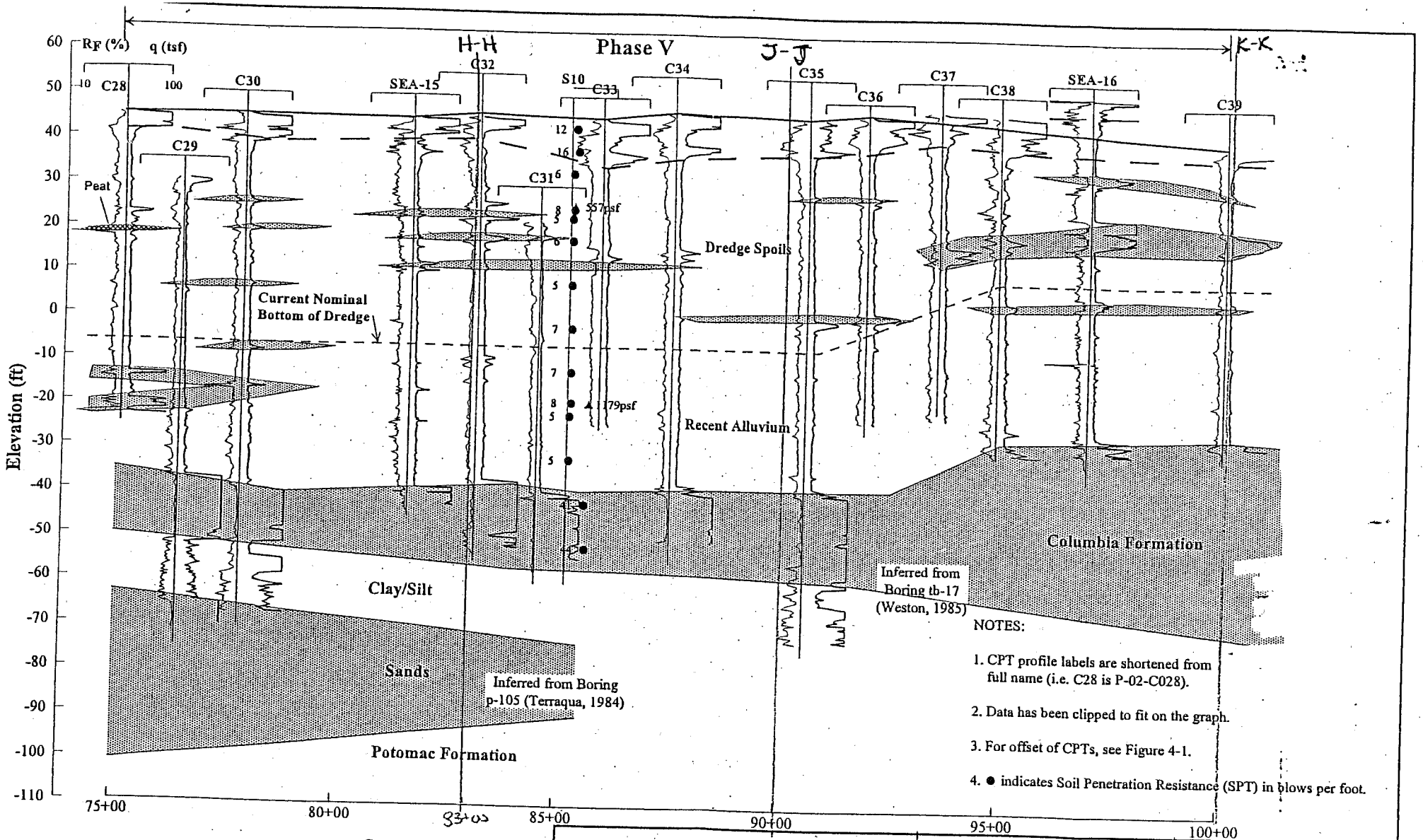
Columbia, Maryland 21046

CPT PROFILES
Station 50+00 to 75+00
(Along Toe)

FIGURE A.3

PROJECT: ME0250 Cherry Island



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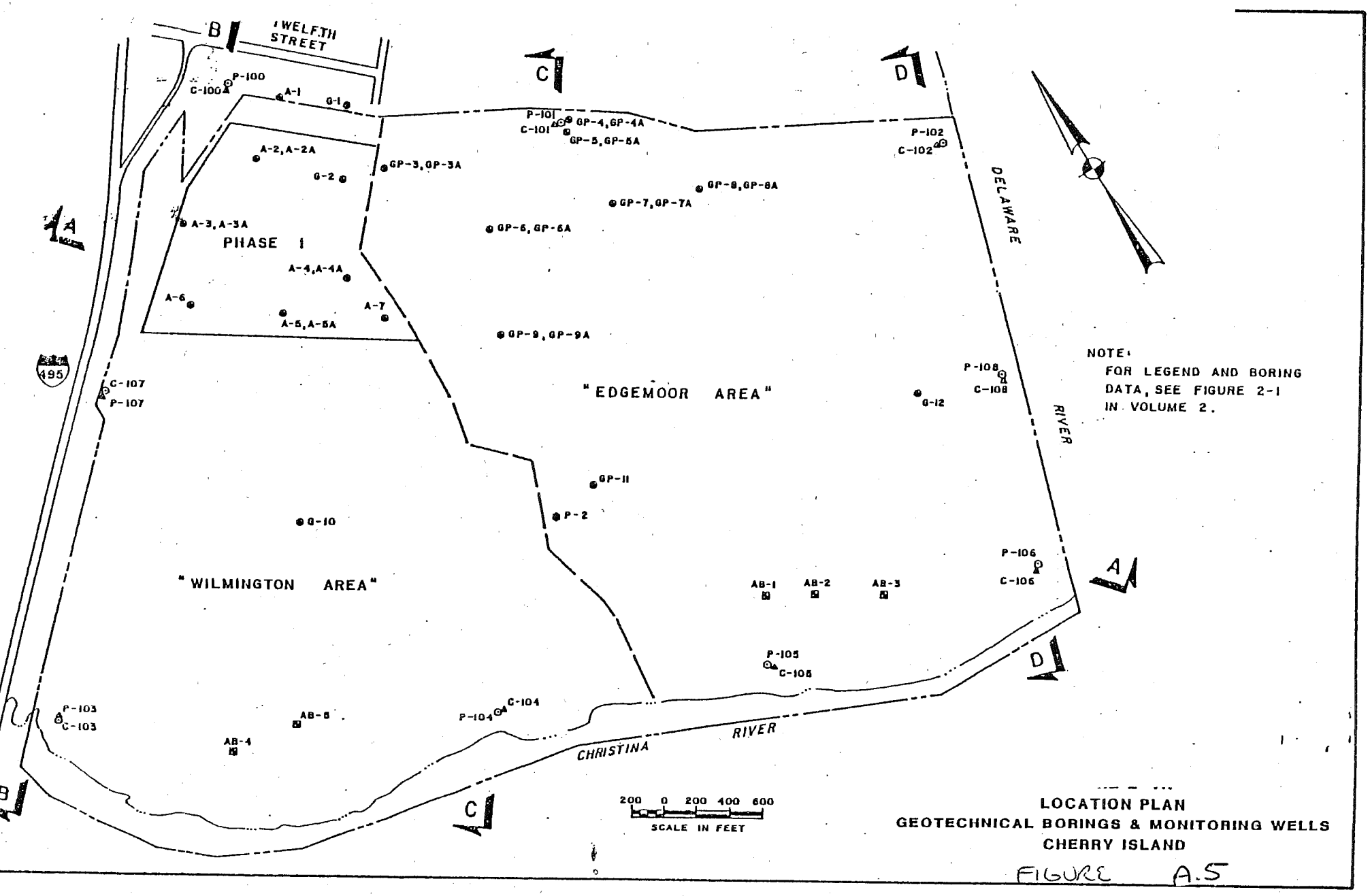
Columbia, Maryland 21046

CPT PROFILES
Station 75+00 to 100+00

FIGURE A.4

PROJECT: ME0250 Cherry Island

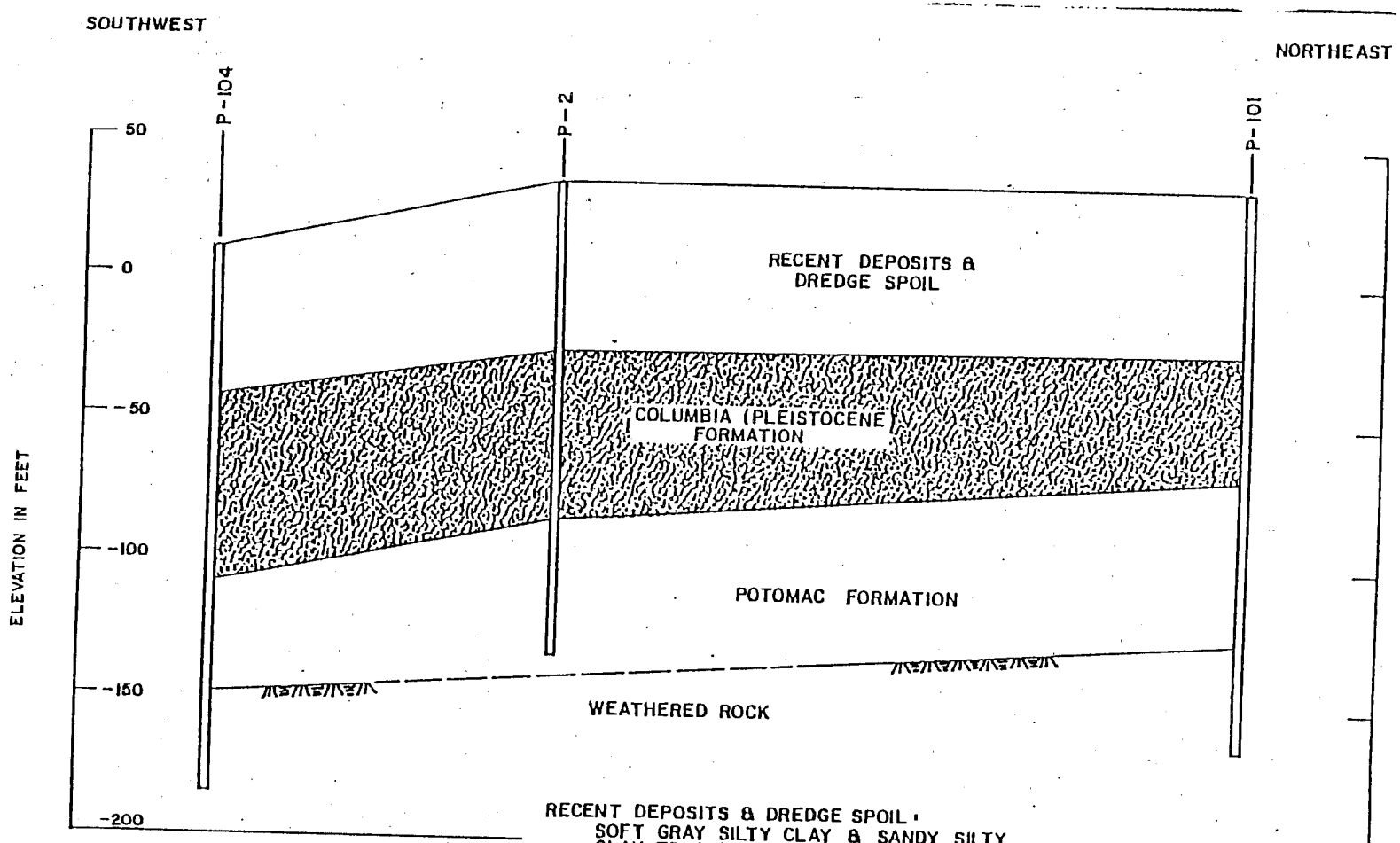
Terraqua Resources/Duffield (1984). "Site S bility Report, Hydrogeological And Geotechnical Evaluation Of The Cherry Island Site." Vol. 1 (Report) & Vol. 2 (Oversize Drawings).



LOCATION PLAN
GEOTECHNICAL BORINGS & MONITORING WELLS
CHERRY ISLAND

FIGURE A.5

Terraqua Resources/Duffield (1984). "Site Suitability Report, Hydrogeological And Geotechnical Evaluation Of The Cherry Island Site." Vol. 1 (Report) & Vol. 2 (Oversize Drawings).



REFERENCE: FIGURE 2-1

0 400 800
Scale In Feet

RECENT DEPOSITS & DREDGE SPOIL:
SOFT GRAY SILTY CLAY & SANDY SILTY CLAY TO SANDY CLAYEY SILT

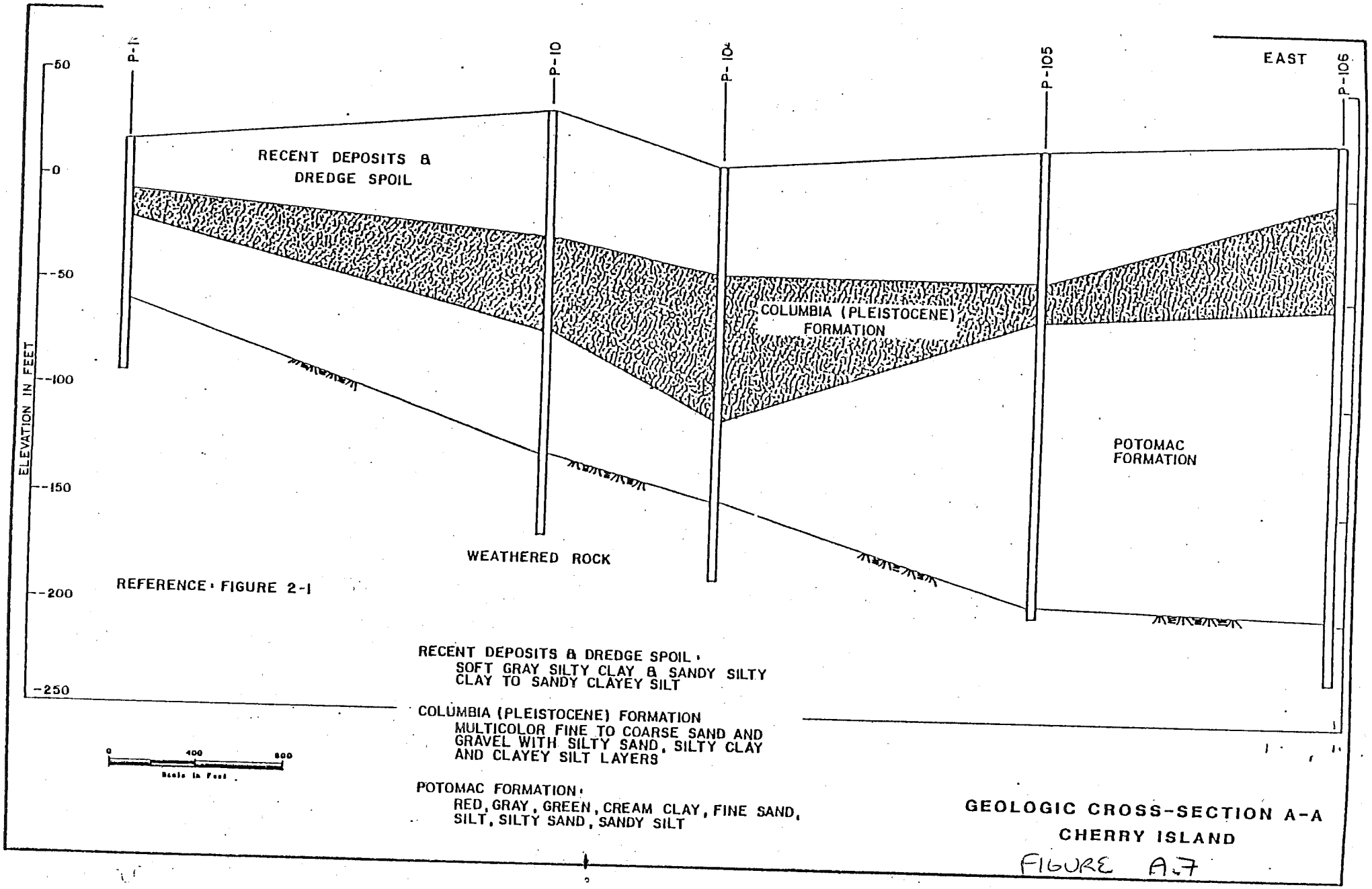
COLUMBIA (PLEISTOCENE) FORMATION
MULTICOLOR FINE TO COARSE SAND AND GRAVEL WITH SILTY SAND, SILTY CLAY AND CLAYEY SILT LAYERS

POTOMAC FORMATION:
RED, GRAY, GREEN, CREAM CLAY, FINE SAND, SILT, SILTY SAND, SANDY SILT

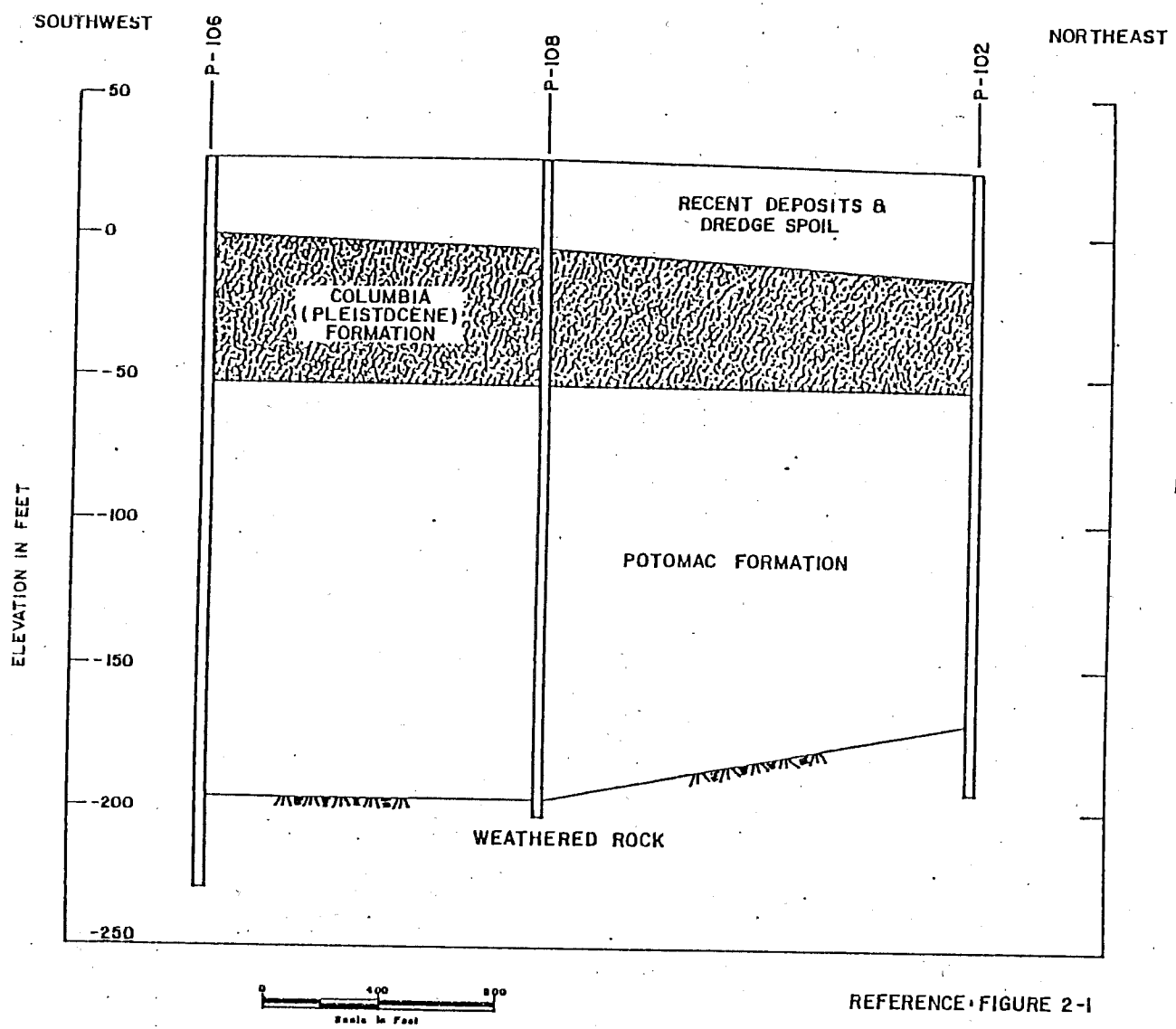
GEOLOGIC CROSS-SECTION C-C
CHERRY ISLAND

FIGURE A.6

Terraqua Resources/Duffield (1984). "Site S bility Report, Hydrogeological And Geotechnical Evaluation Of The Cherry Island Site." Vol. 1 (Report) & Vol. 2 (Oversize Drawings).



Terraqua Resources/Duffield (1984). "Site Suitability Report, Hydrogeological And Geotechnical Evaluation Of The Cherry Island Site." Vol. 1 (Report) & Vol. 2 (Oversize Drawings).



RECENT DEPOSITS & DREDGE SPOIL:
SOFT GRAY SILTY CLAY & SANDY SILTY CLAY TO SANDY CLAYEY SILT

COLUMBIA (PLEISTOCENE) FORMATION
MULTICOLOR FINE TO COARSE SAND AND GRAVEL WITH SILTY SAND, SILTY CLAY AND CLAYEY SILT LAYERS

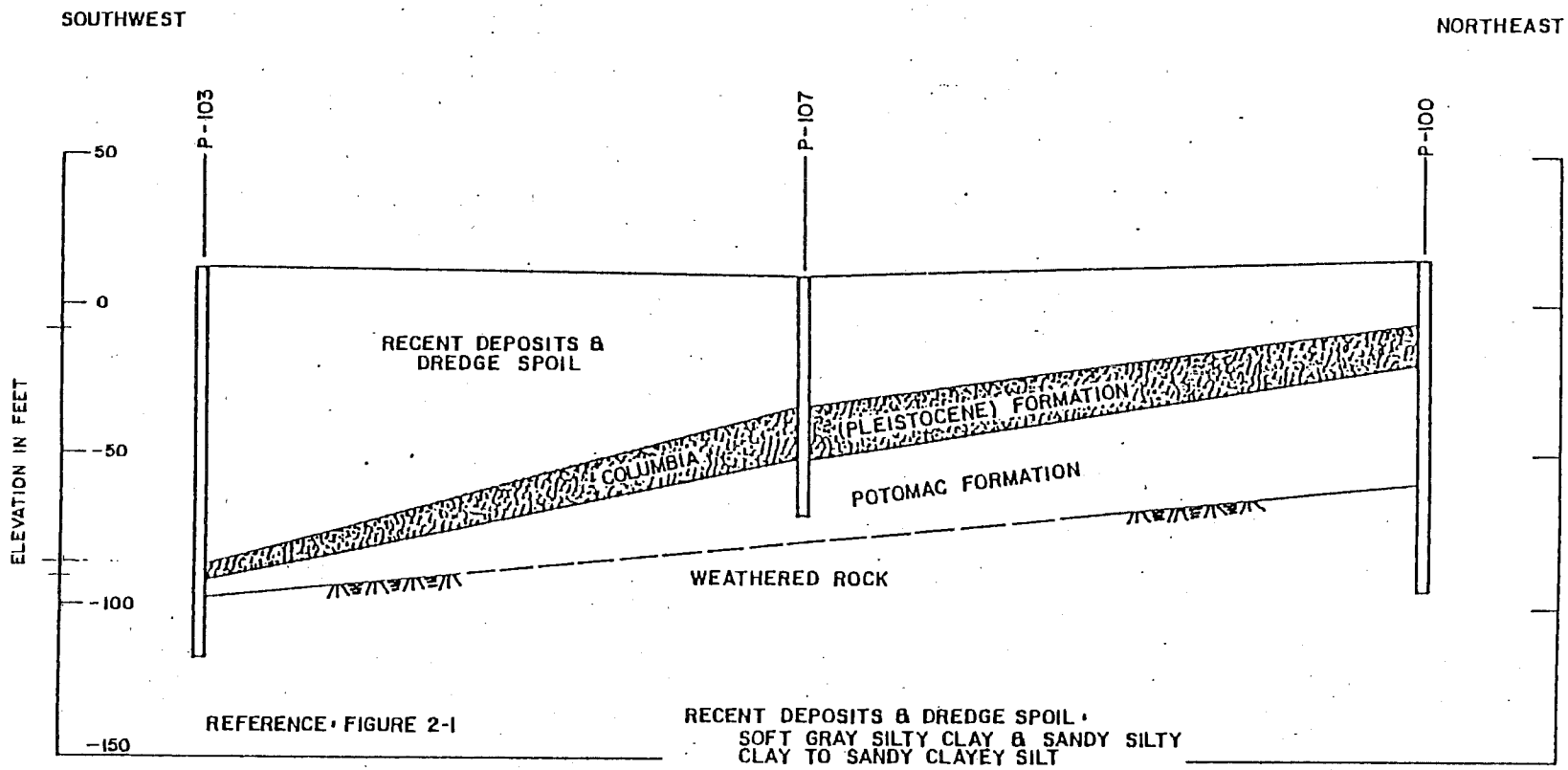
POTOMAC FORMATION:
RED, GRAY, GREEN, CREAM CLAY, FINE SAND, SILT, SILTY SAND, SANDY SILT

REFERENCE: FIGURE 2-1

GEOLOGIC CROSS-SECTION D-D
CHERRY ISLAND

FIGURE A.8

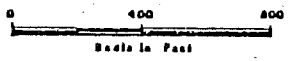
Terraqua Resources/Duffield (1984). "Site S ›ility Report, Hydrogeological And Geotechnical Evaluation Of The Cherry Island Site." Vol. 1 (Report) & Vol. 2 (Oversize Drawings).



RECENT DEPOSITS & DREDGE SPOIL:
SOFT GRAY SILTY CLAY & SANDY SILTY CLAY TO SANDY CLAYEY SILT

COLUMBIA (PLEISTOCENE) FORMATION
MULTICOLOR FINE TO COARSE SAND AND GRAVEL WITH SILTY SAND, SILTY CLAY AND CLAYEY SILT LAYERS

POTOMAC FORMATION:
RED, GRAY, GREEN, CREAM CLAY, FINE SAND, SILT, SILTY SAND, SANDY SILT

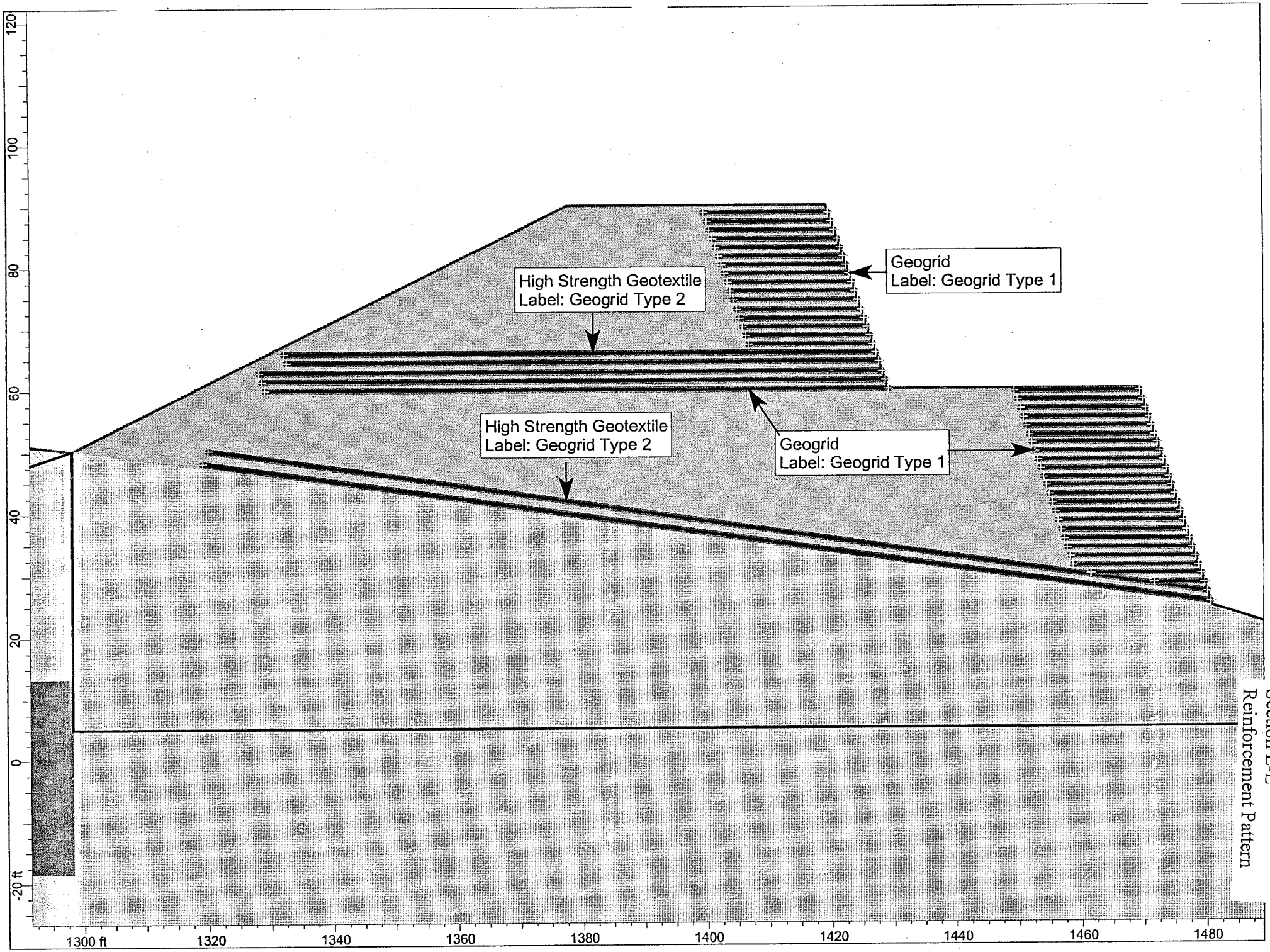


GEOLOGIC CROSS-SECTION B-B
CHERRY ISLAND

FIGURE A.9

Attachment B

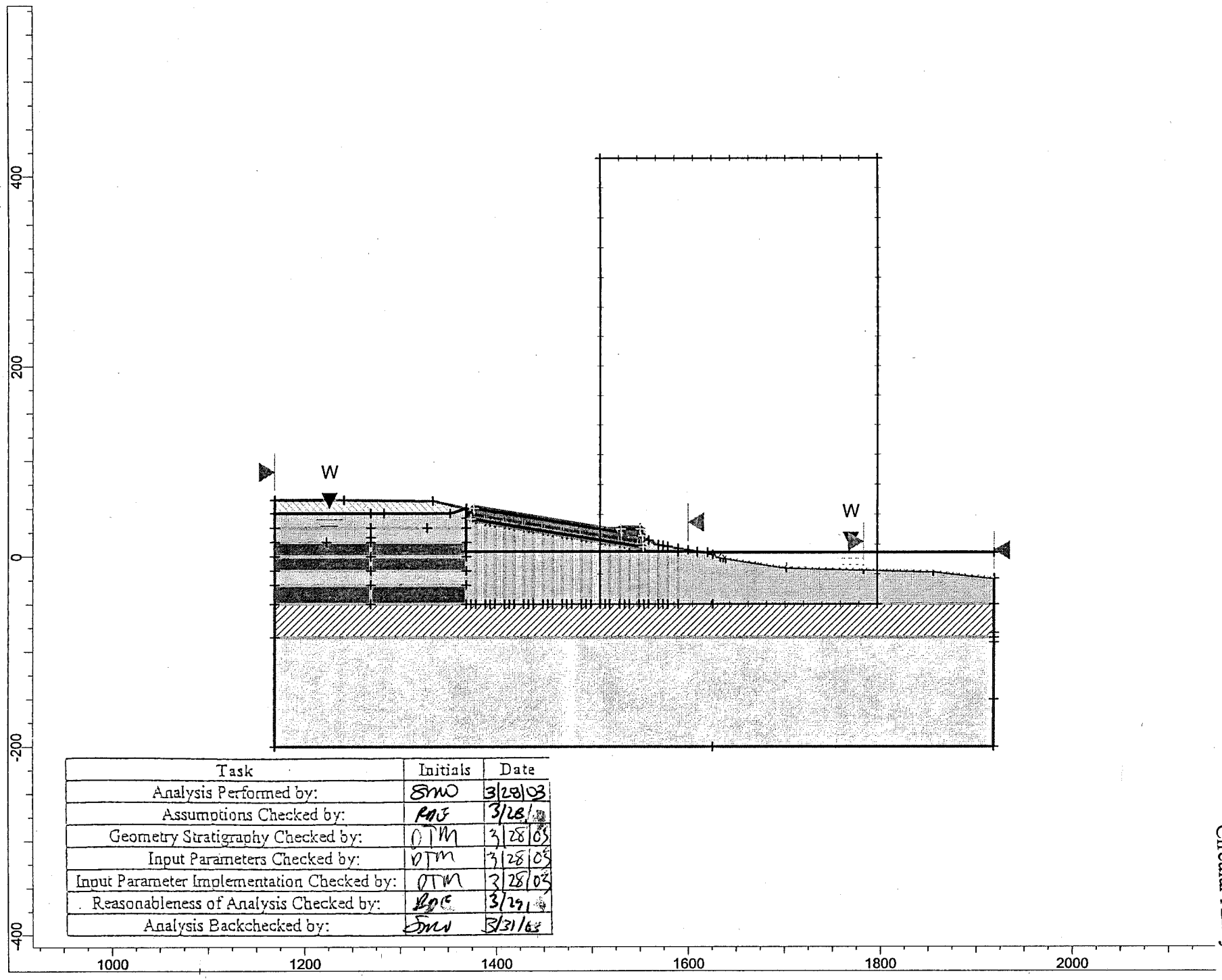
Stability Analysis Results for Construction of Section E-E



Section E-E
Reinforcement Pattern

Explanation of Construction Analysis

Construction Sequence	Represents
Construction 1	Single 10' lift placed on existing ground surface
Construction 2	Single 10' lift placed on existing 10' of fill
Construction 3	Single 10' lift placed on existing 20' of fill
Construction 4	Single 10' lift placed on existing 30' of fill
Construction 5	Single 10' lift placed on existing 50' of fill
Construction 6	Single 10' lift placed on existing 60' of fill
Construction 7	Single 10' lift placed on existing 70' of fill

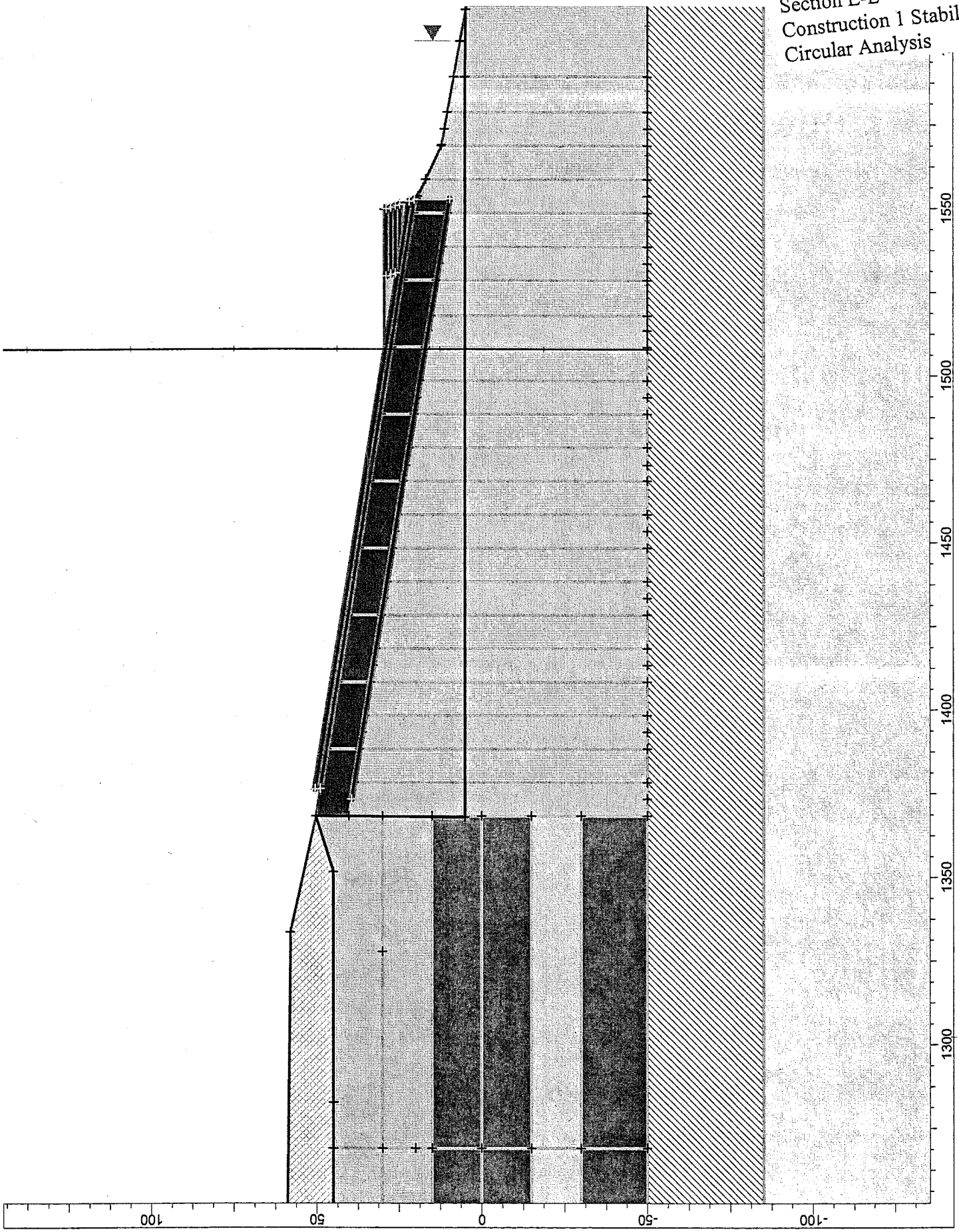


Task	Initials	Date
Analysis Performed by:	SMW	3/28/03
Assumptions Checked by:	RAJ	3/28/03
Geometry Stratigraphy Checked by:	DTM	3/28/03
Input Parameters Checked by:	DTM	3/28/03
Input Parameter Implementation Checked by:	DTM	3/28/03
Reasonableness of Analysis Checked by:	BJC	3/29/03
Analysis Backchecked by:	SMW	3/31/03

Section E-E
Construction 1 Stability
Circular Analysis

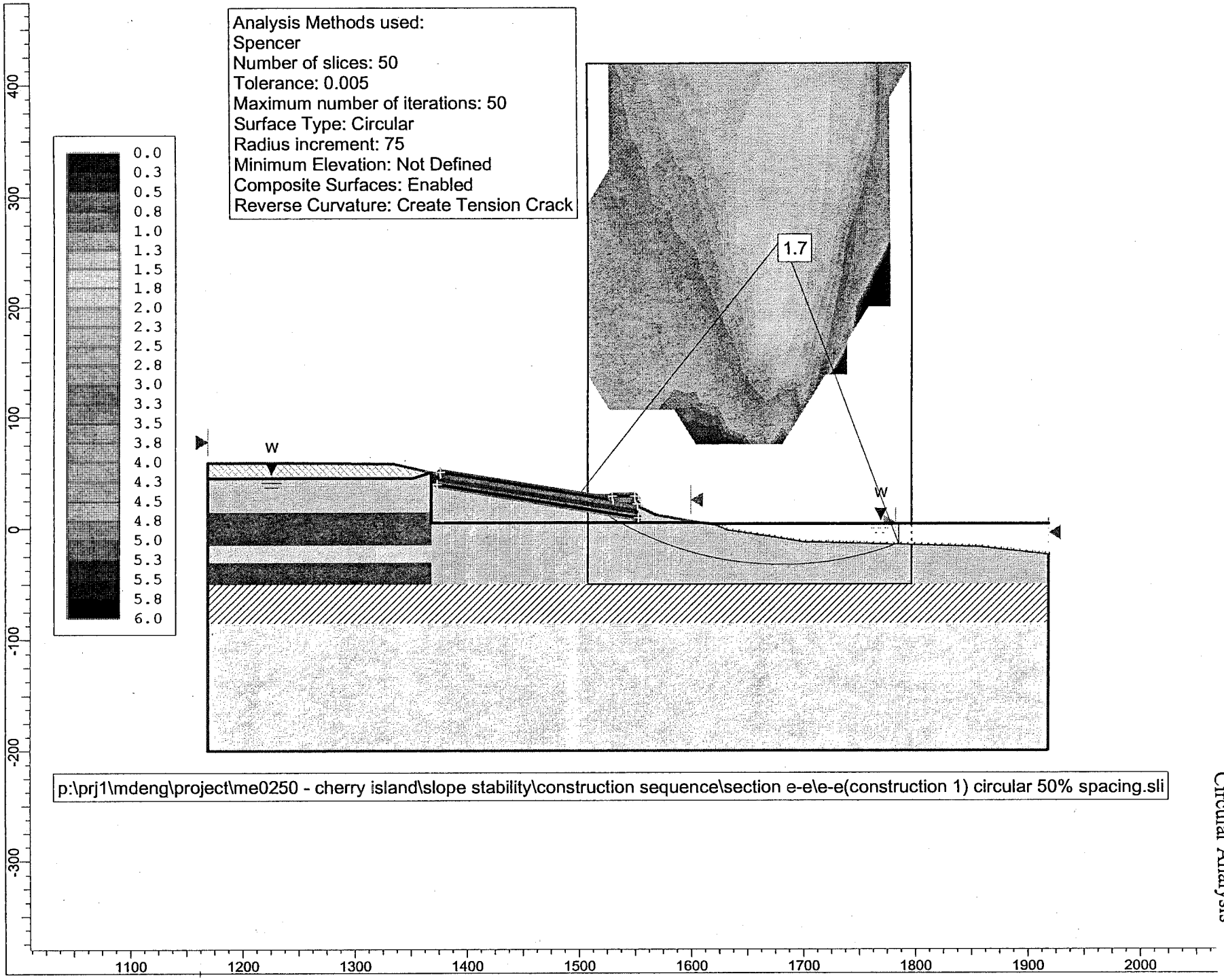
E-1

Section E-E
Construction 1 Stability
Circular Analysis



ECT-2

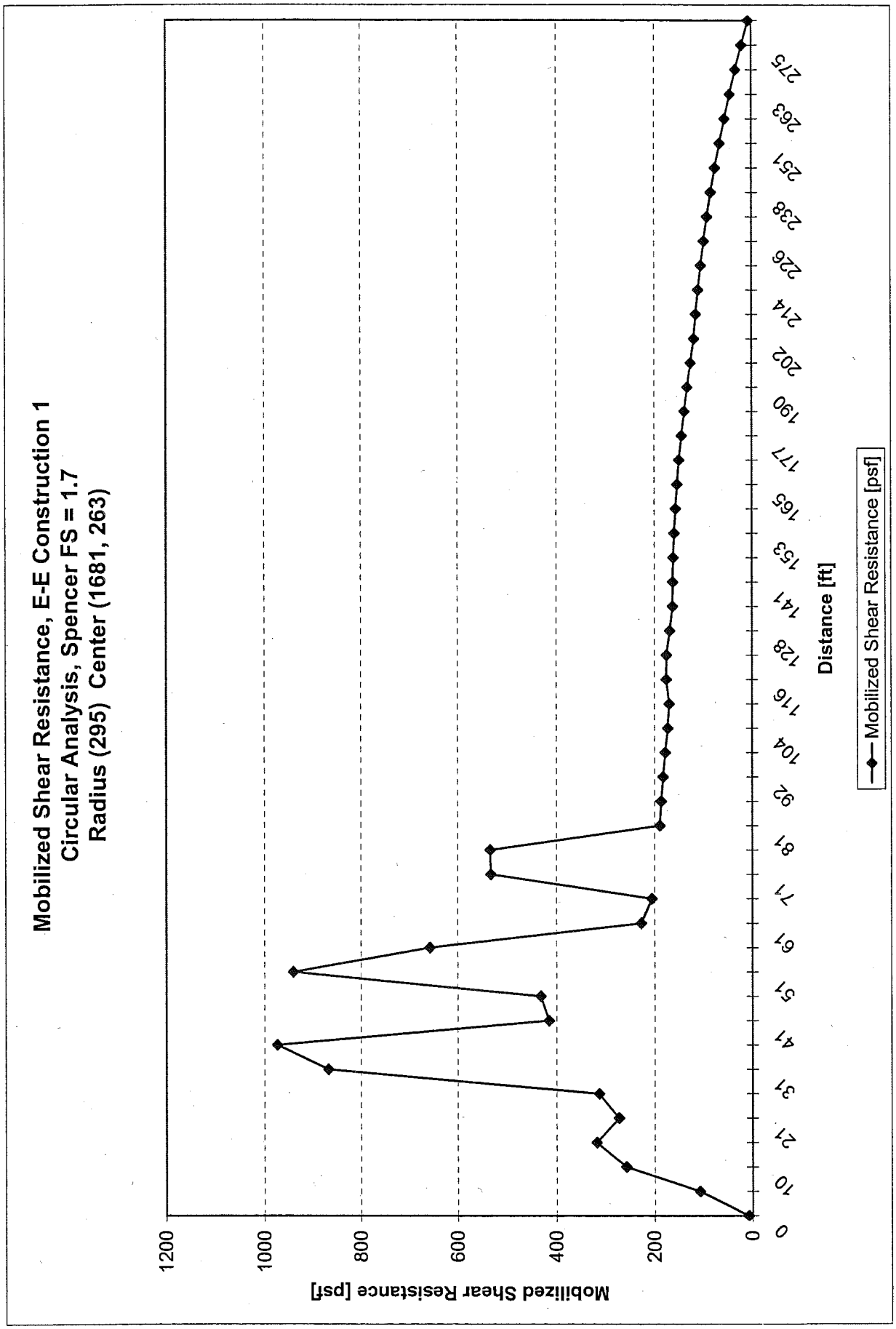
Section E-E
Construction 1 Stability
Circular Analysis



p:\prj1\mdeng\project\me0250 - cherry island\slope stability\construction sequence\section e-e\e-e(construction 1) circular 50% spacing.sli

E01-3

Section E-E
Construction 1 Stability
Circular Analysis



PRJ1/ME0250/SlopeStability/ConstructionSequence/Mobilized Shear Strength E Cons

ECT-4

Slide Analysis Information

Document Name

File Name: e-e(construction 1) circular 50% spacing

Project Settings

Project Title: SLIDE - An Interactive Slope Stability Program
Failure Direction: Left to Right
Units of Measurement: Imperial Units
Pore Fluid Unit Weight: 62.4 lb/ft3
Groundwater Method: Water Surfaces
Data Output: Standard

Analysis Methods

Analysis Methods used:
Spencer

Number of slices: 50
Tolerance: 0.005
Maximum number of iterations: 50

Surface Options

Surface Type: Circular
Radius increment: 75
Minimum Elevation: Not Defined
Composite Surfaces: Enabled
Reverse Curvature: Create Tension Crack

Loading

Seismic Load Coefficient (Horizontal): 0
Seismic Load Coefficient (Vertical): 0

Material Properties

Material: Potomac Formation
Strength Type: Undrained
Unit Weight: 120 lb/ft3
Cohesion Type: Function of Depth
Cohesion (Top): 4500 psf
Cohesion Change: 14.4 psf/ft
Cutoff: 10000 psf
Water Surface: None

Material: Waste (0 to 20)
Strength Type: Mohr-Coulomb
Unit Weight: 60 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Undrained PVD Area
Strength Type: Strength=F(overburden)
Unit Weight: 85 lb/ft3
Tau/Sigma Ratio: 0.29
Water Surface: Water Table
Custom Hu value: 1

Material: d11
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 200 psf
Water Surface: None

Material: d12
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 400 psf
Water Surface: None

Material: d13
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 600 psf
Water Surface: None

Material: d14
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 800 psf
Water Surface: None

Material: River Sediments
Strength Type: Strength=F(overburden)
Unit Weight: 85 lb/ft3
Tau/Sigma Ratio: 0.29
Water Surface: Water Table
Custom Hu value: 1

Section E-E
Construction 1 Stability
Circular Analysis

ECT-3.

Material: Columbia Formation
Strength Type: Mohr-Coulomb
Unit Weight: 125 lb/ft3
Cohesion: 0 psf
Friction Angle: 40 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: MSE Wall Soil
Strength Type: Mohr-Coulomb
Unit Weight: 90 lb/ft3
Cohesion: 0 psf
Friction Angle: 29 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Drained PVD Area
Strength Type: Shear Normal function
Unit Weight: 85 lb/ft3
Water Surface: Water Table
Custom Hu value: 1

Material: Strucural Fill
Strength Type: Mohr-Coulomb
Unit Weight: 110 lb/ft3
Cohesion: 0 psf
Friction Angle: 35 degrees
Water Surface: Water Table
Custom Hu value: 1

Support Properties

Support: Geogrid
Support Type: GeoTextile
Force Application: Passive
Force Orientation: Bisector of Parallel and Tangent
Anchorage: Slope Face
Shear Strength Model: Linear
Strip Coverage: 100 percent
Tensile Strength: 5000 lb/ft
Pullout Strength Adhesion: 0 lb/ft2
Pullout Strength Friction Angle: 25 degrees

Support: Geogrid2
Support Type: GeoTextile
Force Application: Passive
Force Orientation: Bisector of Parallel and Tangent
Anchorage: Slope Face
Shear Strength Model: Linear
Strip Coverage: 100 percent
Tensile Strength: 21000 lb/ft
Pullout Strength Adhesion: 0 lb/ft2
Pullout Strength Friction Angle: 25 degrees

Global Minimums

Method: spencer
SF: 1.70788
Center: 1680.8, 262.555
Radius: 295.387
Left Slip Surface Endpoint: 1499.5, 29.3504
Right Slip Surface Endpoint: 1784.64, -13.9788
Left Slope Intercept: 1499.5 29.3504
Right Slope Intercept: 1784.64 4

Method Statistics

Method: spencer
Number of Valid Surfaces: 10921
Number of Invalid Surfaces: 8535
Error Codes:
Error Code -101 reported for 155 surfaces
Error Code -103 reported for 72 surfaces
Error Code -108 reported for 212 surfaces
Error Code -111 reported for 2229 surfaces
Error Code -112 reported for 3345 surfaces
Error Code -113 reported for 394 surfaces
Error Code -1000 reported for 2128 surfaces

Error Codes

The following errors were encountered during the computation:

-101 = Only one (or zero) surface / slope intersections.

-103 = Two surface / slope intersections, but one or more surface / nonslope external polygon intersections lie between them. This usually occurs when the slip surface extends past the bottom of the soil region, but may also occur on a benched slope model with two sets of Slope Limits.

-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).

-111 = safety factor equation did not converge

-112 = The coefficient M-Alpha = cos(alpha)(1+tan(alpha)tan(phi)/F) < 0.2 for the final iteration of the safety factor calculation. This screens out some slip surfaces which may not be valid in the context of the analysis, in particular, deep seated slip surfaces with many high negative base

angle slices in the passive zone.

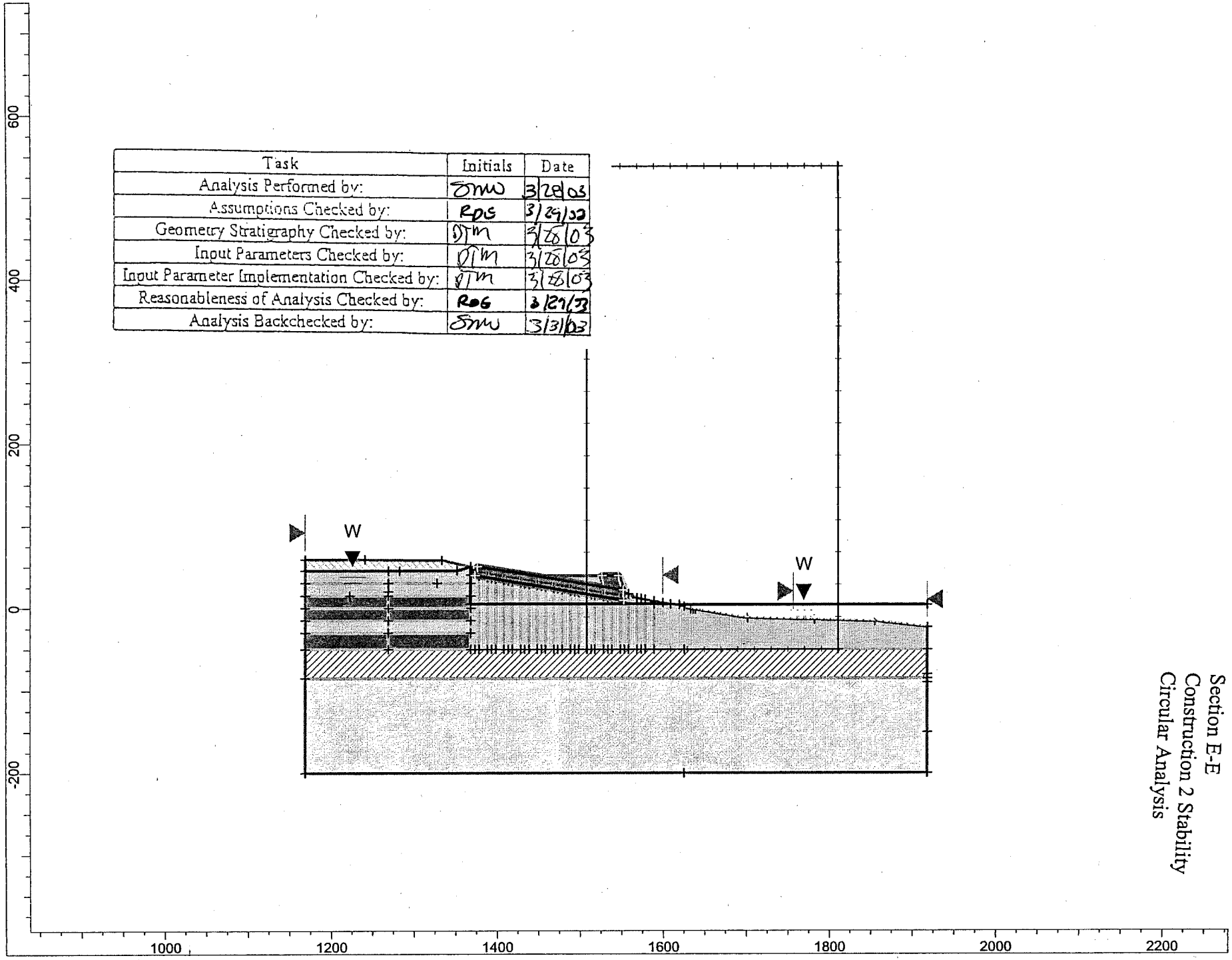
-113 = Surface intersects outside slope limits.

-1000 = No valid slip surfaces are generated at a grid center. Unable to draw a surface.

Section E-E'
Construction 1 Stability
Circular Analysis

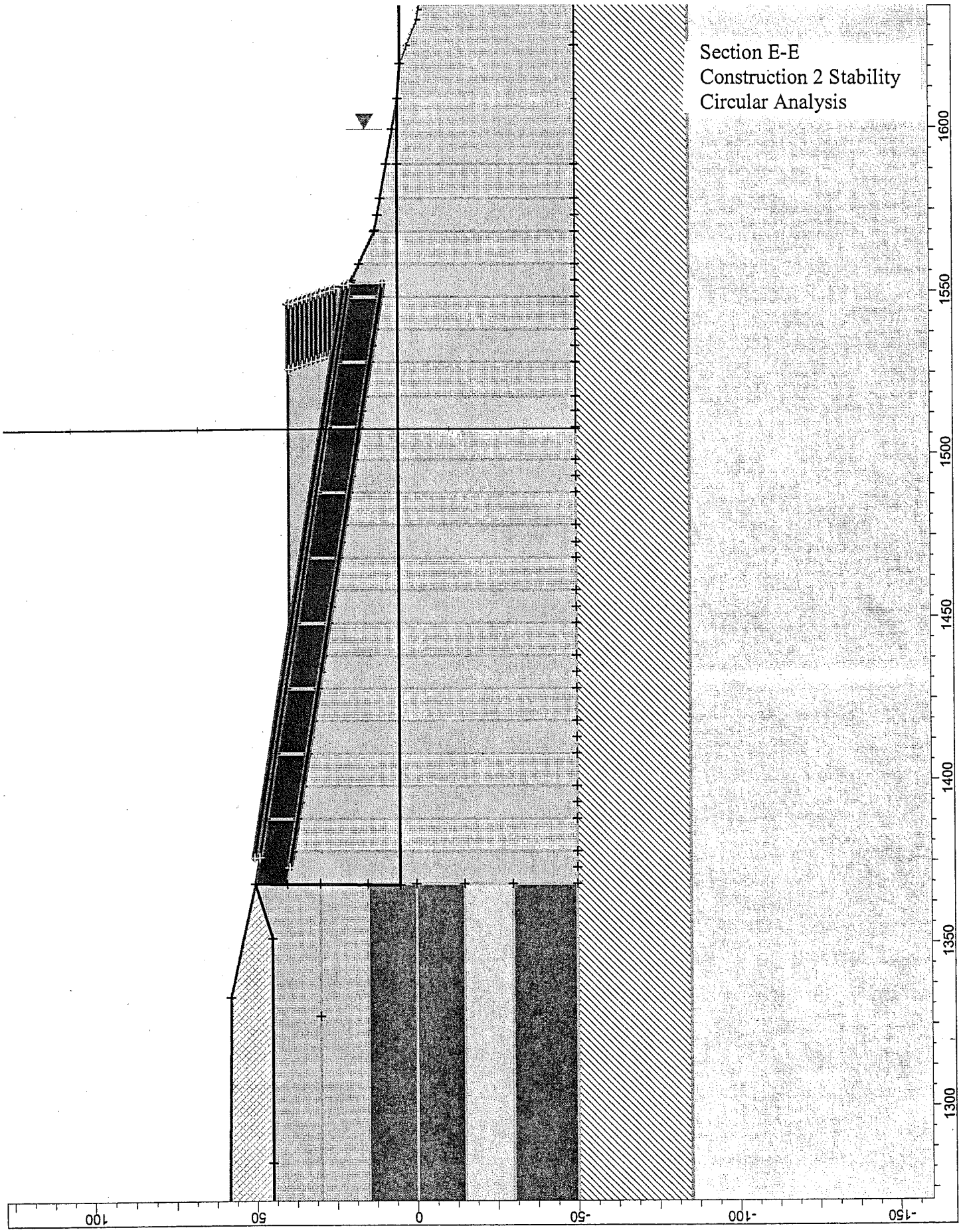
EC1.6

Task	Initials	Date
Analysis Performed by:	SMW	3/28/03
Assumptions Checked by:	RDS	3/29/03
Geometry Stratigraphy Checked by:	DTM	3/28/03
Input Parameters Checked by:	DTM	3/28/03
Input Parameter Implementation Checked by:	DTM	3/28/03
Reasonableness of Analysis Checked by:	RDG	3/27/03
Analysis Backchecked by:	SMW	3/31/03

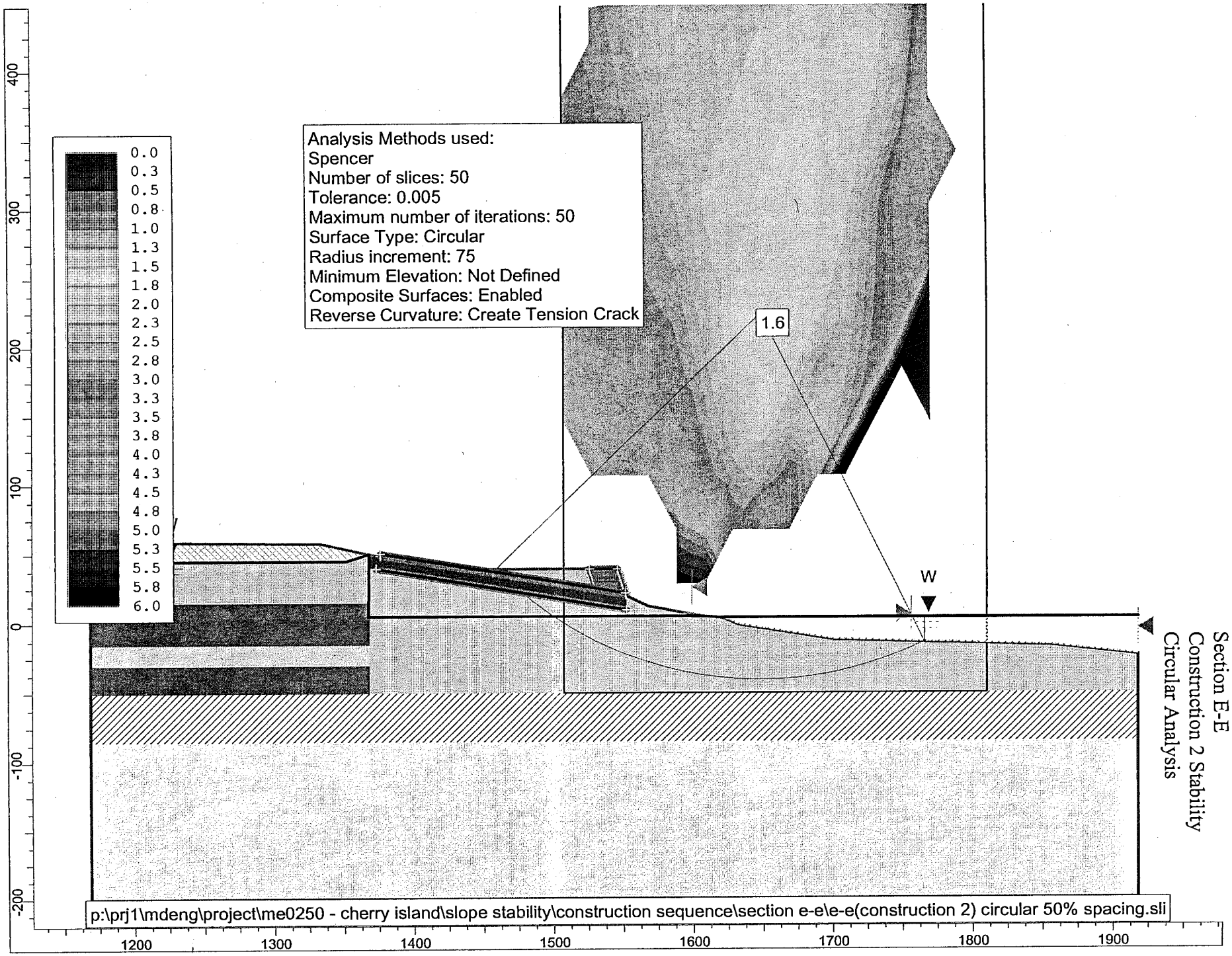


Section E-E
Construction 2 Stability
Circular Analysis

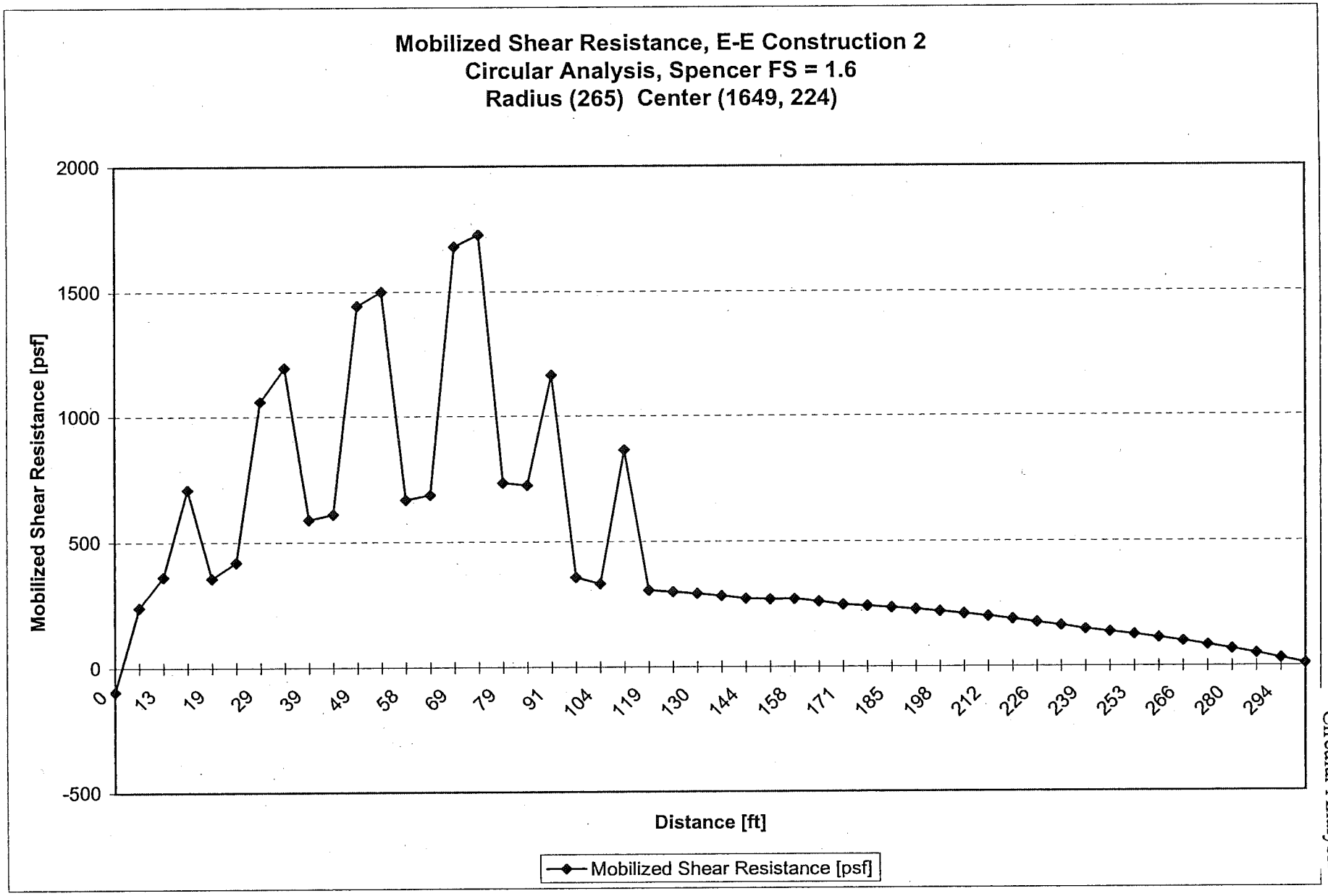
ECT. 4


Section E-E
Construction 2 Stability
Circular Analysis
1600
1550
1500
1450
1400
1350
1300
100
50
0
-50
-100
-150

ECT-8



Section E-E
Construction 2 Stability
Circular Analysis



Section E-E
Construction 2 Stability
Circular Analysis

PRJ1/ME0250/SlopeStability/ConstructionSequence/Mobilized Shear Strength E Cons.

EC 16

Slide Analysis Information

Document Name

File Name: e-e(construction 2) circular 50% spacing

Project Settings

Project Title: SLIDE - An Interactive Slope Stability Program
Failure Direction: Left to Right
Units of Measurement: Imperial Units
Pore Fluid Unit Weight: 62.4 lb/ft3
Groundwater Method: Water Surfaces
Data Output: Standard

Analysis Methods

Analysis Methods used:
Spencer

Number of slices: 50
Tolerance: 0.005
Maximum number of iterations: 50

Surface Options

Surface Type: Circular
Radius increment: 75
Minimum Elevation: Not Defined
Composite Surfaces: Enabled
Reverse Curvature: Create Tension Crack

Loading

Seismic Load Coefficient (Horizontal): 0
Seismic Load Coefficient (Vertical): 0

Material Properties

Material: Potomac Formation
Strength Type: Undrained
Unit Weight: 120 lb/ft3
Cohesion Type: Function of Depth
Cohesion (Top): 4500 psf
Cohesion Change: 14.4 psf/ft
Cutoff: 10000 psf
Water Surface: None

Material: Waste (0 to 20)
Strength Type: Mohr-Coulomb
Unit Weight: 60 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Undrained PVD Area
Strength Type: Strength=F(overburden)
Unit Weight: 85 lb/ft3
Tau/Sigma Ratio: 0.29
Water Surface: Water Table
Custom Hu value: 1

Material: d11
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 200 psf
Water Surface: None

Material: d12
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 400 psf
Water Surface: None

Material: d13
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 600 psf
Water Surface: None

Material: d14
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 800 psf
Water Surface: None

Material: River Sediments
Strength Type: Strength=F(overburden)
Unit Weight: 85 lb/ft3
Tau/Sigma Ratio: 0.29
Water Surface: Water Table
Custom Hu value: 1

Section E-E
Construction 2 Stability
Circular Analysis

ECT-11

Material: Columbia Formation
Strength Type: Mohr-Coulomb
Unit Weight: 125 lb/ft3
Cohesion: 0 psf
Friction Angle: 40 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: MSE Wall Soil
Strength Type: Mohr-Coulomb
Unit Weight: 90 lb/ft3
Cohesion: 0 psf
Friction Angle: 29 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Drained PVD Area
Strength Type: Shear Normal function
Unit Weight: 85 lb/ft3
Water Surface: Water Table
Custom Hu value: 1

Material: Strucural Fill
Strength Type: Mohr-Coulomb
Unit Weight: 110 lb/ft3
Cohesion: 0 psf
Friction Angle: 35 degrees
Water Surface: Water Table
Custom Hu value: 1

Support Properties

Support: Geogrid
Support Type: GeoTextile
Force Application: Passive
Force Orientation: Bisector of Parallel and Tangent
Anchorage: Slope Face
Shear Strength Model: Linear
Strip Coverage: 100 percent
Tensile Strength: 5000 lb/ft
Pullout Strength Adhesion: 0 lb/ft2
Pullout Strength Friction Angle: 25 degrees

Support: Geogrid2
Support Type: GeoTextile
Force Application: Passive
Force Orientation: Bisector of Parallel and Tangent
Anchorage: Slope Face
Shear Strength Model: Linear
Strip Coverage: 100 percent
Tensile Strength: 21000 lb/ft
Pullout Strength Adhesion: 0 lb/ft2
Pullout Strength Friction Angle: 25 degrees

Global Minimums

Method: spencer
SF: 1.59289
Center: 1648.92, 224.197
Radius: 264.807
Left Slip Surface Endpoint: 1459.38, 39.2738
Right Slip Surface Endpoint: 1765.66, -13.4909
Left Slope Intercept: 1459.38 39.2738
Right Slope Intercept: 1765.66 4

Method Statistics

Method: spencer
Number of Valid Surfaces: 10638
Number of Invalid Surfaces: 8818
Error Codes:
Error Code -101 reported for 125 surfaces
Error Code -103 reported for 70 surfaces
Error Code -108 reported for 233 surfaces
Error Code -111 reported for 2221 surfaces
Error Code -112 reported for 2576 surfaces
Error Code -113 reported for 933 surfaces
Error Code -1000 reported for 2660 surfaces

Error Codes

The following errors were encountered during the computation:

-101 = Only one (or zero) surface / slope intersections.

-103 = Two surface / slope intersections, but one or more surface / nonslope external polygon intersections lie between them. This usually occurs when the slip surface extends past the bottom of the soil region, but may also occur on a benched slope model with two sets of Slope Limits.

-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).

-111 = safety factor equation did not converge

-112 = The coefficient M-Alpha = cos(alpha)(1+tan(alpha)tan(phi)/F) < 0.2 for the final iteration of the safety factor calculation. This screens out some slip surfaces which may not be valid in the context of the analysis, in particular, deep seated slip surfaces with many high negative base

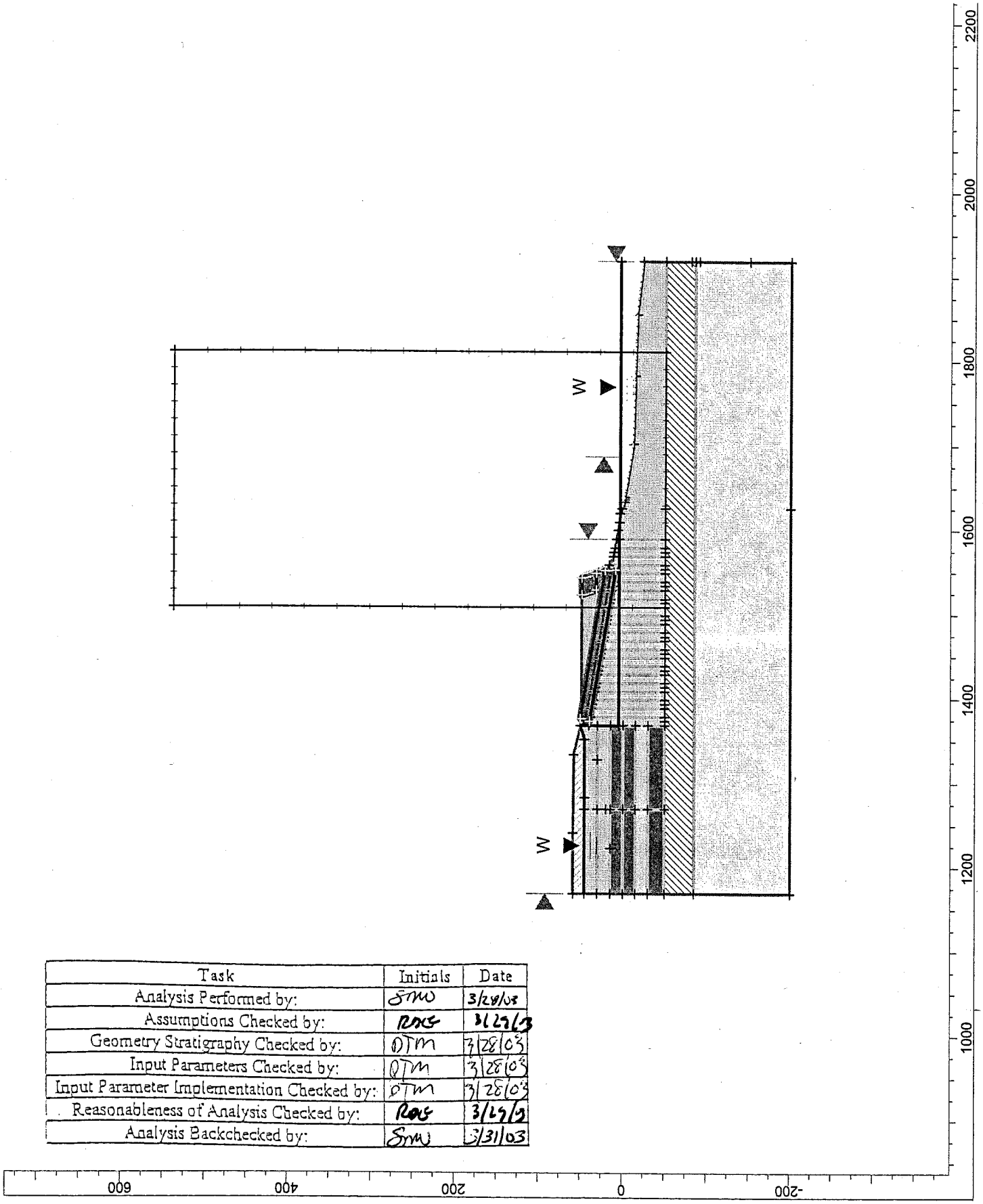
Section E-E
Construction 2 Stability
Circular Analysis

angle slices in the passive zone.

-113 = Surface intersects outside slope limits.

-1000 = No valid slip surfaces are generated at a grid center. Unable to draw a surface.

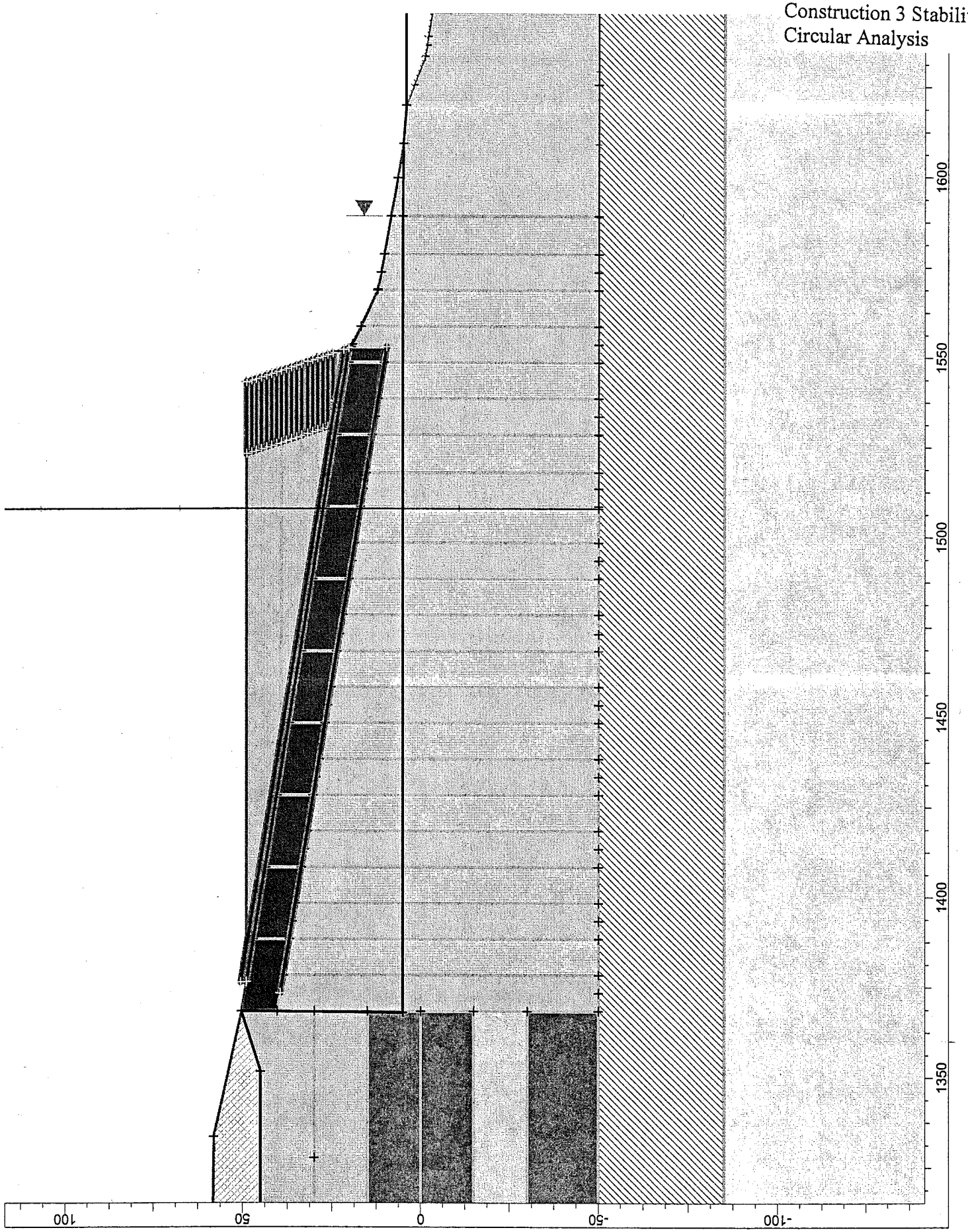
Section E-E
Construction 3 Stability
Circular Analysis



Task	Initials	Date
Analysis Performed by:	SMW	3/28/03
Assumptions Checked by:	RAG	3/29/03
Geometry Stratigraphy Checked by:	DTM	3/28/03
Input Parameters Checked by:	DTM	3/28/03
Input Parameter Implementation Checked by:	DTM	3/28/03
Reasonableness of Analysis Checked by:	RAG	3/29/03
Analysis Backchecked by:	SMW	3/31/03

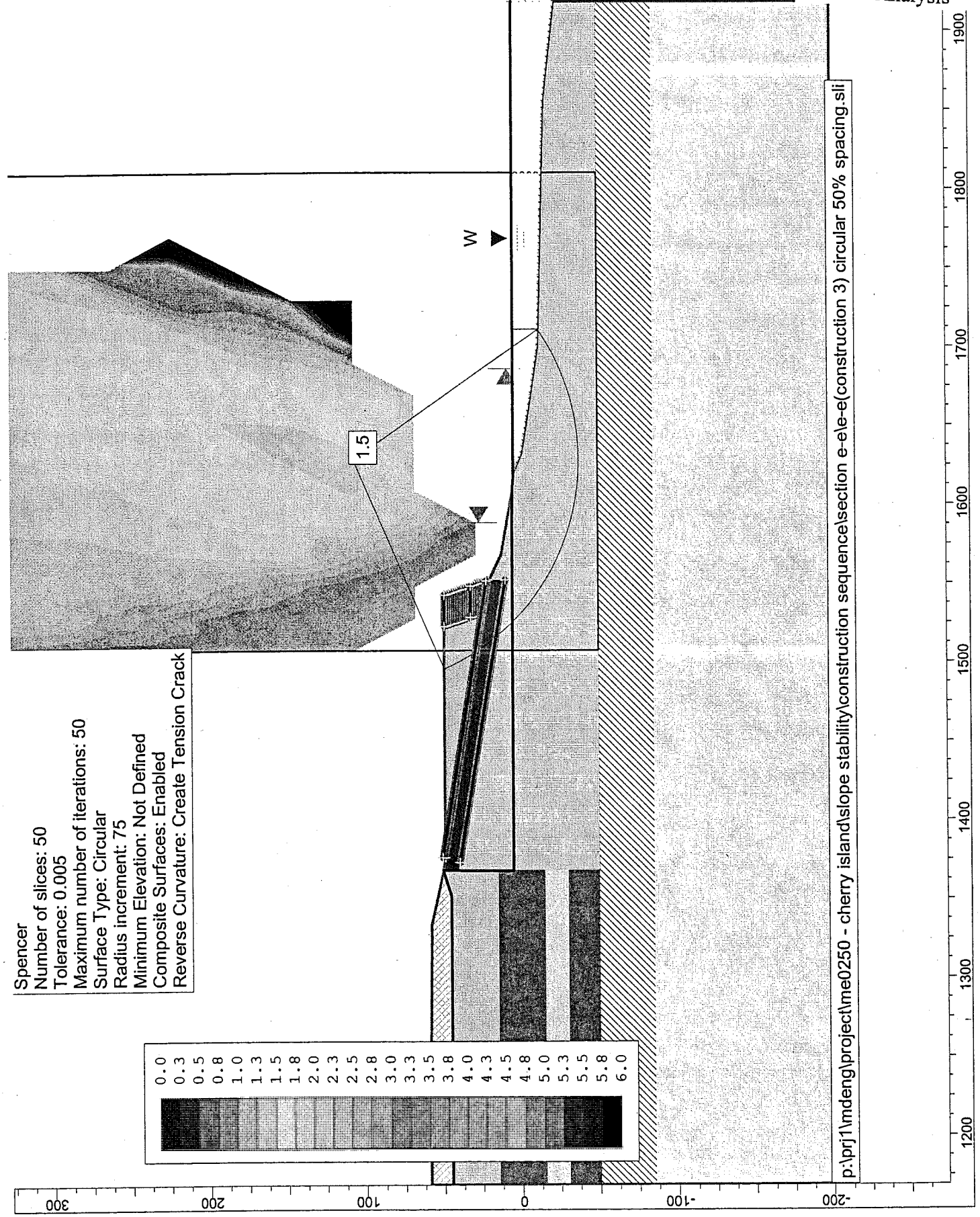
ECT-13

Section E-E
Construction 3 Stability
Circular Analysis



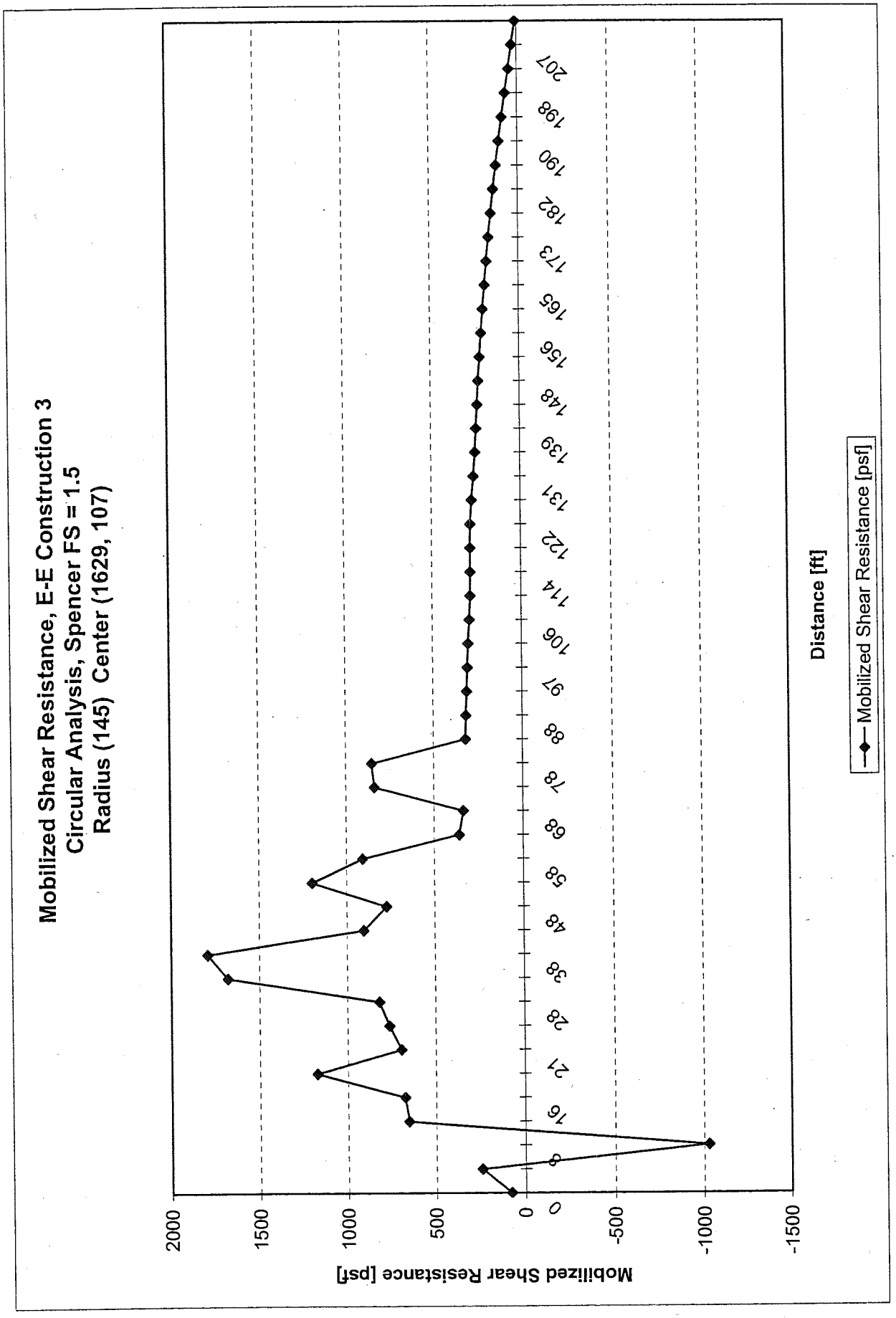
ECT·14

Section E-E
Construction 3 Stability
Circular Analysis



ECT-15

Section E-E
Construction 3 Stability
Circular Analysis



PRJ1/ME0250/SlopeStability/ConstructionSequence/Mobilized Shear Strength E Const

ECT-16

Slide Analysis Information

Document Name

File Name: e-e(construction 3) circular 50% spacing

Project Settings

Project Title: SLIDE - An Interactive Slope Stability Program
Failure Direction: Left to Right
Units of Measurement: Imperial Units
Pore Fluid Unit Weight: 62.4 lb/ft3
Groundwater Method: Water Surfaces
Data Output: Standard

Analysis Methods

Analysis Methods used:
Spencer

Number of slices: 50
Tolerance: 0.005
Maximum number of iterations: 50

Surface Options

Surface Type: Circular
Radius Increment: 75
Minimum Elevation: Not Defined
Composite Surfaces: Enabled
Reverse Curvature: Create Tension Crack

Loading

Seismic Load Coefficient (Horizontal): 0
Seismic Load Coefficient (Vertical): 0

Material Properties

Material: Potomac Formation
Strength Type: Undrained
Unit Weight: 120 lb/ft3
Cohesion Type: Function of Depth
Cohesion (Top): 4500 psf
Cohesion Change: 14.4 psf/ft
Cutoff: 10000 psf
Water Surface: None

Material: Waste (0 to 20)
Strength Type: Mohr-Coulomb
Unit Weight: 60 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Undrained PVD Area
Strength Type: Strength=F(overburden)
Unit Weight: 85 lb/ft3
Tau/Sigma Ratio: 0.29
Water Surface: Water Table
Custom Hu value: 1

Material: d11
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 200 psf
Water Surface: None

Material: d12
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 400 psf
Water Surface: None

Material: d13
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 600 psf
Water Surface: None

Material: d14
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 800 psf
Water Surface: None

Material: River Sediments
Strength Type: Strength=F(overburden)
Unit Weight: 85 lb/ft3
Tau/Sigma Ratio: 0.29
Water Surface: Water Table
Custom Hu value: 1

Section E-E
Construction 3 Stability
Circular Analysis

ECT.17

Material: Columbia Formation
Strength Type: Mohr-Coulomb
Unit Weight: 125 lb/ft3
Cohesion: 0 psf
Friction Angle: 40 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: MSE Wall Soil
Strength Type: Mohr-Coulomb
Unit Weight: 90 lb/ft3
Cohesion: 0 psf
Friction Angle: 29 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Drained PVD Area
Strength Type: Shear Normal function
Unit Weight: 85 lb/ft3
Water Surface: Water Table
Custom Hu value: 1

Material: Strucural Fill
Strength Type: Mohr-Coulomb
Unit Weight: 110 lb/ft3
Cohesion: 0 psf
Friction Angle: 35 degrees
Water Surface: Water Table
Custom Hu value: 1

Support Properties

Support: Geogrid
Support Type: GeoTextile
Force Application: Passive
Force Orientation: Bisector of Parallel and Tangent
Anchorage: Slope Face
Shear Strength Model: Linear
Strip Coverage: 100 percent
Tensile Strength: 5000 lb/ft
Pullout Strength Adhesion: 0 lb/ft2
Pullout Strength Friction Angle: 25 degrees

Support: Geogrid2
Support Type: GeoTextile
Force Application: Passive
Force Orientation: Bisector of Parallel and Tangent
Anchorage: Slope Face
Shear Strength Model: Linear
Strip Coverage: 100 percent
Tensile Strength: 21000 lb/ft
Pullout Strength Adhesion: 0 lb/ft2
Pullout Strength Friction Angle: 25 degrees

Global Minimums

Method: spencer
SF: 1.4654
Center: 1628.75, 106.684
Radius: 144.687
Left Slip Surface Endpoint: 1496.09, 48.9419
Right Slip Surface Endpoint: 1711.33, -12.1226
Left Slope Intercept: 1496.09 48.9419
Right Slope Intercept: 1711.33 4

Method Statistics

Method: spencer
Number of Valid Surfaces: 10683
Number of Invalid Surfaces: 8773
Error Codes:
Error Code -101 reported for 113 surfaces
Error Code -103 reported for 44 surfaces
Error Code -108 reported for 234 surfaces
Error Code -111 reported for 2318 surfaces
Error Code -112 reported for 2428 surfaces
Error Code -113 reported for 1052 surfaces
Error Code -1000 reported for 2584 surfaces

Error Codes

The following errors were encountered during the computation:

-101 = Only one (or zero) surface / slope intersections.

-103 = Two surface / slope intersections, but one or more surface / nonslope external polygon intersections lie between them. This usually occurs when the slip surface extends past the bottom of the soil region, but may also occur on a benched slope model with two sets of Slope Limits.

-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).

-111 = safety factor equation did not converge

-112 = The coefficient M-Alpha = cos(alpha)(1+tan(alpha)tan(phi)/F) < 0.2 for the final iteration of the safety factor calculation. This screens out some slip surfaces which may not be valid in the context of the analysis, in particular, deep seated slip surfaces with many high negative base

angle slices in the passive zone.

-113 = Surface intersects outside slope limits.

-1000 = No valid slip surfaces are generated at a grid center. Unable to draw a surface.

Section E-E
Construction 3 Stability
Circular Analysis

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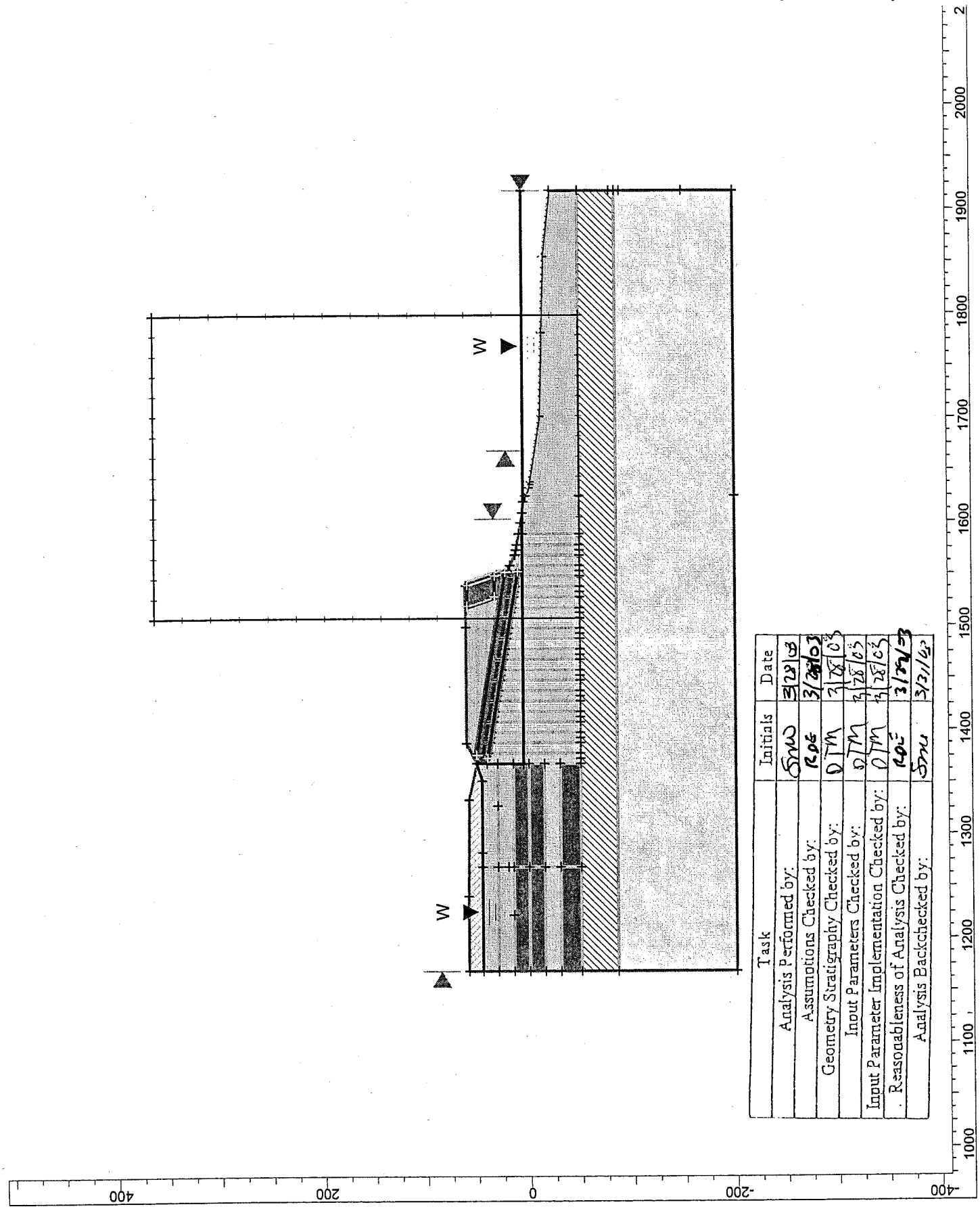
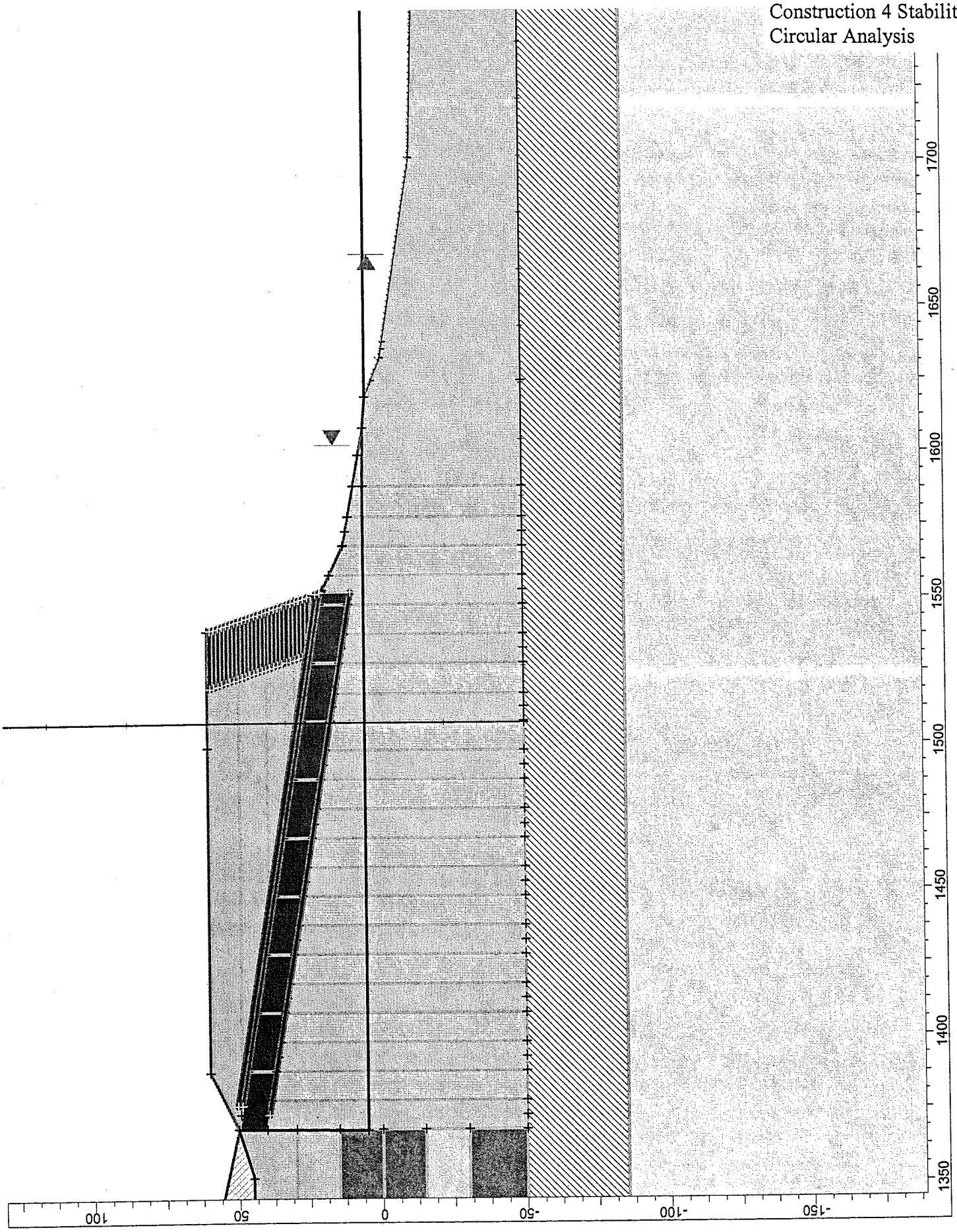
Section E-E
Construction 4 Stability
Circular Analysis



Task	Initials	Date
Analysis Performed by:	SMW	3/28/03
Assumptions Checked by:	RDE	3/28/03
Geometry Stratigraphy Checked by:	DTM	3/28/03
Input Parameters Checked by:	DTM	3/28/03
Input Parameter Implementation Checked by:	DTM	3/28/03
Reasonableness of Analysis Checked by:	RDE	3/28/03
Analysis Backchecked by:	SMW	3/31/03

ECT-14

Section E-E
Construction 4 Stability
Circular Analysis



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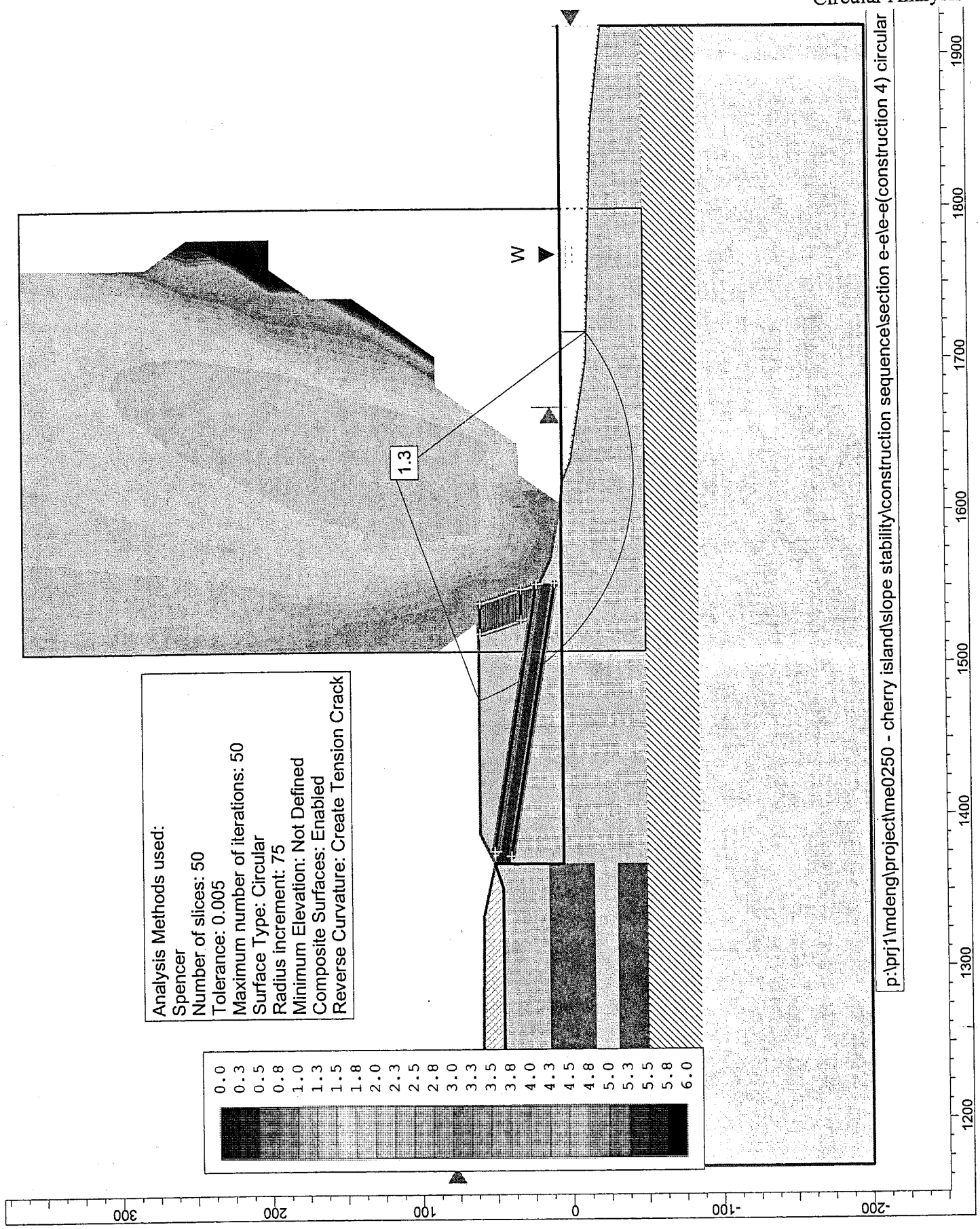
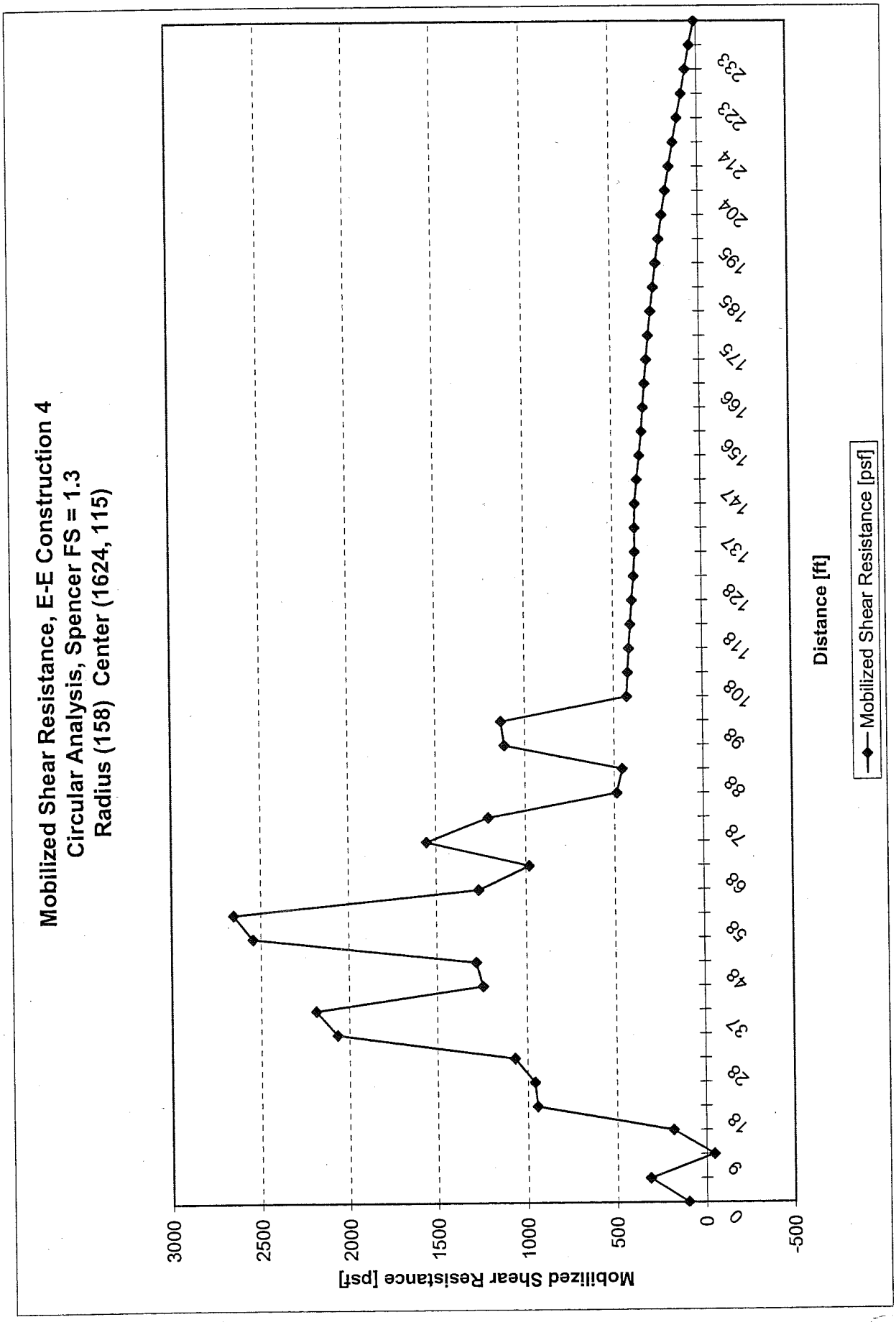
Section E-E
Construction 4 Stability
Circular Analysis



ECT-21

Section E-E
Construction 4 Stability
Circular Analysis



PRJ1/ME0250/SlopeStability/ConstructionSequence/Mobilized Shear Strength E Const

ECI-22

Slide Analysis Information

Document Name

File Name: e-e(construction 4) circular 50% spacing

Project Settings

Project Title: SLIDE - An Interactive Slope Stability Program
Failure Direction: Left to Right
Units of Measurement: Imperial Units
Pore Fluid Unit Weight: 62.4 lb/ft3
Groundwater Method: Water Surfaces
Data Output: Standard

Analysis Methods

Analysis Methods used:
Spencer

Number of slices: 50
Tolerance: 0.005
Maximum number of iterations: 50

Surface Options

Surface Type: Circular
Radius increment: 75
Minimum Elevation: Not Defined
Composite Surfaces: Enabled
Reverse Curvature: Create Tension Crack

Loading

Seismic Load Coefficient (Horizontal): 0
Seismic Load Coefficient (Vertical): 0

Material Properties

Material: Potomac Formation
Strength Type: Undrained
Unit Weight: 120 lb/ft3
Cohesion Type: Function of Depth
Cohesion (Top): 4500 psf
Cohesion Change: 14.4 psf/ft
Cutoff: 10000 psf
Water Surface: None

Material: Waste (0 to 20)
Strength Type: Mohr-Coulomb
Unit Weight: 60 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Undrained PVD Area
Strength Type: Strength=F(overburden)
Unit Weight: 85 lb/ft3
Tau/Sigma Ratio: 0.29
Water Surface: Water Table
Custom Hu value: 1

Material: d11
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 200 psf
Water Surface: None

Material: d12
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 400 psf
Water Surface: None

Material: d13
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 600 psf
Water Surface: None

Material: d14
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 800 psf
Water Surface: None

Material: River Sediments
Strength Type: Strength=F(overburden)
Unit Weight: 85 lb/ft3
Tau/Sigma Ratio: 0.29
Water Surface: Water Table
Custom Hu value: 1

Section E-E
Construction 4 Stability
Circular Analysis

EC1.25

Material: Columbia Formation
Strength Type: Mohr-Coulomb
Unit Weight: 125 lb/ft3
Cohesion: 0 psf
Friction Angle: 40 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: MSE Wall Soil
Strength Type: Mohr-Coulomb
Unit Weight: 90 lb/ft3
Cohesion: 0 psf
Friction Angle: 29 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Drained PVD Area
Strength Type: Shear Normal function
Unit Weight: 85 lb/ft3
Water Surface: Water Table
Custom Hu value: 1

Material: Strucural Fill
Strength Type: Mohr-Coulomb
Unit Weight: 110 lb/ft3
Cohesion: 0 psf
Friction Angle: 35 degrees
Water Surface: Water Table
Custom Hu value: 1

Support Properties

Support: Geogrid
Support Type: GeoTextile
Force Application: Passive
Force Orientation: Bisector of Parallel and Tangent
Anchorage: Slope Face
Shear Strength Model: Linear
Strip Coverage: 100 percent
Tensile Strength: 5000 lb/ft
Pullout Strength Adhesion: 0 lb/ft2
Pullout Strength Friction Angle: 25 degrees

Support: Geogrid2
Support Type: GeoTextile
Force Application: Passive
Force Orientation: Bisector of Parallel and Tangent
Anchorage: Slope Face
Shear Strength Model: Linear
Strip Coverage: 100 percent
Tensile Strength: 21000 lb/ft
Pullout Strength Adhesion: 0 lb/ft2
Pullout Strength Friction Angle: 25 degrees

Global Minimums

Method: spencer
SF: 1.26443
Center: 1624.11, 115.331
Radius: 158.402
Left Slip Surface Endpoint: 1475.68, 60
Right Slip Surface Endpoint: 1717.94, -12.2891
Left Slope Intercept: 1475.68 60
Right Slope Intercept: 1717.94 4

Method Statistics

Method: spencer
Number of Valid Surfaces: 9942
Number of Invalid Surfaces: 9514
Error Codes:
Error Code -101 reported for 118 surfaces
Error Code -103 reported for 49 surfaces
Error Code -108 reported for 429 surfaces
Error Code -111 reported for 2315 surfaces
Error Code -112 reported for 3431 surfaces
Error Code -113 reported for 1120 surfaces
Error Code -1000 reported for 2052 surfaces

Error Codes

The following errors were encountered during the computation:

-101 = Only one (or zero) surface / slope intersections.

-103 = Two surface / slope intersections, but one or more surface / nonslope external polygon Intersections lie between them. This usually occurs when the slip surface extends past the bottom of the soil region, but may also occur on a benched slope model with two sets of Slope Limits.

-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).

-111 = safety factor equation did not converge

-112 = The coefficient M-Alpha = cos(alpha)(1+tan(alpha)tan(phi)/F) < 0.2 for the final iteration of the safety factor calculation. This screens out some slip surfaces which may not be valid in the context of the analysis, in particular, deep seated slip surfaces with many high negative base

Appendix VIb-D.4

Mechanically Stabilized Earth Berm Construction Analysis

GEOSYNTEC CONSULTANTS

COMPUTATION COVER SHEET

Client: DSWA **Project:** Cherry Island **Project/Proposal #:** ME0250 **Task #:** 2.2.5

TITLE OF COMPUTATIONS Mechanically Stabilized Earth Berm Construction Stability Analysis

COMPUTATIONS BY:

Signature

DATE 03/31/03

Printed Name and Title S. Opdyke, Staff Engineer

ASSUMPTIONS AND PROCEDURES CHECKED BY:
(Peer Reviewer)

Signature

DATE 04/01/03

Printed Name and Title David Espinoza, Senior Engineer

COMPUTATIONS CHECKED BY:

Signature

DATE 04/01/03

Printed Name and Title David Espinoza, Senior Engineer

COMPUTATIONS BACKCHECKED BY:
(Originator)

Signature

DATE 04/01/03

Printed Name and Title S. Opdyke, Staff Engineer

APPROVED BY:
(PM or Designate)

Signature

DATE 04/01/03

Printed Name and Title David Espinoza, Senior Engineer

APPROVAL NOTES:

REVISIONS (Number and initial all revisions)

NO.	SHEET	DATE	BY	CHECKED BY	APPROVAL

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Written by: Shana Opdyke Date: 03/31/03 Reviewed by: R.D. Espinoza Date: 04/01/03

Client: DSWA Project: Cherry Island Project/Proposal No.: ME0250 Task No.: 2.2.5

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(continued)

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Figure 4 Example of Circular Failure Surface

ATTACHMENTS

Attachment A Soil Stratigraphy
Attachment B Stability Analysis Results for Construction of Section E-E

Written by: Shana Opdyke Date: 03/31/03 Reviewed by: R.D. Espinoza Date: 04/01/03

Client: DSWA Project: Cherry Island Project/Proposal No.: ME0250 Task No.: 2.2.5

MECHANICALLY STABILIZED EARTH BERM CONSTRUCTION STABILITY ANALYSIS

1. INTRODUCTION

The purpose of this analysis to evaluate the local stability of the proposed perimeter mechanically stabilized earth (MSE) berm at the Cherry Island Landfill (CIL). The analysis focuses on the stability of the MSE berm during construction. Overall stability of the proposed landfill expansion is addressed in a separate calculation package, "Landfill Stability Analysis (Static) - Phases III to V", (see Appendix VIb-D.2).

In the proposed landfill expansion, the maximum elevation in Phases III to V is increased to approximately 290 ft-msl, whereas the maximum elevations in Phases I and II are essentially unchanged except at the boundary with Phases III to V. To allow expansion of the landfill to the proposed elevations, both construction of a MSE berm and installation of prefabricated vertical drains (PVD) around the perimeter of Phases III, IV, and V (outside the existing waste footprint) are required.

2. SECTIONS FOR ANALYSIS

A total of eight (8) sections located in Phases III through V were selected for static stability analysis and are evaluated in the calculation package entitled "Landfill Stability Analysis (Static) - Phases III to V", (see Appendix VIb-D.2). The locations of the cross sections are shown in Figure 1. Each of the cross sections have been selected to take into consideration unique features of the landfill geometry (e.g., maximum height, bench location), foundation stratigraphy (thickness of dredge/alluvium, thickness of the Potomac Formation) and other surface features such as distance to the river and wetlands. Due to the proximity to the Delaware River, the minimal area of PVD placement, and maximum MSE berm height of 70 ft, section E-E is the most critical sections during construction and thus is analyzed in this calculation package.

Existing ground surface information is obtained from aerial topography performed in October, 2002. The ground surface information in the Christina and Delaware rivers was obtained from 2002-bathymetric information provided by the United States Army Corps of Engineers. Both the Delaware and Christina Rivers contain navigable shipping channels. However, dredge operations only affects approximately 25 ft outside the limits of the navigation

channels. As the limits of the navigation channels are located approximately 800 ft away from the shoreline, dredging operations will not affect the stability of the MSE berm.

3. STABILITY CRITERIA

The slope stability analysis is performed to verify that the MSE berm configuration has an adequate factor of safety against failure under static loading conditions. According to technical manual published by the USEPA entitled, "Solid Waste Disposal Facility Criteria" [USEPA, 1993], the minimum recommended factor of safety against slope stability failure for temporary conditions is 1.25.

4. LOADING CONDITIONS

The main static load applied to the soft dredge/alluvial deposits is the gravity load exerted by the MSE berm. As the MSE berm is constructed, the additional load generates excess pore pressures in the saturated dredge/alluvium. Successful construction of the MSE berm without causing overall stability problems depends upon the ability of this soft material to gain additional strength (i.e., dissipate pore pressures) as the load is placed. Excess pore pressure in the saturated dredge/alluvium under the proposed MSE berm will dissipate via radial drainage to the PVDs, and then to the Columbia Formation and drainage layer placed at the ground surface. The dredge's ability to dissipate the excess pore pressures generated during loading is directly proportional to the material's permeability and inversely proportional to the square of the PVD spacing. Because the PVD spacing could vary from 4 ft. to 8 ft., assuming that the permeability at the site is approximately homogeneous, the strength gain rate of the 4 ft. PVD spacing will be 4 times faster than that provided by the 8 ft. PVD.

Based on the above discussion, the rate of construction is an important part of this stability analysis. Generally, the MSE berm will be constructed in increments of ten feet. Subsequent lifts will be placed only after approximately 90 percent of the excess pore pressure generated in the dredge/alluvium during placement of the previous lift has been dissipated. Based on the radial consolidation theory, the time required to dissipate 90 percent of the excessive pore pressure for a 4-ft PVD spacing is approximately five months. A pilot test program to study the influence of PVD spacing is currently being undertaken at the CIL site. Based on preliminary results from the pilot test and analytical results using radial consolidation theory, GeoSyntec estimates that it will take approximately four to five months to dissipate 90 percent of the excess pore pressure for a 4-ft spacing. This preliminary information indicates that a ten foot lift could be constructed every four to five months. However, the actual construction rate will be

determined after complete results from the pilot test have been obtained and analyzed. In addition, the final PVD spacing will be selected based not only on its ability to allow construction of the MSE berm but also on the ability of the PVD area to act drained during waste placement (see calculation package entitled "Landfill Stability Analyses (Static) – Phases III to V," Appendix VIb-D.2).

5. STRATIGRAPHY AND MATERIAL PARAMETERS

5.1 General

As shown Figure 2, below the waste and MSE berm the stratigraphy at the CIL site includes dredge, alluvium, the Columbia Formation and the Potomac Formation. On the river side of the berm, the soil above the Columbia Formation is assumed to be alluvium. Properties for each cross section are based upon the information collected in the Geotechnical Characterization Report (GCR) [GeoSyntec 2003]. The boundary between the dredge/alluvium and the Columbia Formation is based on the stratigraphy presented in the GCR (Figures A.1 to A.4 in Attachment A). As a supplement to this information, the boundary between the Columbia and Potomac Formations, based on the information provided by Terraqua [1982], is provided in Figures A.5 to A.9 in Attachment A. The remainder of this section addresses the parameters of these soil types used in the stability analysis. A table at the end of this section summarizes the soil parameters used in the analysis.

5.2 Waste

GeoSyntec performed field investigations and laboratory testing in March and April 2002 to characterize the waste at the CIL site. Based on the results of the field investigation and subsequent laboratory testing, the MSW was found to have an average density ranging from 60 lbs/ft^3 (in the upper 20 feet) to 75 lbs/ft^3 (20 ft below the waste surface). Higher densities (i.e., 80 to 100 lbs/ft^3) were found for saturated waste. In the analysis, the unit weight adopted is 60 lbs/ft^3 for moist waste and 100 lbs/ft^3 for saturated waste.

Nine laboratory shear strength tests performed on saturated waste at different rates indicate that, except for one test, waste at CIL exhibits a friction angle ranging from 34° to 40°, with an average of 36° and a cohesion ranging from 0 psf to 165 psf. A friction angle of 33° and no cohesion was conservatively used in the analysis. Further discussion on these results can be found in Appendix O of the GCR.

5.3 Dredge/Alluvium

5.3.1 General

GeoSyntec conducted field investigations in March and April 2002 to evaluate the subsurface soil conditions at the site. A brief summary of the findings related to the dredge and alluvium, is presented herein; additional details can be found in the GCR. The dredge consists primarily of sandy silty clay to clayey silt and varies in thickness from 30 to 40 feet. The alluvium is comprised of clayey silts and silty clays with varying amounts of sand and organic matter and silty sands. Because of the similar characteristics of the dredge spoils and the alluvium; these layers are combined as one soil type in the analysis. Although there is no soil data along the riverbed of the Delaware and Christina rivers, the river sediments are likely to have similar soil characteristics as the alluvium.

The average total unit weight for the dredge/alluvium is 85 pcf, while the average saturated unit weight is 97 pcf. The shear strength in the dredge/alluvium depends upon the degree of pore pressure dissipation. In this analysis, the dredge/alluvium strength parameters are considered to be either (i) existing partially consolidated undrained parameters, (ii) consolidated undrained parameters; and (iii) drained parameters. A discussion of the strength parameters follows.

5.3.2 Existing Partially Consolidated Undrained Parameters

This soil type corresponds to the dredge/alluvium beneath the existing waste (see Figures 2a and 2b). The strength of existing dredge/alluvium is conservatively estimated based on CPT data presented in the GCR. The dredge/alluvium zone was divided into six layers. This stratigraphic division was performed to be consistent with the one used in the "Landfill Stability Analyses (Static) – Phases III to V" calculation package presented in Appendix VIb-D.2. The first two layers had cohesion of 200 psf, the third and fourth layer of 400 psf, the fifth of 600 psf and the bottom layer of 800 psf.

5.3.3 Consolidated Undrained Parameters

The consolidated undrained shear strength (S_u) is calculated as a function of the maximum vertical effective stress using the following linear relationship:

$$\frac{S_u}{\sigma_v'} = 0.29 \qquad (1)$$

where σ'_v is the effective vertical stress. The value of 0.29 is in agreement with previous and recent laboratory and field investigation results summarized in the GCR. This condition is applicable to the dredge/alluvium assuming that PVD area is undrained. Because of the PVD spacing, in this analysis, 50 percent of the total available area is considered undrained (see section below).

5.3.4 Drained Parameters

A series of PVD will be installed underneath and beyond the MSE berm. The PVDs will be installed from the ground surface to the Columbia Formation. This area is outside the existing waste footprint. The PVDs will be installed to enhance the dredge's ability to drain and accelerate the dissipation of excess pore pressures generated during berm construction and subsequent waste placement. The rapid dissipation of excess pore pressures in the dredge/alluvium by means of the PVDs, allows a portion of the dredge/alluvium to be modeled assuming drained conditions during MSE berm construction. Based on radial consolidation, an area approximately 1.5 ft around the PVD can be assumed drained. This area corresponds to approximately 50 percent of the total area of the PVD area. An assessment of dredge/alluvium drained conditions is presented in Appendix VIb-D.5. In order to model the influence of the PVDs, the dredge/alluvium is divided into several 10-ft vertical columns of alternating drained/undrained parameters.

The dredge/alluvium drained shear strength is modeled as an envelope based on effective strength parameters obtained from laboratory testing as follows [GeoSyntec, 2003]:

Effective Normal Stress (psf)	Shear Stress (psf)	Effective Friction Angle (Degrees)
0 – 1,000	0 – 1,000	45
1,000 – 3,000	1,000 – 2,678	40
> 3,000	–	34

5.4 Columbia Formation

The Columbia Formation, which is encountered under the dredge/alluvium, consists of poorly sorted, fine-to-coarse sand and gravel with silty sand, silty clay, and clayey silt lenses of varying thicknesses. An effective a friction angle of 40 degrees with no cohesion is used to model the strength of this layer. The unit weight for this formation is 125 pcf. Detailed

discussion on the selection of these parameters can be found in the GCR. At locations where silty clay lenses were significantly thick (i.e., greater than 5 ft), the lens undrained strength parameters were obtained form the field investigation data closest to the analyzed cross section.

5.5 Potomac Formation

The Potomac Formation, which underlies the Columbia Formation, consists of a brownish red (often described as varicolored), stiff to hard, heavily over consolidated, clayey silt to silty clay, with traces of fine sand. Layers of sand are often found in this formation. Based on the information collected in the GCR, the thickness of the Potomac Formation varies from approximately 120 ft along the Delaware River, to approximately 5 ft along the western boundary of the CIL site. The strength parameter of the Potomac Formation is conservatively described for undrained analysis as:

$$S_u = 4{,}500 \text{ psf} + 14.4\,d \qquad (2)$$

where S_u is the undrained shear strength (psf) and d is depth measured from the top of the Potomac Formation.

5.6 Reinforced Soil

The backfill of the MSE berm will include features to promote drainage (e.g., geocomposite drainage chimney, and a backdrain). Non-traditional and cost-effective materials such as dredge and fly ash will be considered for construction. The unit weight of the MSE berm is assumed to be 90 pcf with a friction angle of 29 degrees (i.e., ϕ_{MSE}= of 29°). The unit weight of the lower 10 ft of the MSE berm is assumed to be 120 pcf with a friction angle of 35 degrees (i.e., ϕ_{MSE}= of 35°). For design purposes, both a high strength geogrid of 5,000 lbs/lf, and a high strength geotextile of 21,000 lb/lf are considered. The interface friction angle (δ) between the backfill and the reinforcement was assumed equal to:

$$\tan(\delta) = 0.85 \tan \phi_{MSE} \qquad (3)$$

The width of the MSE berm was iteratively calculated to provide an adequate factor of safety for during waste placement (see "Landfill Stability Analyses (Static) – Phases III to V", Appendix VIb-D.2). Also, the reinforcement pattern (i.e., vertical spacing and reinforcement length) was calculated through an iterative process, described in Section 7.

5.7 Summary of Properties

A summary table of the soil parameters used in this analysis is provided below. The soil numbers in the table correspond to the soil numbers used in the stability analysis.

Material	Label(1)	Condition	Cohesion (psf)	Friction Angle (degrees)	Unit Weight (pcf)	Unit Weight Saturated (pcf)
Waste	Waste (0 to 20)	Drained	0	33	60	100
Dredge/Alluvium	River Sediments, Wetlands, Undrained PVD Area	Consolidated undrained	0.29 σ_v	-	85	97
	Drained PVD Area	Drained	0	34(4)		
	d11,d12, d13, d14	Partially consolidated undrained	200 to 800(2)	-		
Columbia	Columbia Formation	Drained	0	40	125	125
Potomac Formation	Potomac Formation	Undrained	4,500(3)	-	120	120
MSE Berm	MSE Wall Soil	Drained	0	29	90	90
	Structural Fill	Drained	0	35	120	120

(1) Labels used in SLIDE analysis (see Figure 3)
(2) Partially consolidated undrained strength for the existing dredge/alluvium parameters are estimated based on CPT data as reported in GCR.
(3) Minimum undrained strength is 4,500 psf and increases with depth.
(4) Dredge drained parameters is an envelope with a slope of 34 degrees for effective stresses greater than 3,000 psf.

6. WATER TABLE

The current liquid level in the dredge/alluvium is dictated by the elevation of the Delaware, and Christina rivers, liquids in the waste, and the water level at the time of dredge placement. The liquid level in the dredge/alluvium was selected as follows:

- *Under the landfill*: Because dredge is placed fully saturated, the water level can be assumed at the dredge ground surface. For the stability analysis, for undrained conditions, the factors of safety are calculated using total unit weights. Hence, the location of the water level does not influence the calculation of the factors of safety except for the calculation of unit weight.

- *In the PVD area*: Because the PVDs connect the dredge/alluvium with the Columbia Formation, the water level of the dredge/alluvium is influenced by the groundwater elevation of the Columbia Formation. In this area, the water level is assumed to be at elevation 5 ft-msl, which corresponds to measured values of the groundwater elevation of the Columbia Formation around the perimeter berm. This value is 2-ft higher than the average river level.

- *Outside the PVD area (river side and wetland areas)*: The water level in this area is assumed to be influenced by the river elevation. The average river level is approximately 3 ft-msl. In this area the water level is assumed to be at elevation 5 ft-msl. The water level in wetland areas is assumed to be at the ground surface. For the stability analysis, for undrained conditions, the factors of safety are calculated using total unit weights. Hence, the location of the river elevation does not influence the calculation of the factors of safety.

The piezometric level in the Columbia and Potomac Formations is assumed to be equal to the assumed liquid levels in the dredge/alluvium. This assumption is conservative, particularly under the landfill, where the piezometric level in the Columbia and Potomac Formations is likely to be less than the water level in the dredge/alluvium. Higher piezometric levels results in lower effective stresses with corresponding lower shear strength.

7. METHOD OF ANALYSIS

7.1 Introduction

The stability of the selected cross sections was evaluated based on limit equilibrium theory using the methods of slices. The computer program SLIDE [Rocscience, 2002] was used to perform the analyses. SLIDE is a 2D slope stability program that evaluates the factor of safety of circular and non-circular failure surfaces in soils. The procedure consisted of analyzing numerous potential failure surfaces to find the critical failure surface that renders the minimum factor of safety for the slope. Circular and non-circular failure surfaces can be analyzed. For circular and non-circular failure surfaces, the Spencer method [Spencer, 1967] is used. In the Spencer method both force and moment equilibrium are satisfied in each slice, the slope of the inter slice forces is assumed constant and parallel to each other.

During the analysis, the search boundaries were varied to ensure that the most critical surface was captured during the search. Numerous potential failure surfaces were analyzed to find the critical failure surface that result in the minimum factor of safety for the slope. For the slope stability cases analyzed in this calculation, both non-circular and circular failure surfaces were considered.

7.2 Implementation

The ground surfaces of the selected cross sections were obtained using AutoCADD sections in an x,y coordinate system, and subsequently entered into SLIDE. The sections used for the "Landfill Stability Analysis (Static) – Phases III to V" (see Appendix VIb-D.2) were also used to evaluate local stability of the MSE berm during construction. However, the sections were reduced to extend only 200 feet into the landfill from the back of the MSE berm. The bottom of existing waste, assumed to be at elevation 40 ft-msl, is based upon record drawings for Phases III, IV and V and settlements recorded at settlement plates. The horizontal extent of existing waste was obtained from existing limits of waste. The dredge/alluvium strata were divided into six layers. In order to minimize errors, a specific labeling system was developed for the various materials. Figure 3 shows an example of an idealized cross section implemented in SLIDE along with layer divisions and the labeling system used for all analyses. Consistent labeling systems and material boundaries allowed material properties to be imported and exported between files. For example, materials in a file containing a circular analysis of Section E-E during the first stage of construction were exported to a new file for a circular analysis of Section E-E during the second stage of construction. Through this exportation the materials were automatically the same for both files.

The same analysis parameters were used for the circular failure mode in all sections. Parameters for the circular search for the Spencer analysis method include using fifty (50) slices, a tolerance of 0.005, fifty (50) maximum iterations, and for each slip center, 75 regularly spaced circles were analyzed. These parameters were selected such that the analysis was performed accurately and expediently.

For the circular search, a search grid with 20 horizontal increments and 20 vertical increments was used to find the minimum factor of safety (Figure 4). This grid defined a total of 441 (i.e., 21 x 21) slip centers. Hence, the total number of slip surfaces was 33,075 (i.e., 75 x 441). SLIDE provides both the minimum factor of safety and a factor of safety contour map for the computation. In some cases, when the contour lines that contain the minimum factor of safety were not fully closed, the search grid was expanded horizontally or vertically and the

analysis performed again. This iterative process ensured that a global minimum factor of safety (i.e., the true minimum factor of safety), not a local one, was calculated.

All sections were extended horizontally in both directions to ensure that the critical failure surface was not constrained by geometry. If a critical failure surface was found near the right or left boundary, the boundary was extended, and the analysis performed again. This ensured that the analysis identified the minimum factor of safety without being limited by geometry.

7.3 Modeling of Sequential Construction

As discussed earlier, the MSE berm geometry was selected to provide adequate factors of safety for the landfill (see calculation package entitled "Landfill Stability Analysis (Static) – Phases III to V," Appendix VIb-D.2). Because the rate of MSE berm construction will be significantly faster that that of waste placement, drained conditions cannot be assumed for the entire layer in the analysis. For the construction of the MSE berm, 50 percent of the area close to each PVD is assumed drained, whereas for the remaining 50 percent undrained shear strength parameters for the dredge/alluvium in the PVD area is conservatively assumed. A detailed description of the shear strength parameters is presented in the calculation Package entitled: "Assessment of Dredge/Alluvium Drained Conditions", Appendix VI.b-D.5.

The rate of construction depends on the rate of pore pressure dissipation and hence the rate of strength gain of the dredge/alluvium. Pore pressures have to dissipate before construction can proceed vertically. Pore pressure was considered dissipated when 90 percent of the excess pore pressure generated during construction of a given lift has been dissipated.

Construction was modeled in SLIDE as a series of ten foot lifts of soil. For example, section E-E contains a MSE berm that is approximately 70 ft in height. This section was modeled in though a series of 7 analyses, as shown in Attachment B. For example, the file E-E Construction 1 is a representation of a single 10 ft lift of soil placed over existing ground. Likewise, the file E-E Construction 2 is an analysis of a single 10 ft lift of soil placed over the previous 10 ft. lift.

8. STABILITY RESULTS

Stability analyses were performed for the selected cross section for temporary construction conditions. As shown in Attachment B, the MSE berm can be constructed in stages with a factor of safety greater than 1.25.

9. CONCLUSION

The analysis presented in this calculation package shows that the MSE berm can be built in ten foot increments providing that at least 90 percent of the excess pore pressure generated during placement of the previous lift has been dissipated before construction the next lift. The analysis presented herein is conservative because pore pressure will dissipate during construction, therefore, the dredge/alluvium with PVDs will not be fully undrained.

10. REFERENCES

Duncan, J.M., Smith, R.W., Brandon, T.L., Wong, K.S. CONSOL (Version 2.0): A Computer Program for 1-D Analysis of Layered Soil Masses. Virginia Polytechnic Institute and State University, 1988.

GeoSyntec Consultants, "*Geotechnical Characterization Report*", prepared for Delaware Solid Waste Authority Cherry Island Landfill Expansion Project, February 2003.

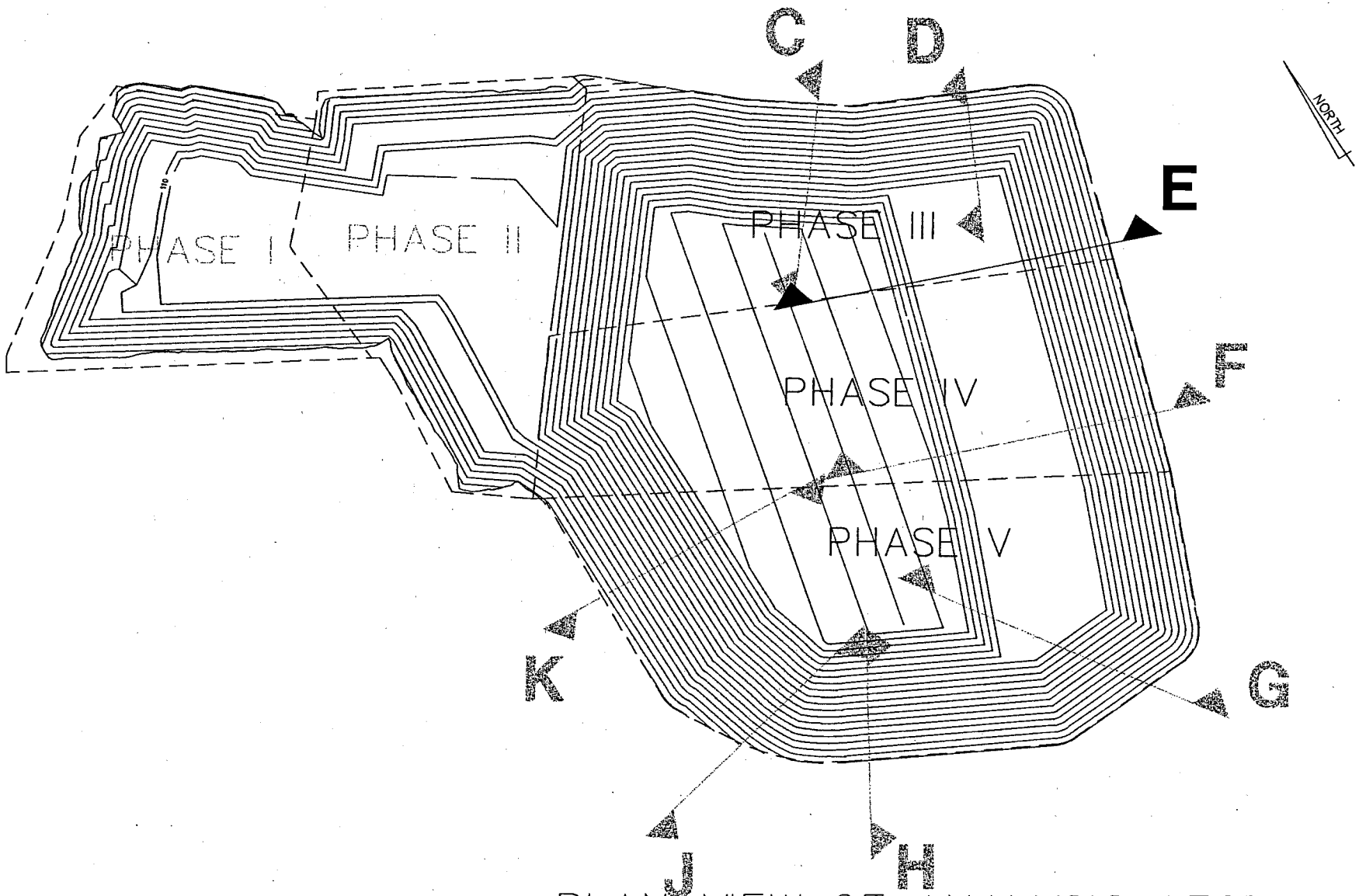
Rocscience, Slide, 2002: A 2D Slope Stability Analysis for Soil and Rock Slopes.", Rocscience, Toronto.

Spencer (1967). "*A method of analysis of the stability of embankments assuming parallel inter-slice forces.*" Geotechnique, London, England, 17(1), 11-26.

Terraqua Resources/Duffield (1984) *"Site Suitability Report, Hydrogeological And Geotechnical Evaluation Of The Cherry Island Site."* Vol. 1 (Report) & Vol. 2 (Oversize Drawings), January.

USEPA (1993). "*Solid Waste Disposal Facility Criteria,"* Document No. EPA 530-R-93-017, United States Environmental Protection Agency, November, 1993.

Figures



PLAN VIEW OF ANALYSIS SECTIONS

450 225 0 450

SCALE: 1" = 450'

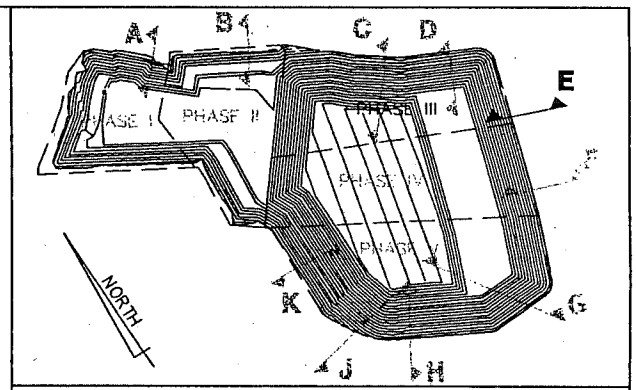
GEOSYNTEC CONSULTANTS

COLUMBIA, MARYLAND

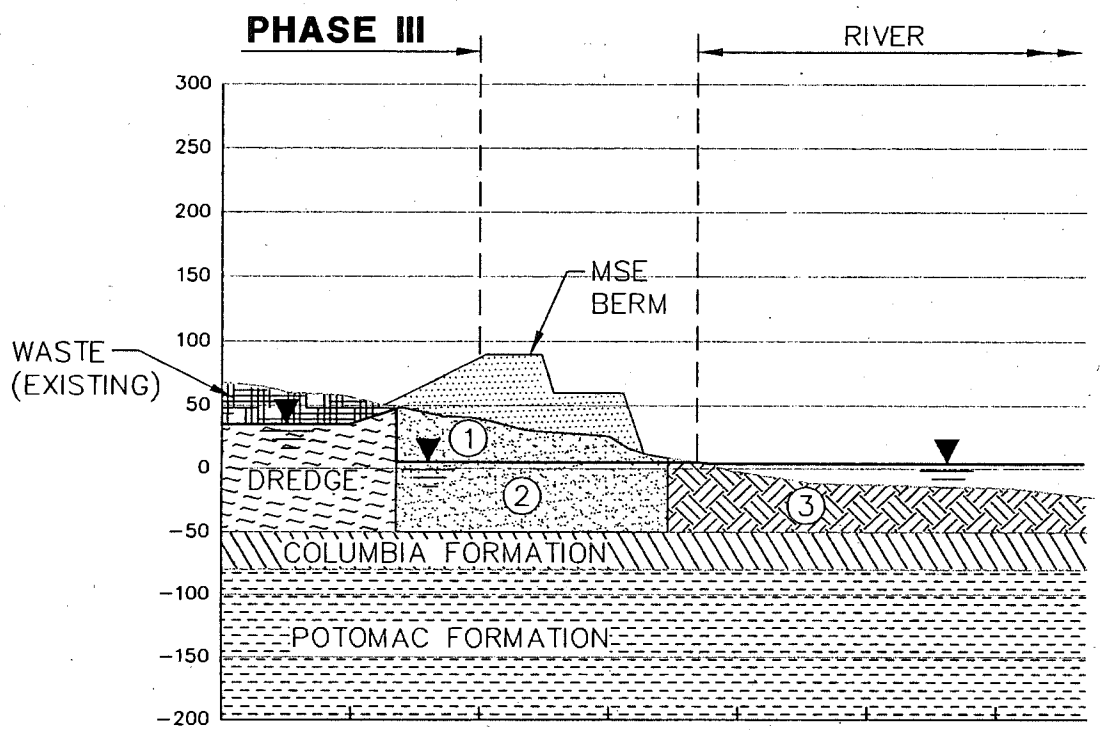
FIGURE NO.	1
PROJECT NO.	ME0250
DOCUMENT NO.	
FILE NO.	0250F609-2

SECTION E

STA 50+00



KEY MAP



① = UNDRAINED PVD AREA

② = DRAINED PVD AREA

③ = RIVER SEDIMENTS

150 75 0 150

SCALE: 1" = 150'

GEOSYNTEC CONSULTANTS

COLUMBIA, MARYLAND

FIGURE NO.	2
PROJECT NO.	ME0250
DOCUMENT NO.	
FILE NO.	0250F609

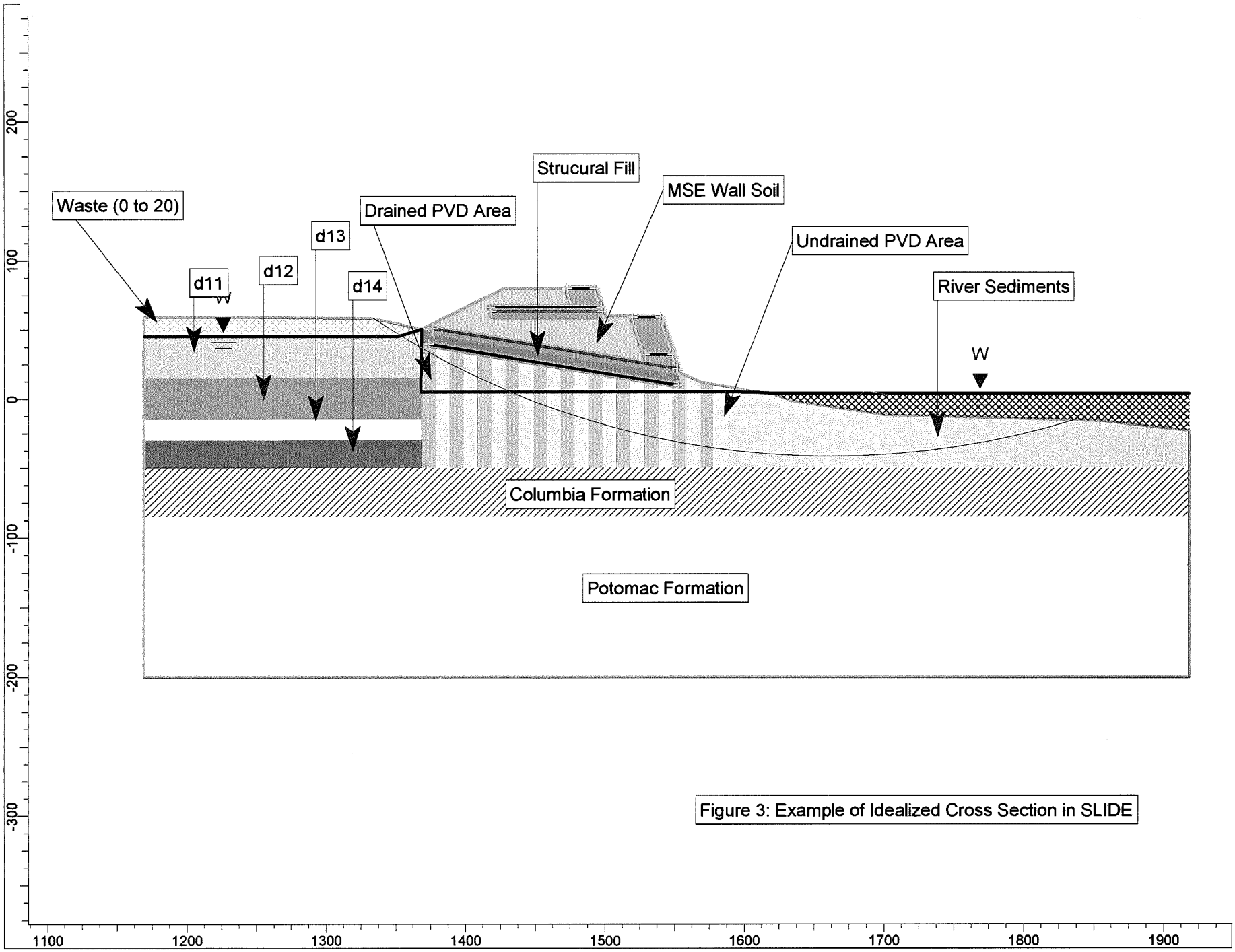


Figure 3: Example of Idealized Cross Section in SLIDE

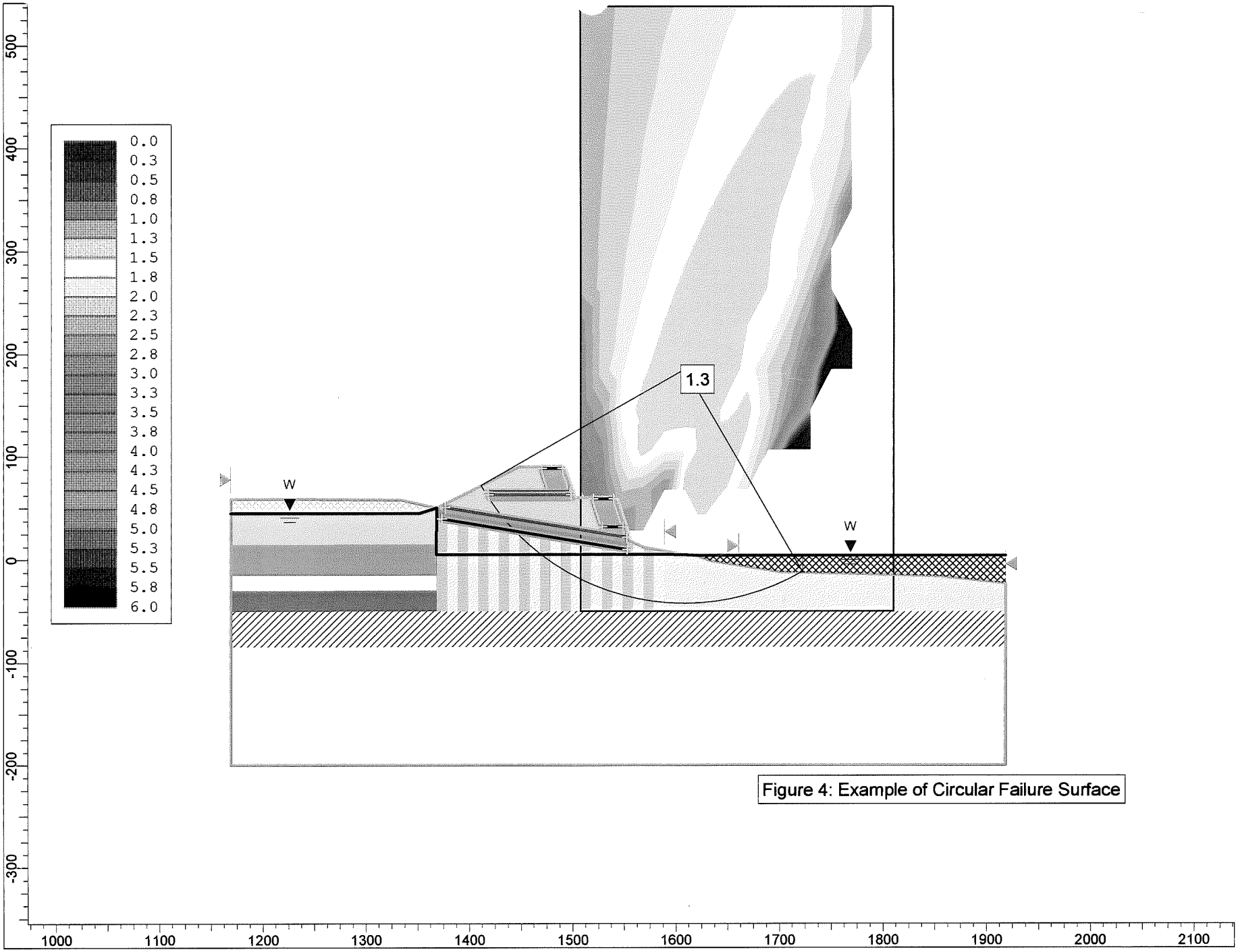
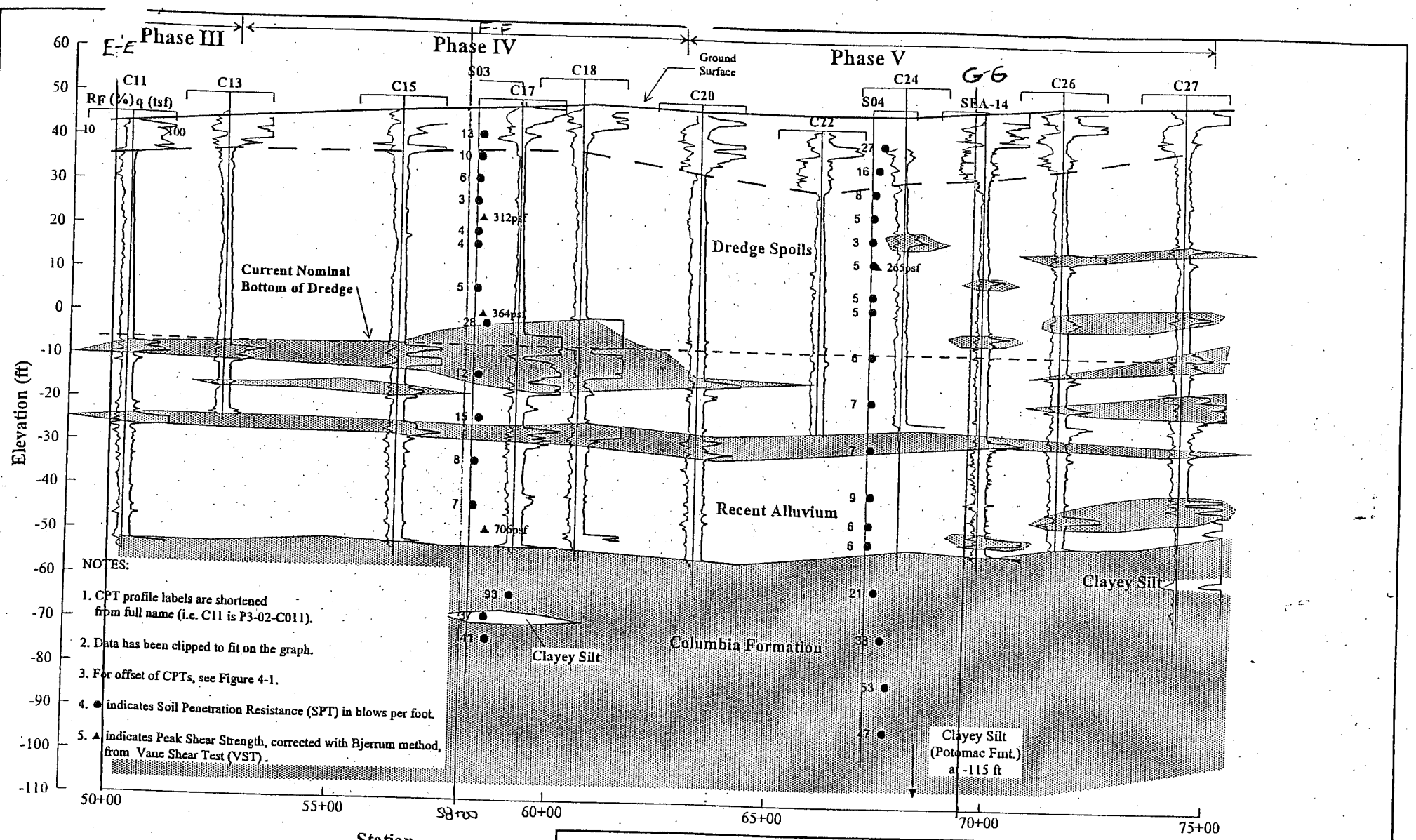


Figure 4: Example of Circular Failure Surface

Attachment A

Soil Stratigraphy



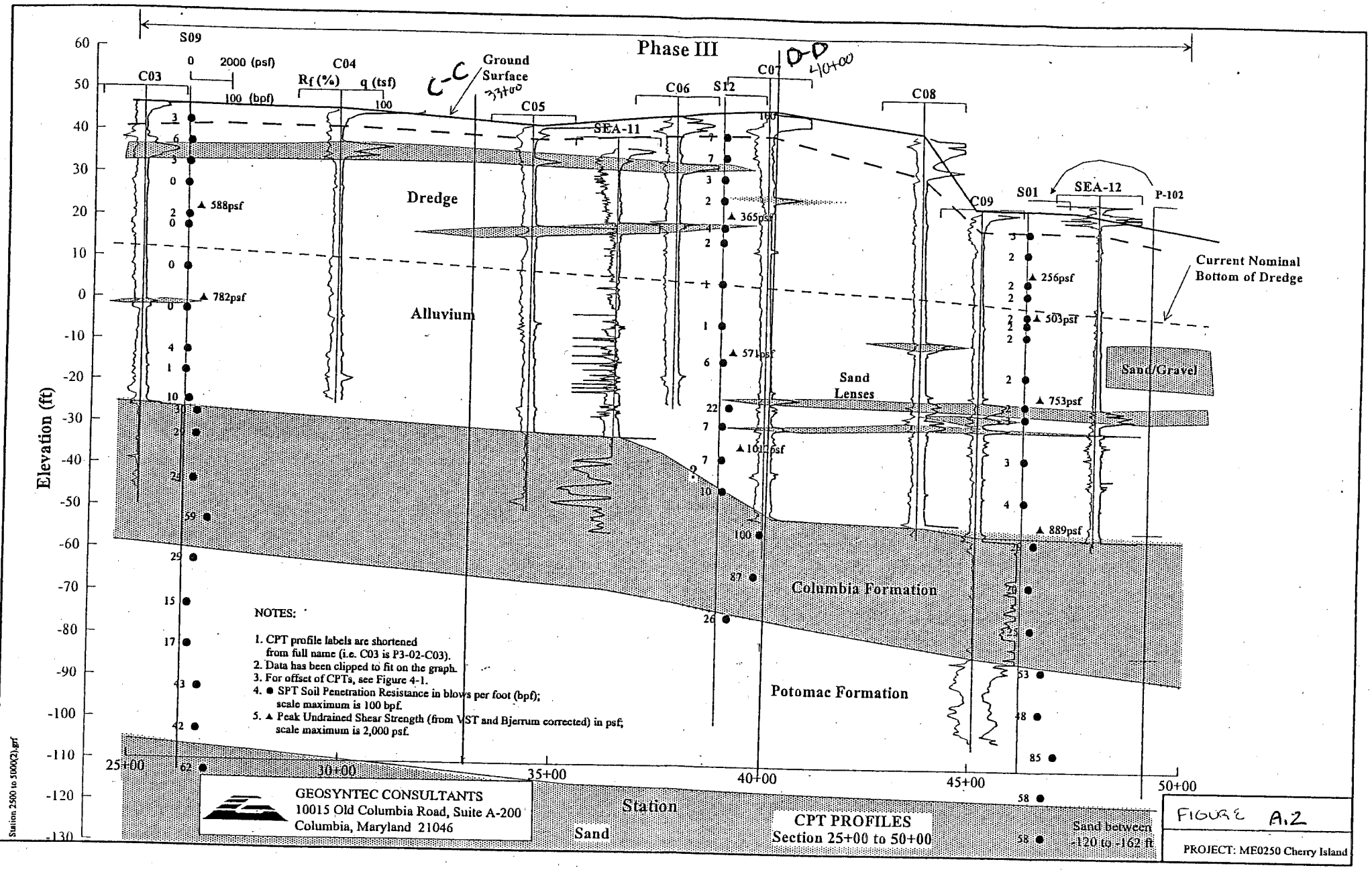
GEOSYNTEC CONSULTANTS
10015 Old Columbia Road, Suite A-200
Columbia, Maryland 21046

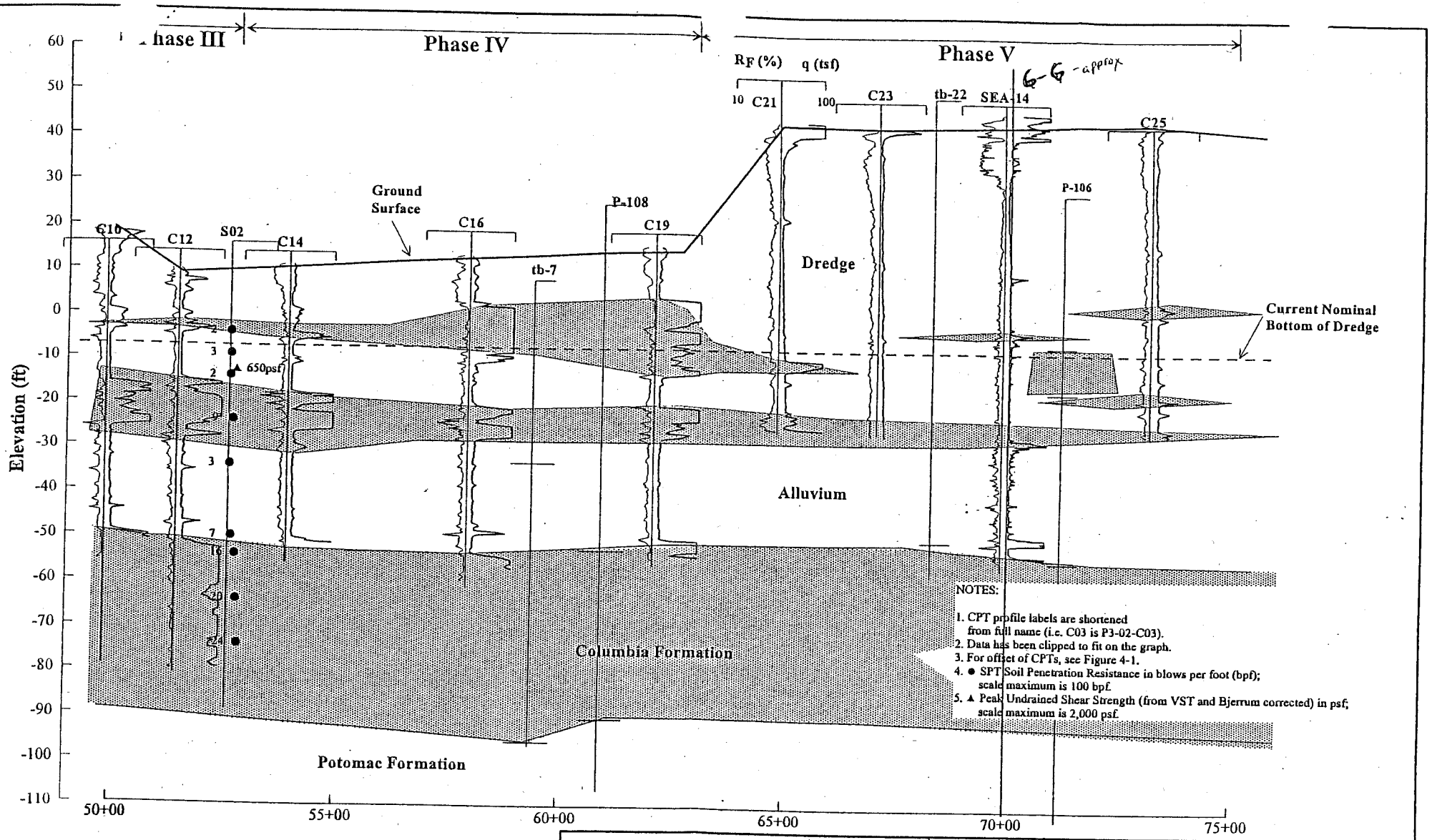
CPT PROFILES
Station 50+00 to 75+00
(Along Dike)

FIGURE A.1

PROJECT: ME0250 Cherry Island

Station 5000 to 7500ba(2).grf


Phase III
S09
C03
C04
C05
C06
S12
C07
C08
C09
S01
SEA-11
SEA-12
P-102
0
2000 (psf)
100 (bpf)
Rf (%)
q (tsf)
100
Ground Surface
C-C
33+00
D-D
40+00
Dredge
Alluvium
Sand Lenses
Sand/Gravel
Columbia Formation
Potomac Formation
Current Nominal Bottom of Dredge
588psf
782psf
365psf
571psf
1012psf
256psf
503psf
753psf
889psf
Elevation (ft)
Station
25+00
30+00
35+00
40+00
45+00
50+00
Sand
Sand between -120 to -162 ft
NOTES:
1. CPT profile labels are shortened from full name (i.e. C03 is P3-02-C03).
2. Data has been clipped to fit on the graph.
3. For offset of CPTs, see Figure 4-1.
4. ● SPT Soil Penetration Resistance in blows per foot (bpf); scale maximum is 100 bpf.
5. ▲ Peak Undrained Shear Strength (from VST and Bjerrum corrected) in psf; scale maximum is 2,000 psf.
GEOSYNTEC CONSULTANTS
10015 Old Columbia Road, Suite A-200
Columbia, Maryland 21046
CPT PROFILES
Section 25+00 to 50+00
FIGURE A.2
PROJECT: ME0250 Cherry Island
Station 2500 to 5000(2).grf

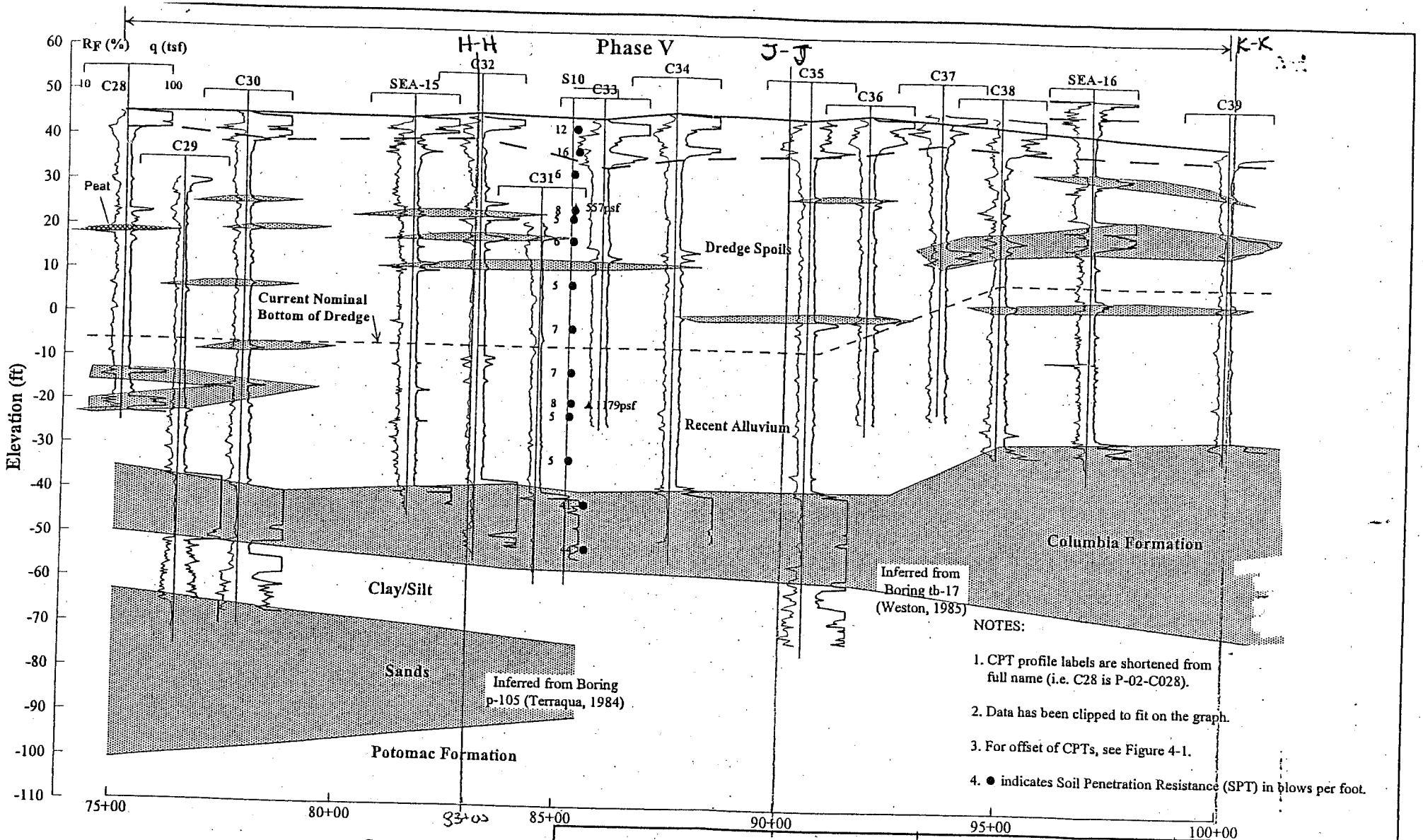


GEOSYNTEC CONSULTANTS
10015 Old Columbia Road, Suite A-200
Columbia, Maryland 21046

CPT PROFILES
Station 50+00 to 75+00
(Along Toe)

FIGURE A.3

PROJECT: ME0250 Cherry Island



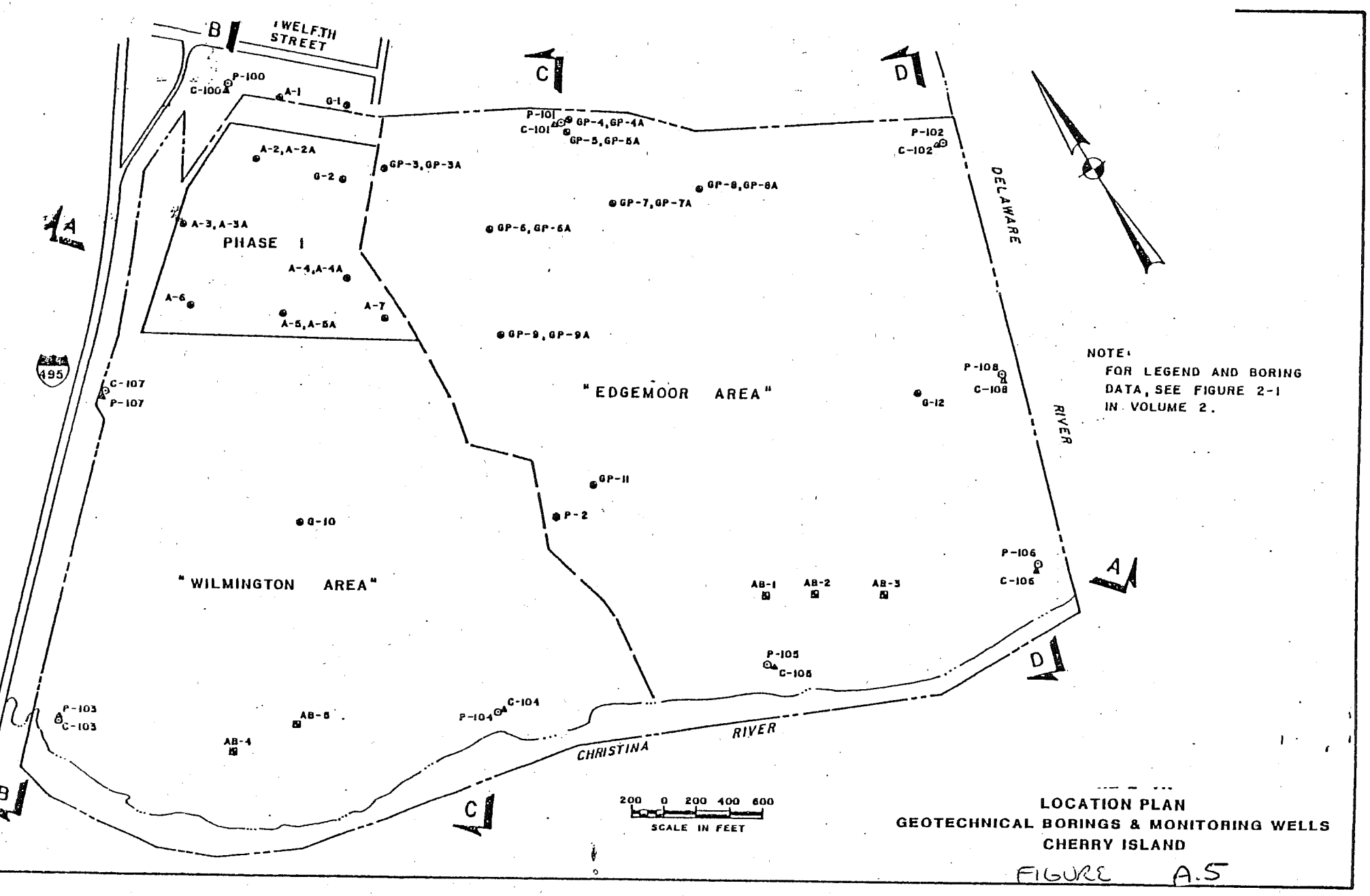
GEOSYNTEC CONSULTANTS
10015 Old Columbia Road, Suite A-200
Columbia, Maryland 21046

CPT PROFILES
Station 75+00 to 100+00

FIGURE A.4

PROJECT: ME0250 Cherry Island

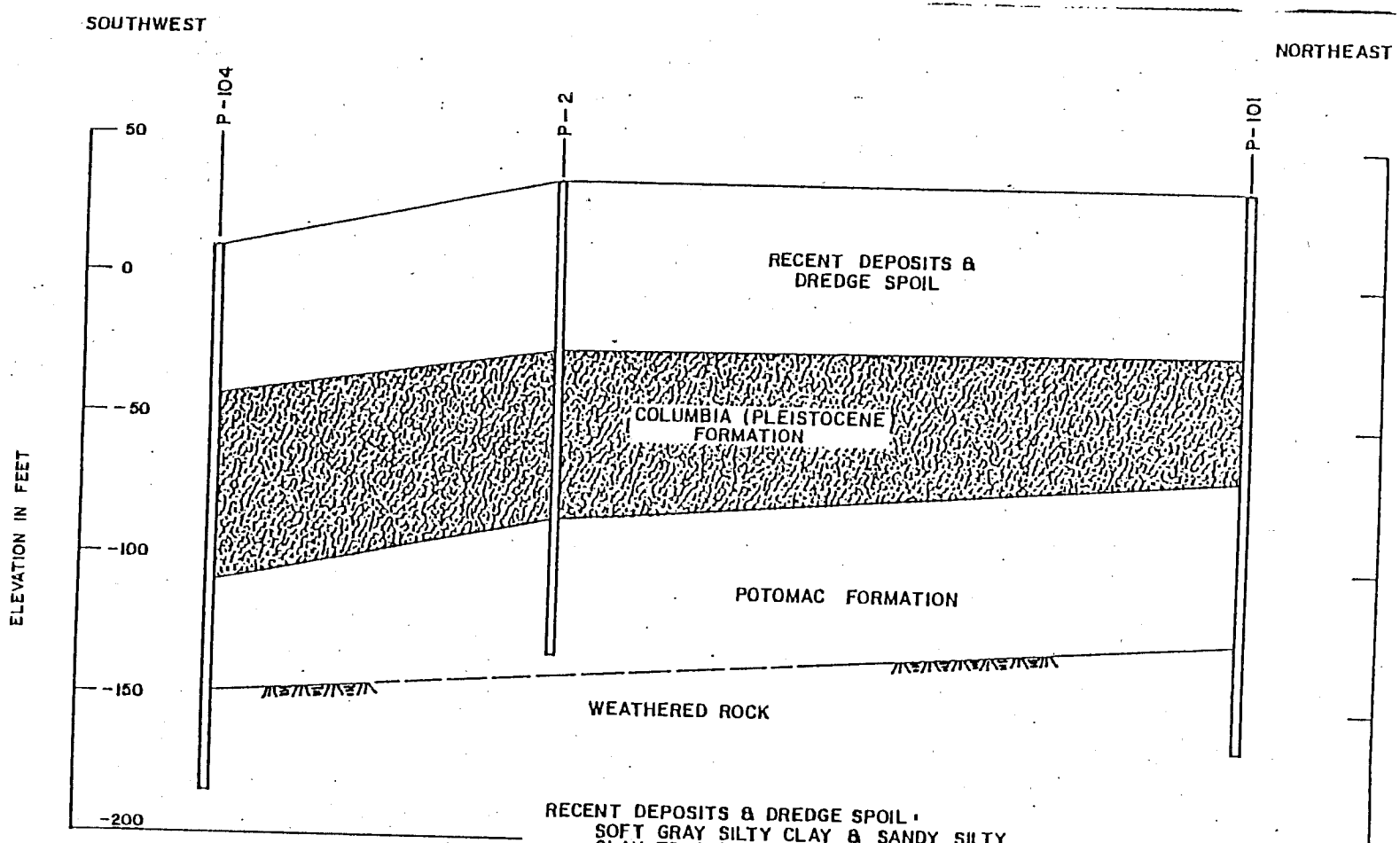
Terraqua Resources/Duffield (1984). "Site S bility Report, Hydrogeological And Geotechnical Evaluation Of The Cherry Island Site." Vol. 1 (Report) & Vol. 2 (Oversize Drawings).



LOCATION PLAN
GEOTECHNICAL BORINGS & MONITORING WELLS
CHERRY ISLAND

FIGURE A.5

Terraqua Resources/Duffield (1984). "Site Suitability Report, Hydrogeological And Geotechnical Evaluation Of The Cherry Island Site." Vol. 1 (Report) & Vol. 2 (Oversize Drawings).



REFERENCE: FIGURE 2-1

0 400 800
Scale In Feet

RECENT DEPOSITS & DREDGE SPOIL:
SOFT GRAY SILTY CLAY & SANDY SILTY CLAY TO SANDY CLAYEY SILT

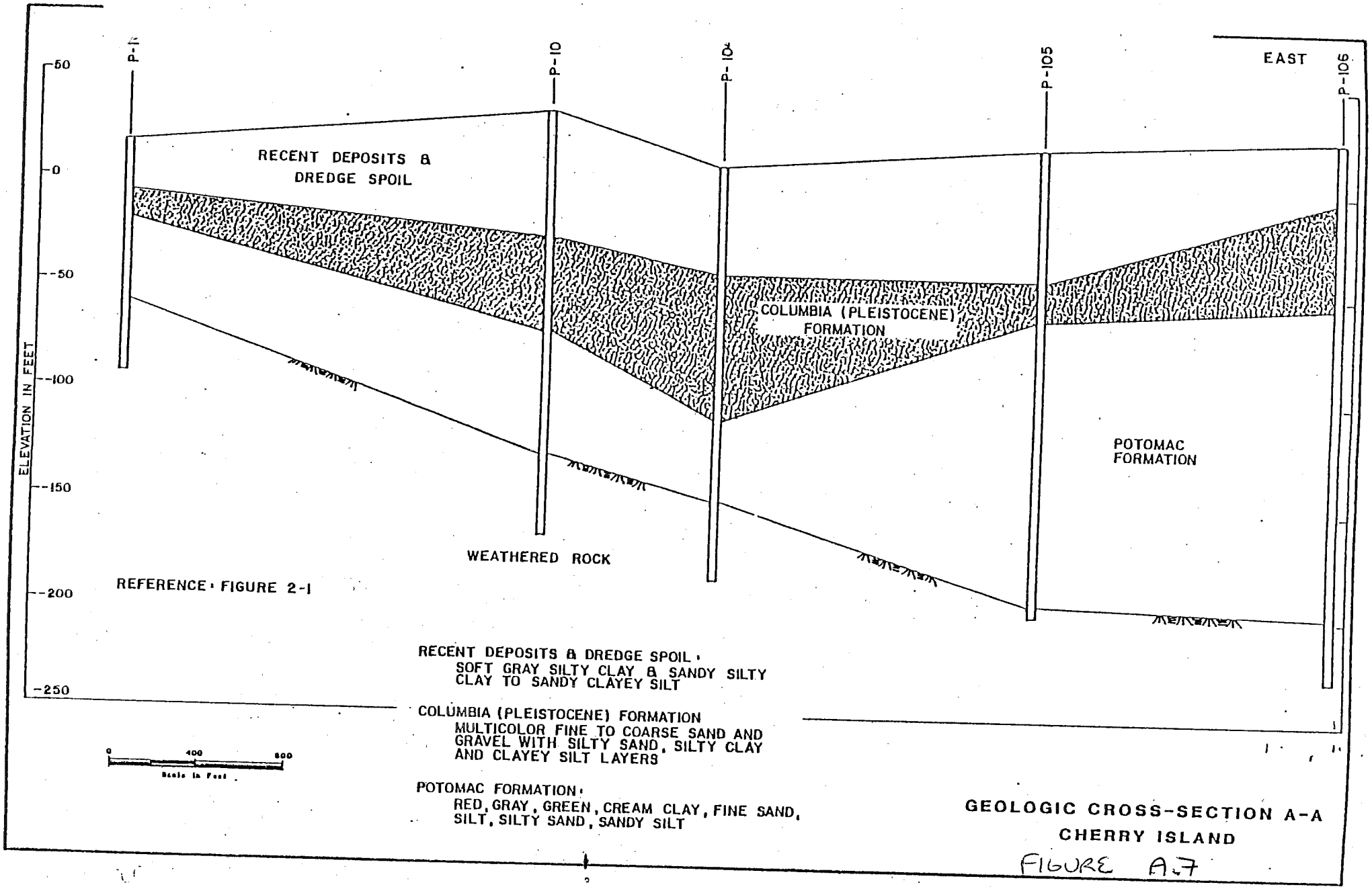
COLUMBIA (PLEISTOCENE) FORMATION
MULTICOLOR FINE TO COARSE SAND AND GRAVEL WITH SILTY SAND, SILTY CLAY AND CLAYEY SILT LAYERS

POTOMAC FORMATION:
RED, GRAY, GREEN, CREAM CLAY, FINE SAND, SILT, SILTY SAND, SANDY SILT

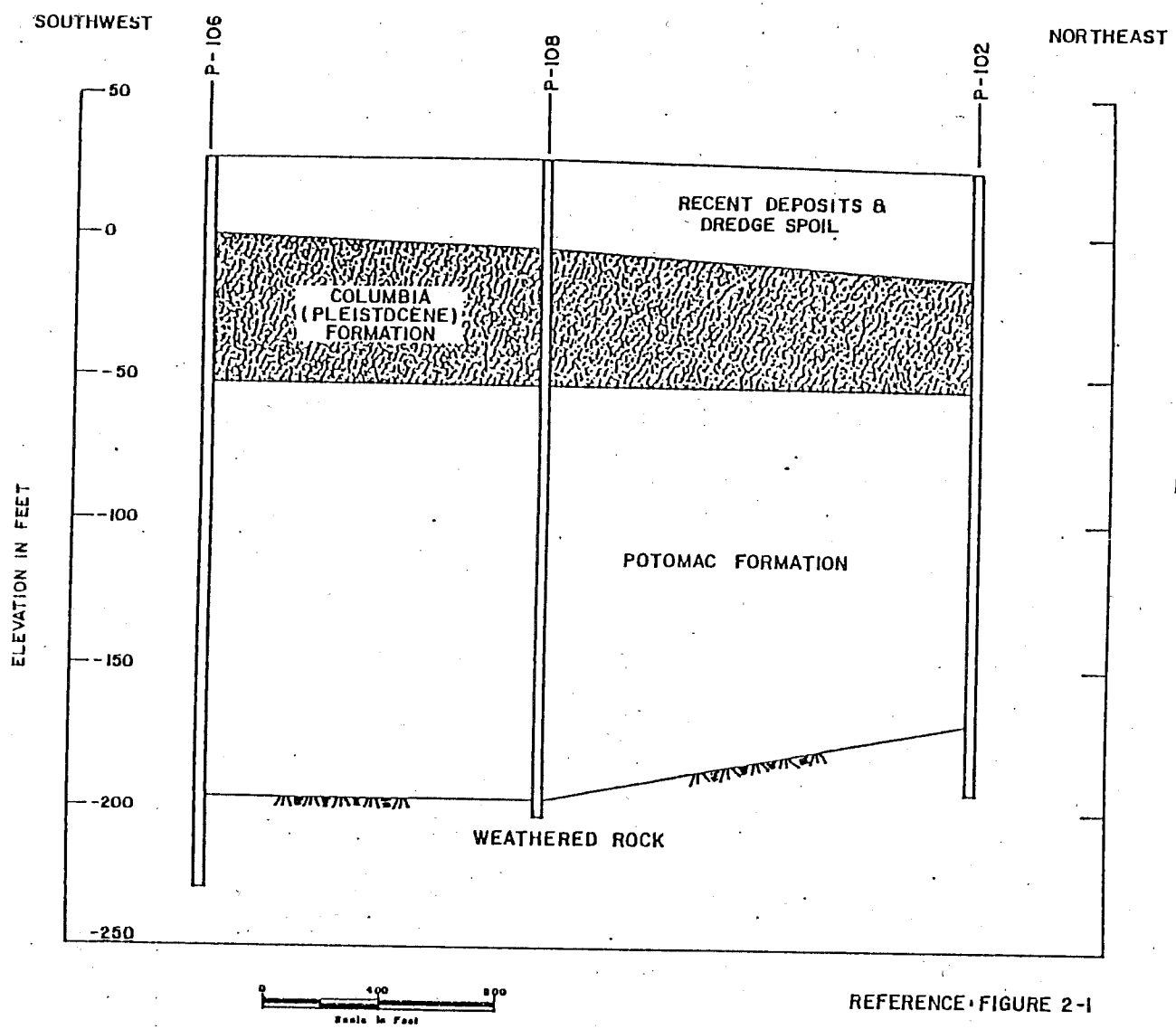
GEOLOGIC CROSS-SECTION C-C
CHERRY ISLAND

FIGURE A.6

Terraqua Resources/Duffield (1984). "Site S bility Report, Hydrogeological And Geotechnical Evaluation Of The Cherry Island Site." Vol. 1 (Report) & Vol. 2 (Oversize Drawings).



Terraqua Resources/Duffield (1984). "Site Suitability Report, Hydrogeological And Geotechnical Evaluation Of The Cherry Island Site." Vol. 1 (Report) & Vol. 2 (Oversize Drawings).



RECENT DEPOSITS & DREDGE SPOIL:
SOFT GRAY SILTY CLAY & SANDY SILTY CLAY TO SANDY CLAYEY SILT

COLUMBIA (PLEISTOCENE) FORMATION
MULTICOLOR FINE TO COARSE SAND AND GRAVEL WITH SILTY SAND, SILTY CLAY AND CLAYEY SILT LAYERS

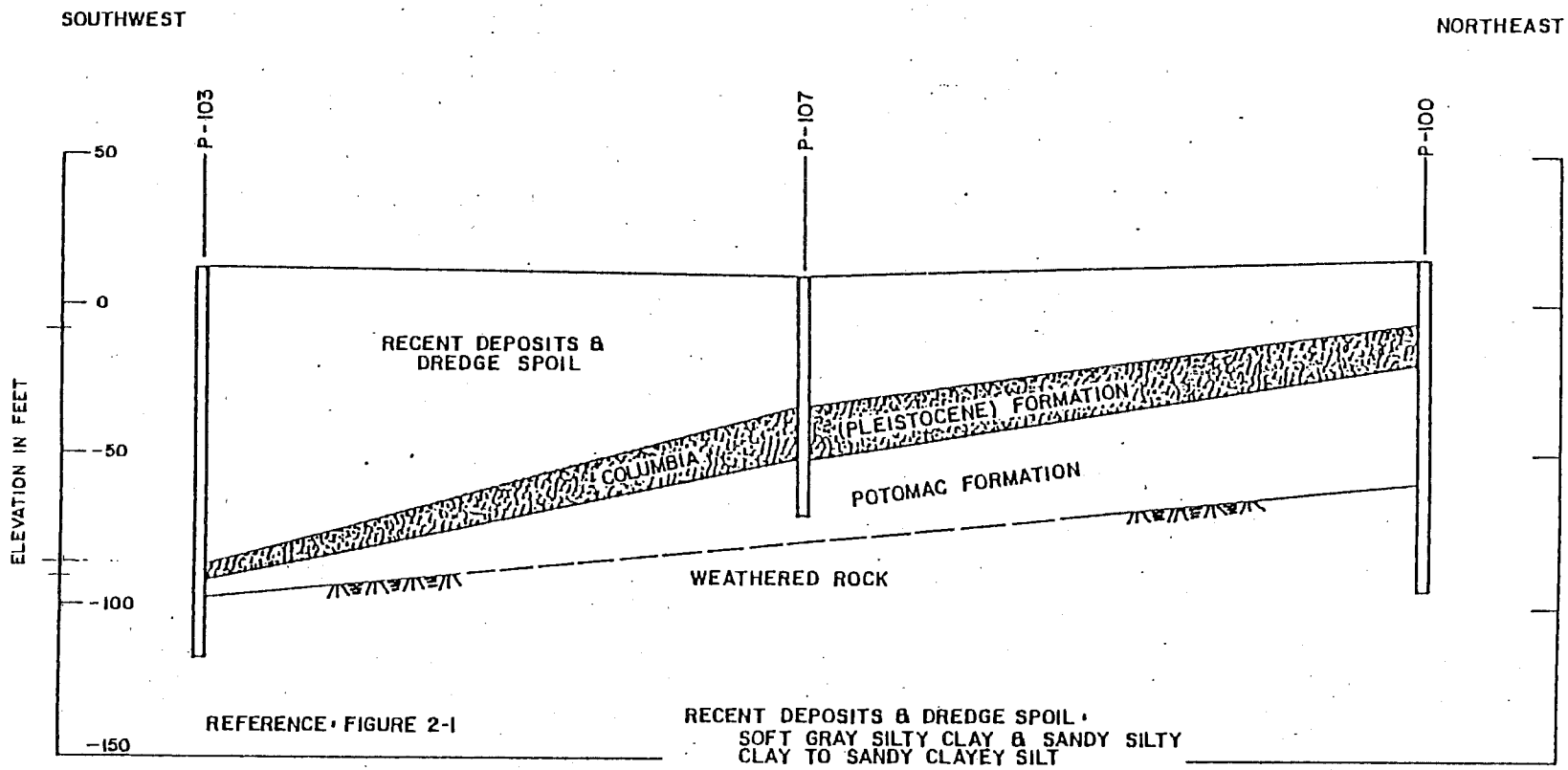
POTOMAC FORMATION:
RED, GRAY, GREEN, CREAM CLAY, FINE SAND, SILT, SILTY SAND, SANDY SILT

REFERENCE: FIGURE 2-1

GEOLOGIC CROSS-SECTION D-D
CHERRY ISLAND

FIGURE A.8

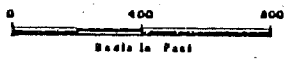
Terraqua Resources/Duffield (1984). "Site S ›ility Report, Hydrogeological And Geotechnical Evaluation Of The Cherry Island Site." Vol. 1 (Report) & Vol. 2 (Oversize Drawings).



RECENT DEPOSITS & DREDGE SPOIL:
SOFT GRAY SILTY CLAY & SANDY SILTY CLAY TO SANDY CLAYEY SILT

COLUMBIA (PLEISTOCENE) FORMATION
MULTICOLOR FINE TO COARSE SAND AND GRAVEL WITH SILTY SAND, SILTY CLAY AND CLAYEY SILT LAYERS

POTOMAC FORMATION:
RED, GRAY, GREEN, CREAM CLAY, FINE SAND, SILT, SILTY SAND, SANDY SILT

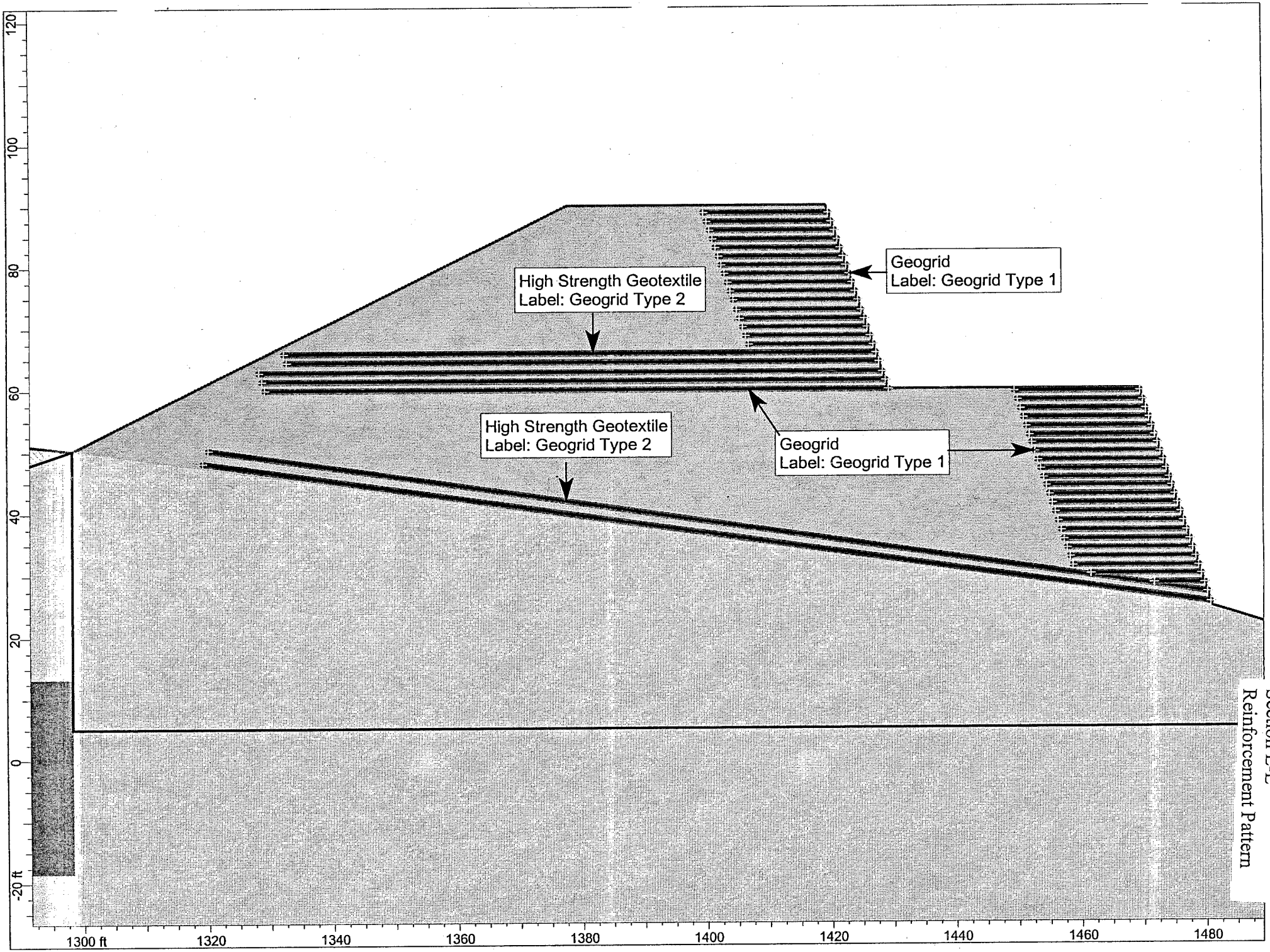


GEOLOGIC CROSS-SECTION B-B
CHERRY ISLAND

FIGURE A.9

Attachment B

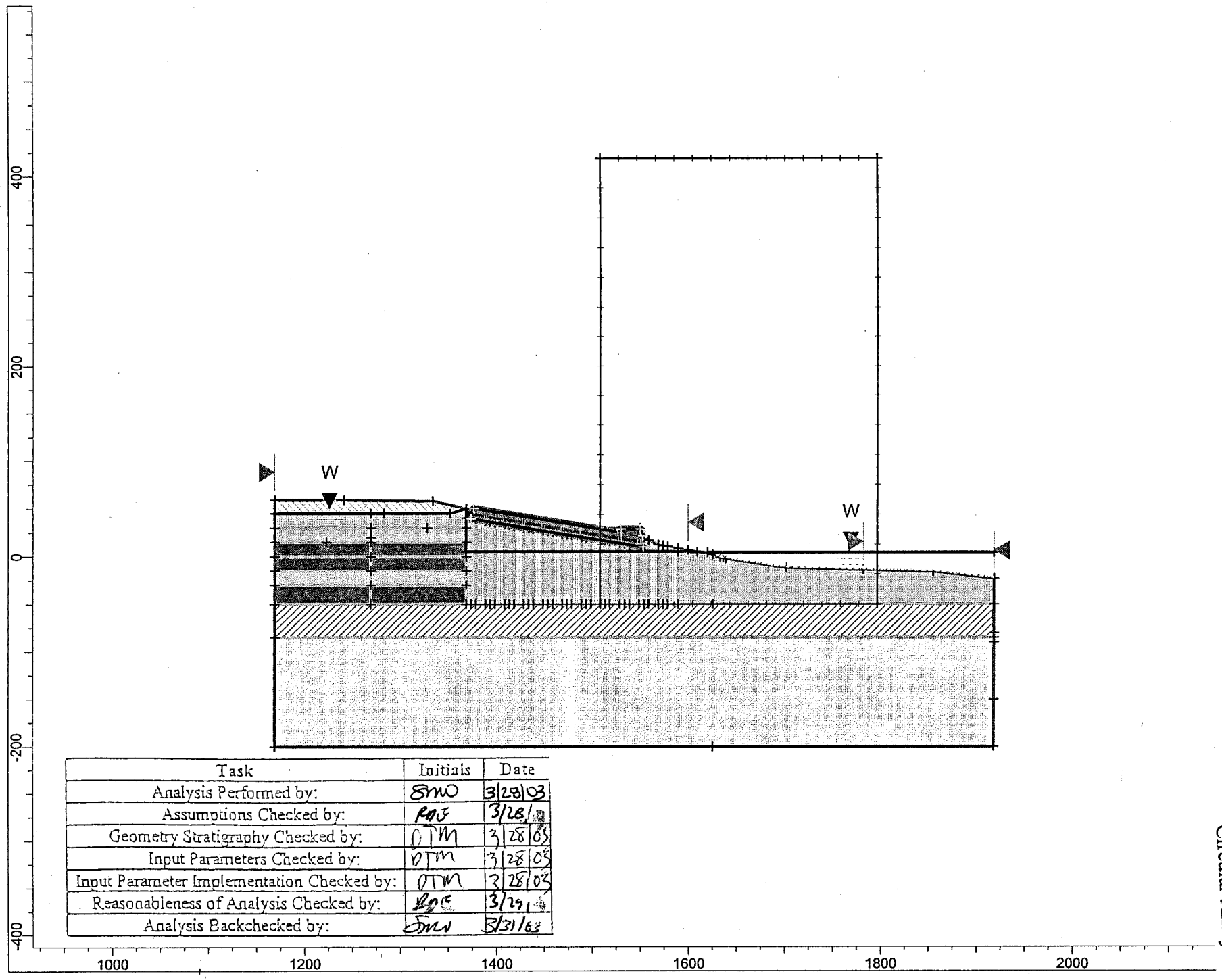
Stability Analysis Results for Construction of Section E-E



Section E-E
Reinforcement Pattern

Explanation of Construction Analysis

Construction Sequence	Represents
Construction 1	Single 10' lift placed on existing ground surface
Construction 2	Single 10' lift placed on existing 10' of fill
Construction 3	Single 10' lift placed on existing 20' of fill
Construction 4	Single 10' lift placed on existing 30' of fill
Construction 5	Single 10' lift placed on existing 50' of fill
Construction 6	Single 10' lift placed on existing 60' of fill
Construction 7	Single 10' lift placed on existing 70' of fill

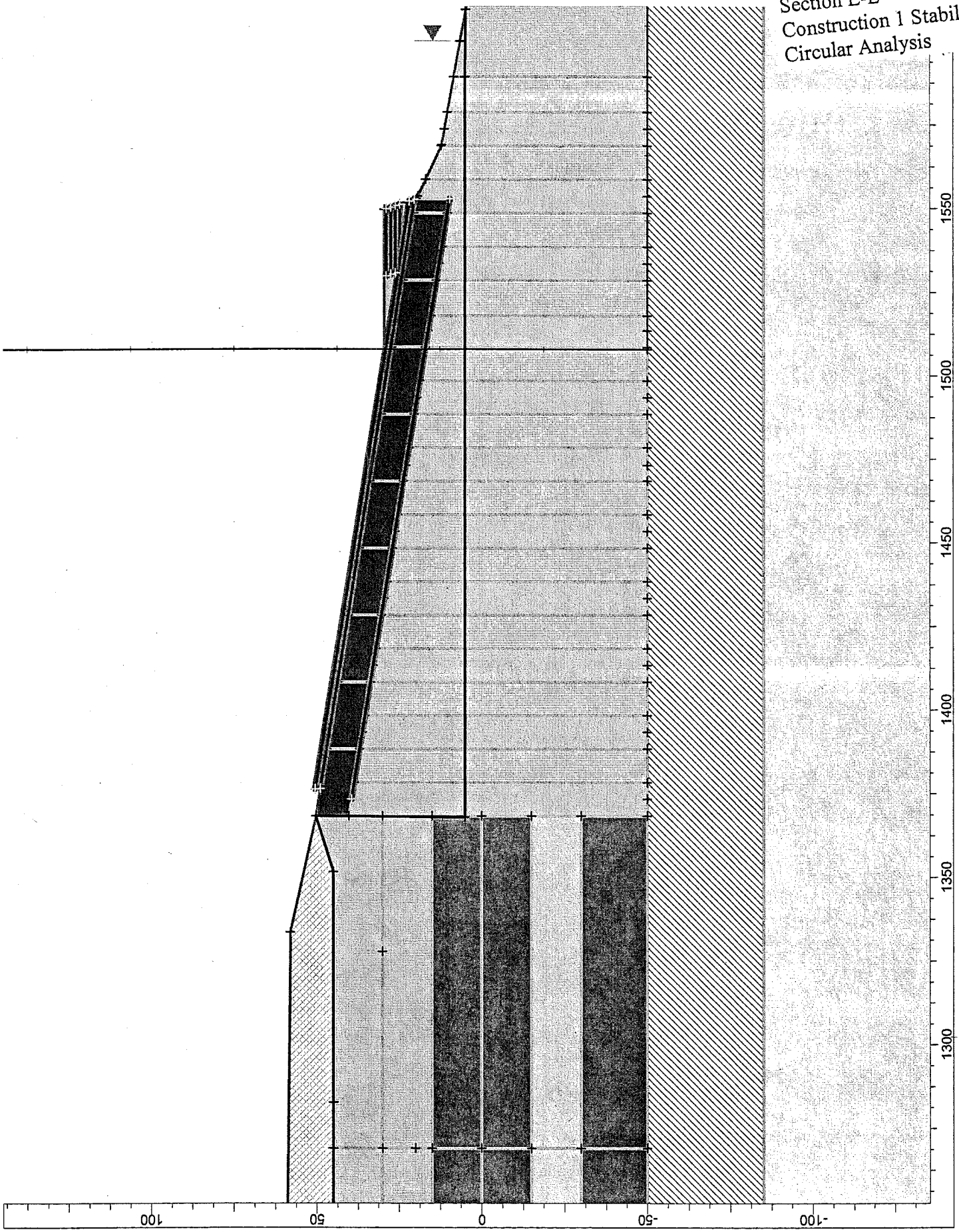


Task	Initials	Date
Analysis Performed by:	SMW	3/28/03
Assumptions Checked by:	RAJ	3/28/03
Geometry Stratigraphy Checked by:	DTM	3/28/03
Input Parameters Checked by:	DTM	3/28/03
Input Parameter Implementation Checked by:	DTM	3/28/03
Reasonableness of Analysis Checked by:	BJC	3/29/03
Analysis Backchecked by:	SMW	3/31/03

Section E-E
Construction 1 Stability
Circular Analysis

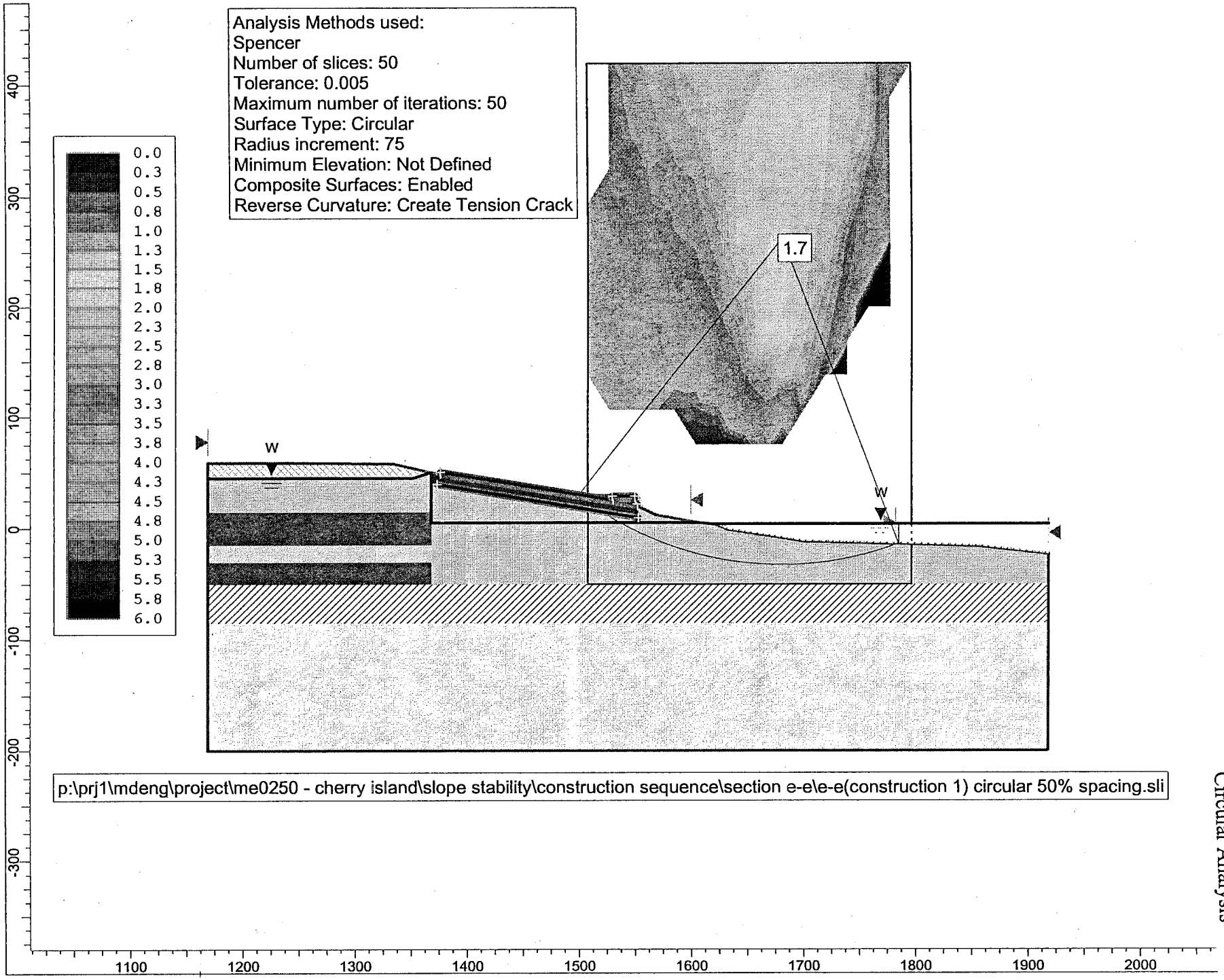
E-1

Section E-E
Construction 1 Stability
Circular Analysis



ECT-2

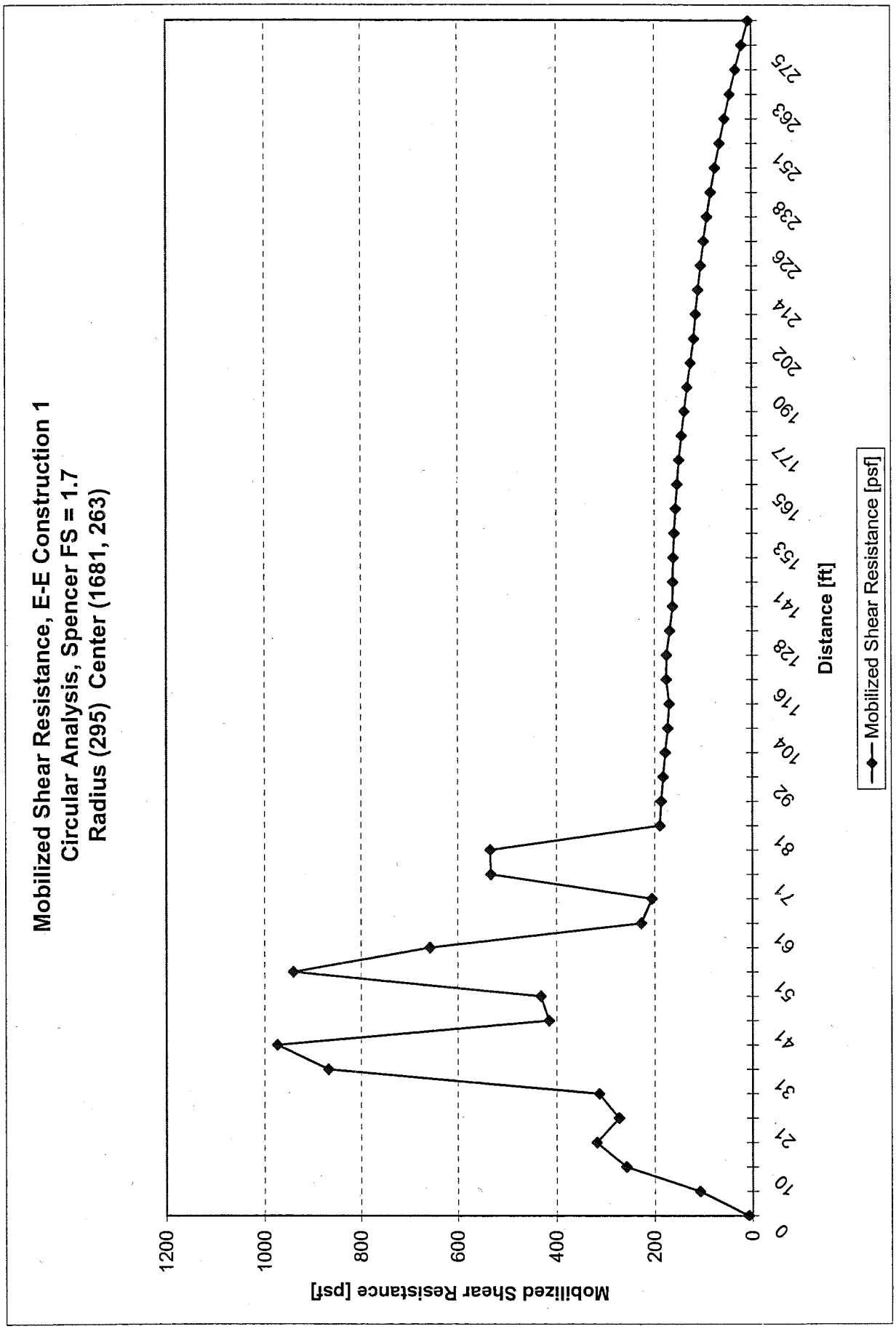
Section E-E
Construction 1 Stability
Circular Analysis



p:\prj1\mdeng\project\me0250 - cherry island\slope stability\construction sequence\section e-e\e-e(construction 1) circular 50% spacing.sli

E01-3

Section E-E
Construction 1 Stability
Circular Analysis



PRJ1/ME0250/SlopeStability/ConstructionSequence/Mobilized Shear Strength E Cons

ECT-4

Slide Analysis Information

Document Name

File Name: e-e(construction 1) circular 50% spacing

Project Settings

Project Title: SLIDE - An Interactive Slope Stability Program
Failure Direction: Left to Right
Units of Measurement: Imperial Units
Pore Fluid Unit Weight: 62.4 lb/ft3
Groundwater Method: Water Surfaces
Data Output: Standard

Analysis Methods

Analysis Methods used:
Spencer

Number of slices: 50
Tolerance: 0.005
Maximum number of iterations: 50

Surface Options

Surface Type: Circular
Radius increment: 75
Minimum Elevation: Not Defined
Composite Surfaces: Enabled
Reverse Curvature: Create Tension Crack

Loading

Seismic Load Coefficient (Horizontal): 0
Seismic Load Coefficient (Vertical): 0

Material Properties

Material: Potomac Formation
Strength Type: Undrained
Unit Weight: 120 lb/ft3
Cohesion Type: Function of Depth
Cohesion (Top): 4500 psf
Cohesion Change: 14.4 psf/ft
Cutoff: 10000 psf
Water Surface: None

Material: Waste (0 to 20)
Strength Type: Mohr-Coulomb
Unit Weight: 60 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Undrained PVD Area
Strength Type: Strength=F(overburden)
Unit Weight: 85 lb/ft3
Tau/Sigma Ratio: 0.29
Water Surface: Water Table
Custom Hu value: 1

Material: d11
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 200 psf
Water Surface: None

Material: d12
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 400 psf
Water Surface: None

Material: d13
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 600 psf
Water Surface: None

Material: d14
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 800 psf
Water Surface: None

Material: River Sediments
Strength Type: Strength=F(overburden)
Unit Weight: 85 lb/ft3
Tau/Sigma Ratio: 0.29
Water Surface: Water Table
Custom Hu value: 1

Section E-E
Construction 1 Stability
Circular Analysis

ECT-3.

Material: Columbia Formation
Strength Type: Mohr-Coulomb
Unit Weight: 125 lb/ft3
Cohesion: 0 psf
Friction Angle: 40 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: MSE Wall Soil
Strength Type: Mohr-Coulomb
Unit Weight: 90 lb/ft3
Cohesion: 0 psf
Friction Angle: 29 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Drained PVD Area
Strength Type: Shear Normal function
Unit Weight: 85 lb/ft3
Water Surface: Water Table
Custom Hu value: 1

Material: Strucural Fill
Strength Type: Mohr-Coulomb
Unit Weight: 110 lb/ft3
Cohesion: 0 psf
Friction Angle: 35 degrees
Water Surface: Water Table
Custom Hu value: 1

Support Properties

Support: Geogrid
Support Type: GeoTextile
Force Application: Passive
Force Orientation: Bisector of Parallel and Tangent
Anchorage: Slope Face
Shear Strength Model: Linear
Strip Coverage: 100 percent
Tensile Strength: 5000 lb/ft
Pullout Strength Adhesion: 0 lb/ft2
Pullout Strength Friction Angle: 25 degrees

Support: Geogrid2
Support Type: GeoTextile
Force Application: Passive
Force Orientation: Bisector of Parallel and Tangent
Anchorage: Slope Face
Shear Strength Model: Linear
Strip Coverage: 100 percent
Tensile Strength: 21000 lb/ft
Pullout Strength Adhesion: 0 lb/ft2
Pullout Strength Friction Angle: 25 degrees

Global Minimums

Method: spencer
SF: 1.70788
Center: 1680.8, 262.555
Radius: 295.387
Left Slip Surface Endpoint: 1499.5, 29.3504
Right Slip Surface Endpoint: 1784.64, -13.9788
Left Slope Intercept: 1499.5 29.3504
Right Slope Intercept: 1784.64 4

Method Statistics

Method: spencer
Number of Valid Surfaces: 10921
Number of Invalid Surfaces: 8535
Error Codes:
Error Code -101 reported for 155 surfaces
Error Code -103 reported for 72 surfaces
Error Code -108 reported for 212 surfaces
Error Code -111 reported for 2229 surfaces
Error Code -112 reported for 3345 surfaces
Error Code -113 reported for 394 surfaces
Error Code -1000 reported for 2128 surfaces

Error Codes

The following errors were encountered during the computation:

-101 = Only one (or zero) surface / slope intersections.

-103 = Two surface / slope intersections, but one or more surface / nonslope external polygon intersections lie between them. This usually occurs when the slip surface extends past the bottom of the soil region, but may also occur on a benched slope model with two sets of Slope Limits.

-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).

-111 = safety factor equation did not converge

-112 = The coefficient M-Alpha = cos(alpha)(1+tan(alpha)tan(phi)/F) < 0.2 for the final iteration of the safety factor calculation. This screens out some slip surfaces which may not be valid in the context of the analysis, in particular, deep seated slip surfaces with many high negative base

angle slices in the passive zone.

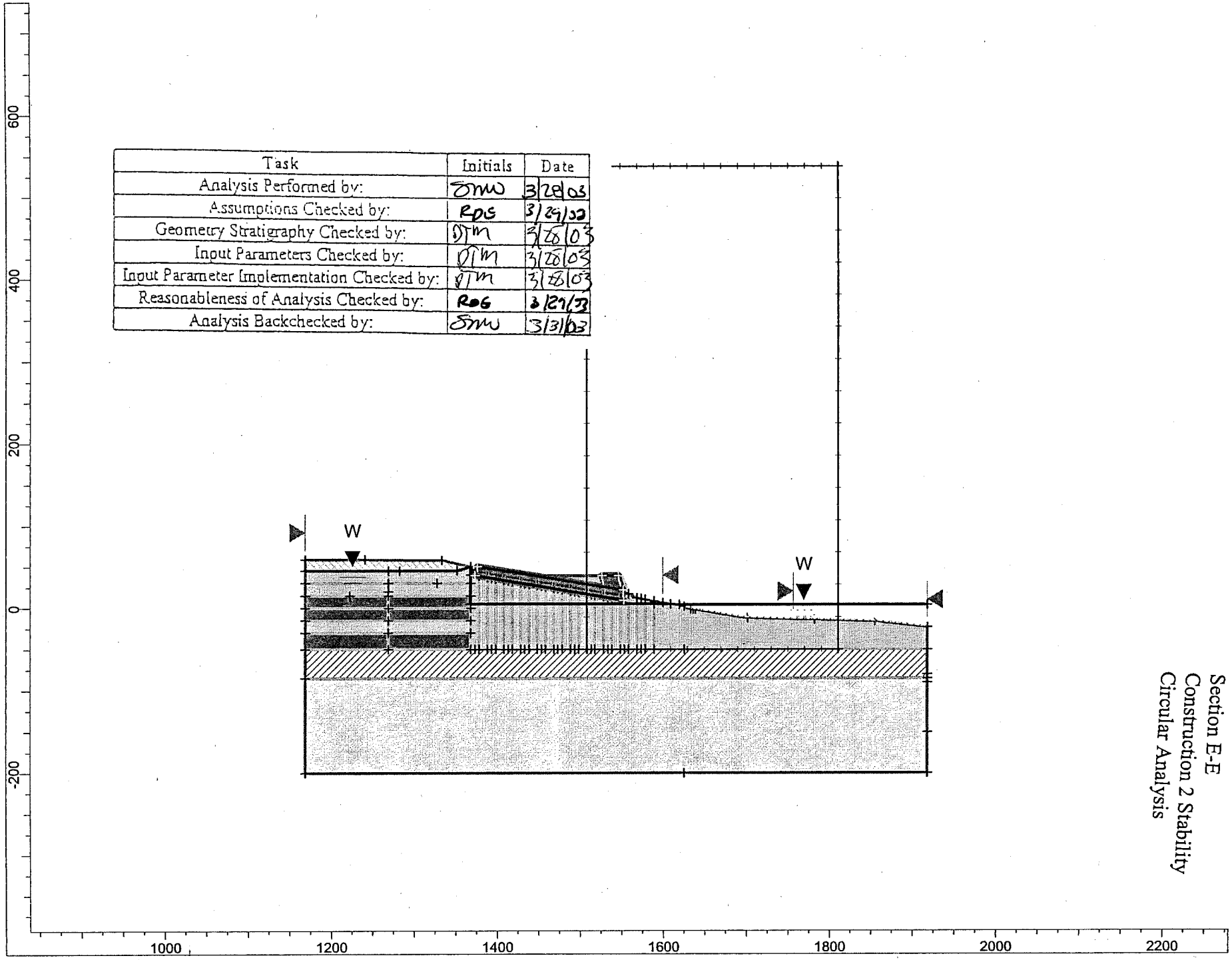
-113 = Surface intersects outside slope limits.

-1000 = No valid slip surfaces are generated at a grid center. Unable to draw a surface.

Section E-E'
Construction 1 Stability
Circular Analysis

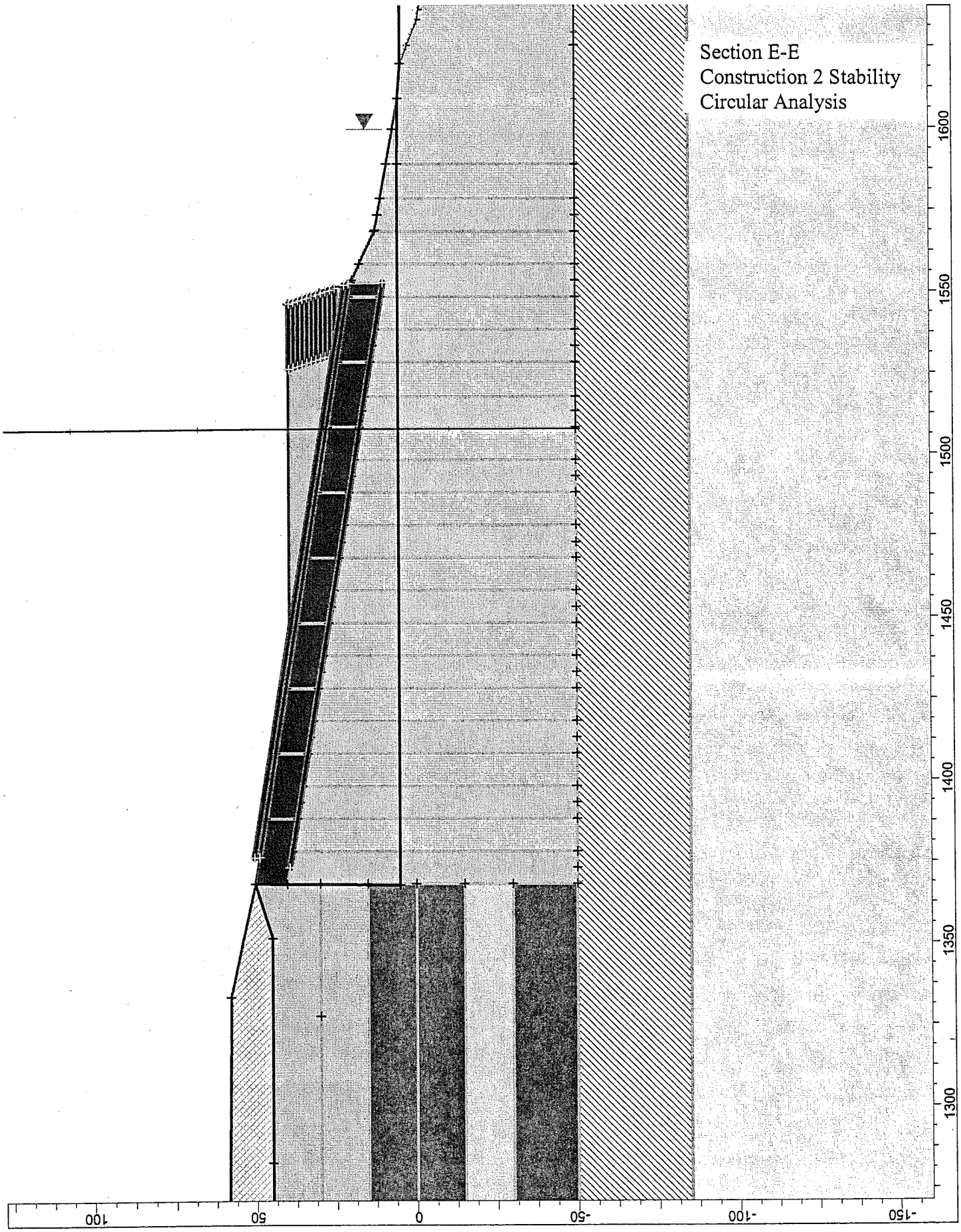
EC1.6

Task	Initials	Date
Analysis Performed by:	SMW	3/28/03
Assumptions Checked by:	RDS	3/29/03
Geometry Stratigraphy Checked by:	DTM	3/28/03
Input Parameters Checked by:	DTM	3/28/03
Input Parameter Implementation Checked by:	DTM	3/28/03
Reasonableness of Analysis Checked by:	RDG	3/27/03
Analysis Backchecked by:	SMW	3/31/03

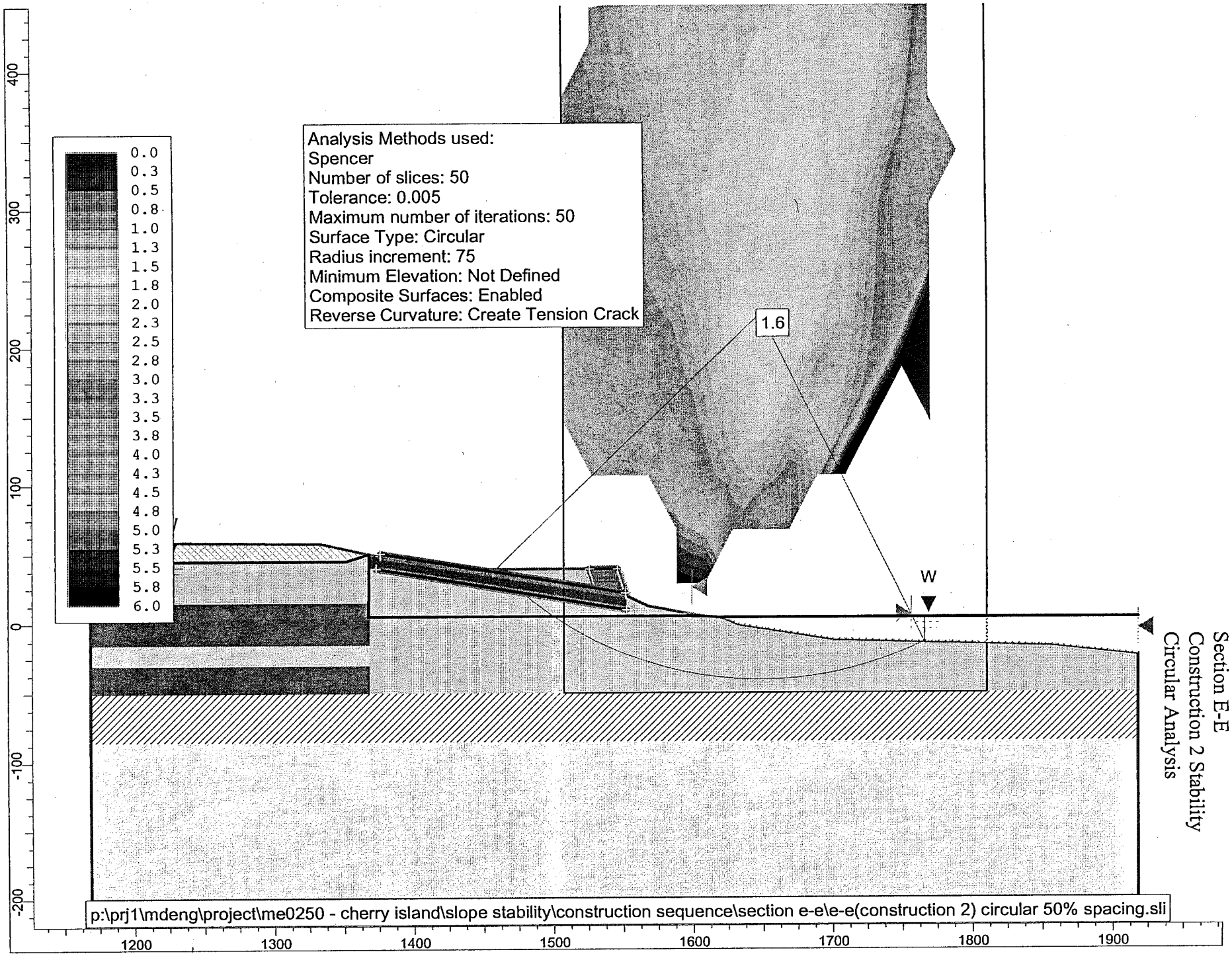


Section E-E
Construction 2 Stability
Circular Analysis

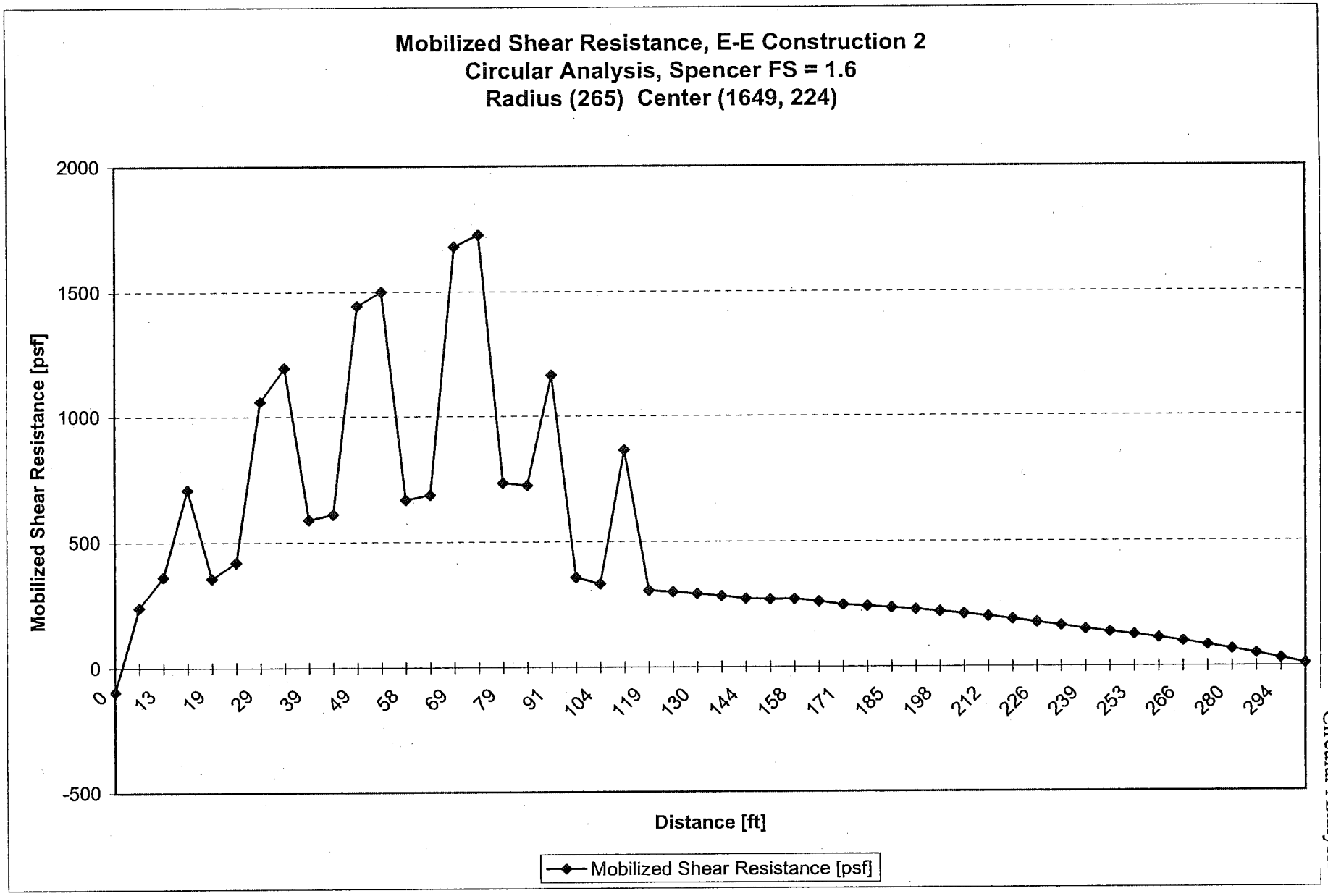
ECT. 4


Section E-E
Construction 2 Stability
Circular Analysis
1600
1550
1500
1450
1400
1350
1300
100
50
0
-50
-100
-150

ECT-8



Section E-E
Construction 2 Stability
Circular Analysis



Section E-E
Construction 2 Stability
Circular Analysis

PRJ1/ME0250/SlopeStability/ConstructionSequence/Mobilized Shear Strength E Cons.

EC 16

Slide Analysis Information

Document Name

File Name: e-e(construction 2) circular 50% spacing

Project Settings

Project Title: SLIDE - An Interactive Slope Stability Program
Failure Direction: Left to Right
Units of Measurement: Imperial Units
Pore Fluid Unit Weight: 62.4 lb/ft3
Groundwater Method: Water Surfaces
Data Output: Standard

Analysis Methods

Analysis Methods used:
Spencer

Number of slices: 50
Tolerance: 0.005
Maximum number of iterations: 50

Surface Options

Surface Type: Circular
Radius increment: 75
Minimum Elevation: Not Defined
Composite Surfaces: Enabled
Reverse Curvature: Create Tension Crack

Loading

Seismic Load Coefficient (Horizontal): 0
Seismic Load Coefficient (Vertical): 0

Material Properties

Material: Potomac Formation
Strength Type: Undrained
Unit Weight: 120 lb/ft3
Cohesion Type: Function of Depth
Cohesion (Top): 4500 psf
Cohesion Change: 14.4 psf/ft
Cutoff: 10000 psf
Water Surface: None

Material: Waste (0 to 20)
Strength Type: Mohr-Coulomb
Unit Weight: 60 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Undrained PVD Area
Strength Type: Strength=F(overburden)
Unit Weight: 85 lb/ft3
Tau/Sigma Ratio: 0.29
Water Surface: Water Table
Custom Hu value: 1

Material: d11
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 200 psf
Water Surface: None

Material: d12
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 400 psf
Water Surface: None

Material: d13
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 600 psf
Water Surface: None

Material: d14
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 800 psf
Water Surface: None

Material: River Sediments
Strength Type: Strength=F(overburden)
Unit Weight: 85 lb/ft3
Tau/Sigma Ratio: 0.29
Water Surface: Water Table
Custom Hu value: 1

Section E-E
Construction 2 Stability
Circular Analysis

ECT-11

Material: Columbia Formation
Strength Type: Mohr-Coulomb
Unit Weight: 125 lb/ft3
Cohesion: 0 psf
Friction Angle: 40 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: MSE Wall Soil
Strength Type: Mohr-Coulomb
Unit Weight: 90 lb/ft3
Cohesion: 0 psf
Friction Angle: 29 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Drained PVD Area
Strength Type: Shear Normal function
Unit Weight: 85 lb/ft3
Water Surface: Water Table
Custom Hu value: 1

Material: Strucural Fill
Strength Type: Mohr-Coulomb
Unit Weight: 110 lb/ft3
Cohesion: 0 psf
Friction Angle: 35 degrees
Water Surface: Water Table
Custom Hu value: 1

Support Properties

Support: Geogrid
Support Type: GeoTextile
Force Application: Passive
Force Orientation: Bisector of Parallel and Tangent
Anchorage: Slope Face
Shear Strength Model: Linear
Strip Coverage: 100 percent
Tensile Strength: 5000 lb/ft
Pullout Strength Adhesion: 0 lb/ft2
Pullout Strength Friction Angle: 25 degrees

Support: Geogrid2
Support Type: GeoTextile
Force Application: Passive
Force Orientation: Bisector of Parallel and Tangent
Anchorage: Slope Face
Shear Strength Model: Linear
Strip Coverage: 100 percent
Tensile Strength: 21000 lb/ft
Pullout Strength Adhesion: 0 lb/ft2
Pullout Strength Friction Angle: 25 degrees

Global Minimums

Method: spencer
SF: 1.59289
Center: 1648.92, 224.197
Radius: 264.807
Left Slip Surface Endpoint: 1459.38, 39.2738
Right Slip Surface Endpoint: 1765.66, -13.4909
Left Slope Intercept: 1459.38 39.2738
Right Slope Intercept: 1765.66 4

Method Statistics

Method: spencer
Number of Valid Surfaces: 10638
Number of Invalid Surfaces: 8818
Error Codes:
Error Code -101 reported for 125 surfaces
Error Code -103 reported for 70 surfaces
Error Code -108 reported for 233 surfaces
Error Code -111 reported for 2221 surfaces
Error Code -112 reported for 2576 surfaces
Error Code -113 reported for 933 surfaces
Error Code -1000 reported for 2660 surfaces

Error Codes

The following errors were encountered during the computation:

-101 = Only one (or zero) surface / slope intersections.

-103 = Two surface / slope intersections, but one or more surface / nonslope external polygon intersections lie between them. This usually occurs when the slip surface extends past the bottom of the soil region, but may also occur on a benched slope model with two sets of Slope Limits.

-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).

-111 = safety factor equation did not converge

-112 = The coefficient M-Alpha = cos(alpha)(1+tan(alpha)tan(phi)/F) < 0.2 for the final iteration of the safety factor calculation. This screens out some slip surfaces which may not be valid in the context of the analysis, in particular, deep seated slip surfaces with many high negative base

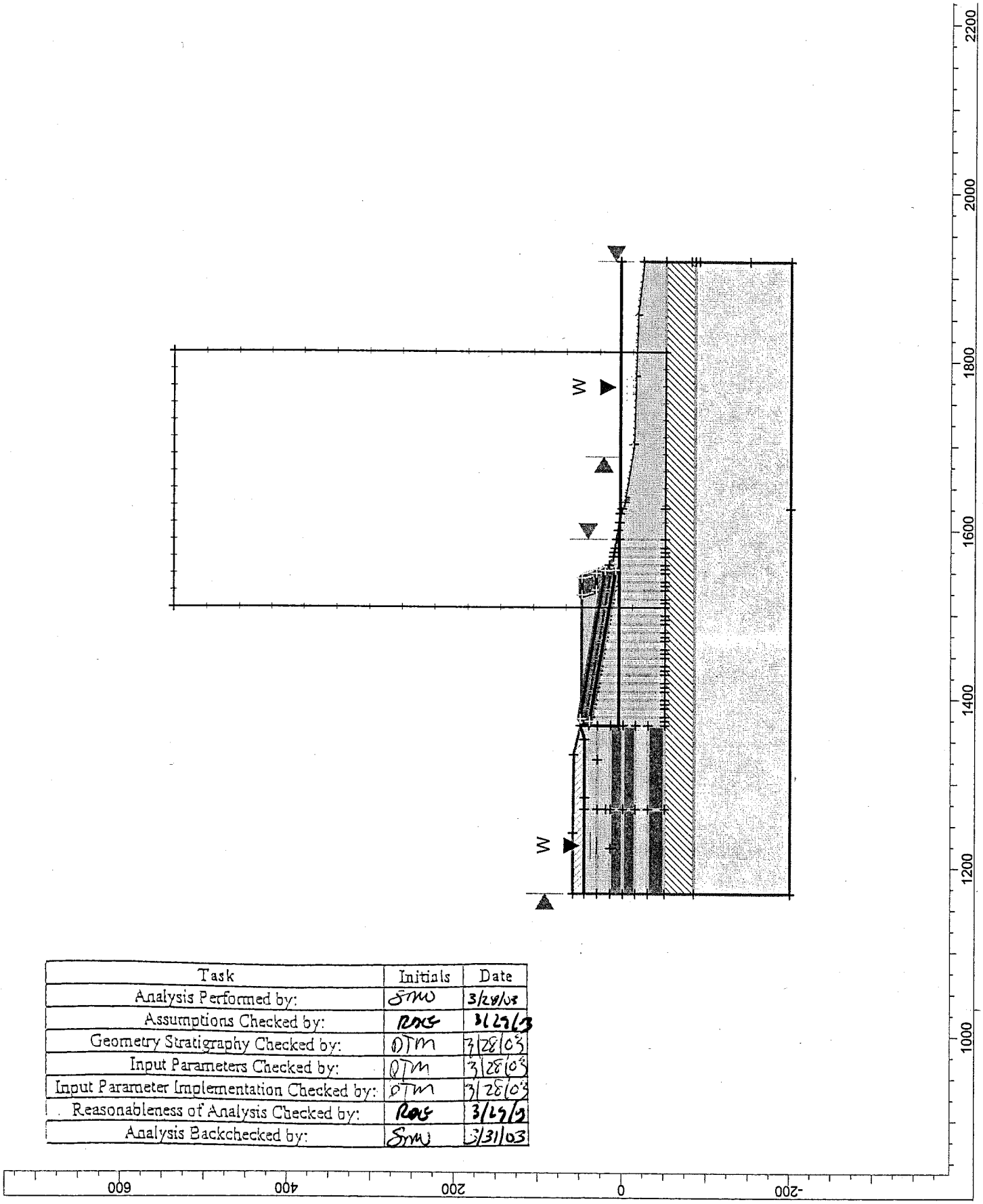
Section E-E
Construction 2 Stability
Circular Analysis

angle slices in the passive zone.

-113 = Surface intersects outside slope limits.

-1000 = No valid slip surfaces are generated at a grid center. Unable to draw a surface.

Section E-E
Construction 3 Stability
Circular Analysis



Task	Initials	Date
Analysis Performed by:	SMW	3/28/03
Assumptions Checked by:	RAG	3/29/03
Geometry Stratigraphy Checked by:	DTM	3/28/03
Input Parameters Checked by:	DTM	3/28/03
Input Parameter Implementation Checked by:	DTM	3/28/03
Reasonableness of Analysis Checked by:	RAG	3/29/03
Analysis Backchecked by:	SMW	3/31/03

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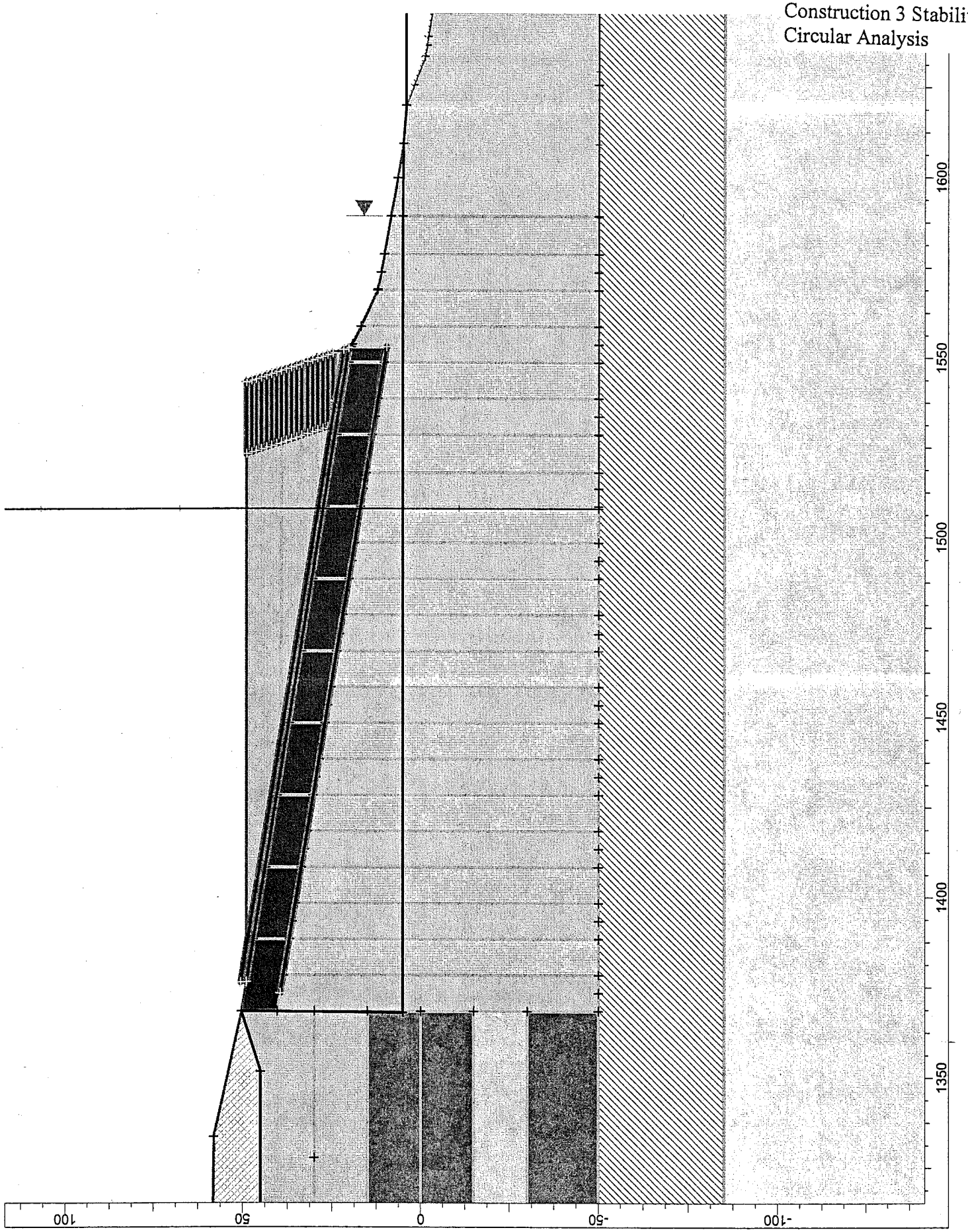
Section E-E
Construction 3 Stability
Circular Analysis



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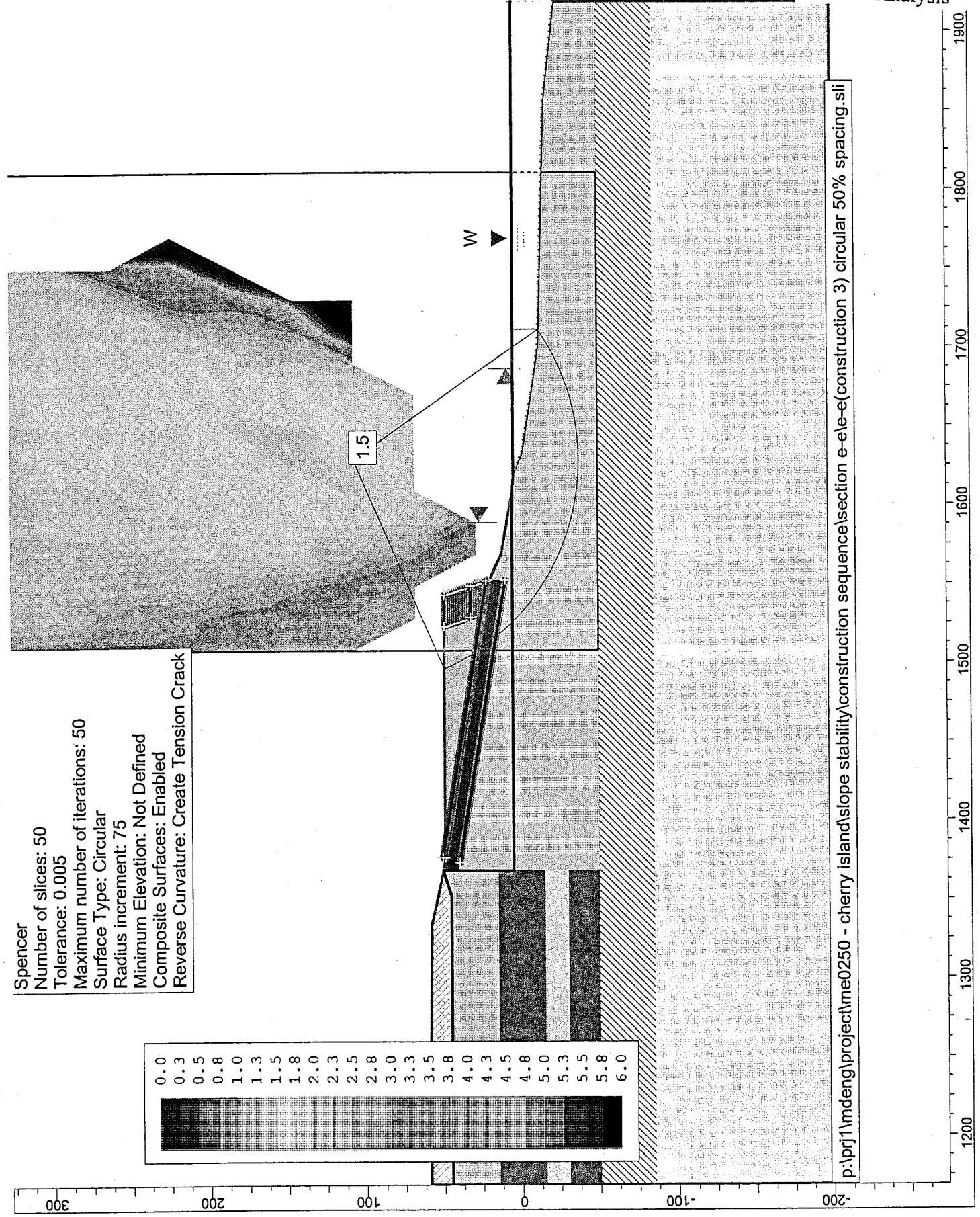
Section E-E
Construction 3 Stability
Circular Analysis



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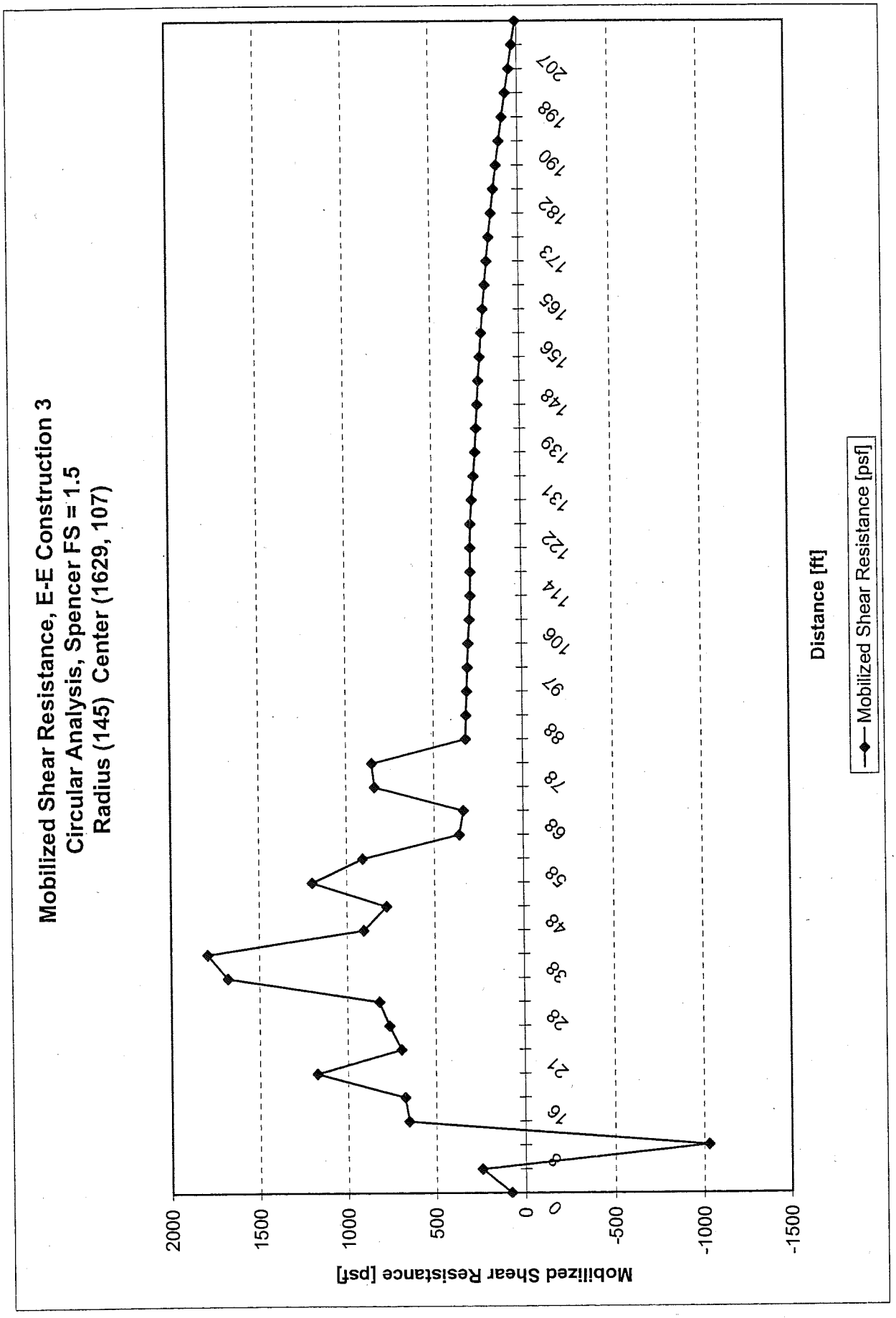
Section E-E
Construction 3 Stability
Circular Analysis



PRJ1/ME0250/SlopeStability/ConstructionSequence/Mobilized Shear Strength E Const

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Slide Analysis Information

Document Name

File Name: e-e(construction 3) circular 50% spacing

Project Settings

Project Title: SLIDE - An Interactive Slope Stability Program
Failure Direction: Left to Right
Units of Measurement: Imperial Units
Pore Fluid Unit Weight: 62.4 lb/ft3
Groundwater Method: Water Surfaces
Data Output: Standard

Analysis Methods

Analysis Methods used:
Spencer

Number of slices: 50
Tolerance: 0.005
Maximum number of iterations: 50

Surface Options

Surface Type: Circular
Radius Increment: 75
Minimum Elevation: Not Defined
Composite Surfaces: Enabled
Reverse Curvature: Create Tension Crack

Loading

Seismic Load Coefficient (Horizontal): 0
Seismic Load Coefficient (Vertical): 0

Material Properties

Material: Potomac Formation
Strength Type: Undrained
Unit Weight: 120 lb/ft3
Cohesion Type: Function of Depth
Cohesion (Top): 4500 psf
Cohesion Change: 14.4 psf/ft
Cutoff: 10000 psf
Water Surface: None

Material: Waste (0 to 20)
Strength Type: Mohr-Coulomb
Unit Weight: 60 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Undrained PVD Area
Strength Type: Strength=F(overburden)
Unit Weight: 85 lb/ft3
Tau/Sigma Ratio: 0.29
Water Surface: Water Table
Custom Hu value: 1

Material: d11
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 200 psf
Water Surface: None

Material: d12
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 400 psf
Water Surface: None

Material: d13
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 600 psf
Water Surface: None

Material: d14
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 800 psf
Water Surface: None

Material: River Sediments
Strength Type: Strength=F(overburden)
Unit Weight: 85 lb/ft3
Tau/Sigma Ratio: 0.29
Water Surface: Water Table
Custom Hu value: 1

Section E-E
Construction 3 Stability
Circular Analysis

ECT.17

Material: Columbia Formation
Strength Type: Mohr-Coulomb
Unit Weight: 125 lb/ft3
Cohesion: 0 psf
Friction Angle: 40 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: MSE Wall Soil
Strength Type: Mohr-Coulomb
Unit Weight: 90 lb/ft3
Cohesion: 0 psf
Friction Angle: 29 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Drained PVD Area
Strength Type: Shear Normal function
Unit Weight: 85 lb/ft3
Water Surface: Water Table
Custom Hu value: 1

Material: Strucural Fill
Strength Type: Mohr-Coulomb
Unit Weight: 110 lb/ft3
Cohesion: 0 psf
Friction Angle: 35 degrees
Water Surface: Water Table
Custom Hu value: 1

Support Properties

Support: Geogrid
Support Type: GeoTextile
Force Application: Passive
Force Orientation: Bisector of Parallel and Tangent
Anchorage: Slope Face
Shear Strength Model: Linear
Strip Coverage: 100 percent
Tensile Strength: 5000 lb/ft
Pullout Strength Adhesion: 0 lb/ft2
Pullout Strength Friction Angle: 25 degrees

Support: Geogrid2
Support Type: GeoTextile
Force Application: Passive
Force Orientation: Bisector of Parallel and Tangent
Anchorage: Slope Face
Shear Strength Model: Linear
Strip Coverage: 100 percent
Tensile Strength: 21000 lb/ft
Pullout Strength Adhesion: 0 lb/ft2
Pullout Strength Friction Angle: 25 degrees

Global Minimums

Method: spencer
SF: 1.4654
Center: 1628.75, 106.684
Radius: 144.687
Left Slip Surface Endpoint: 1496.09, 48.9419
Right Slip Surface Endpoint: 1711.33, -12.1226
Left Slope Intercept: 1496.09 48.9419
Right Slope Intercept: 1711.33 4

Method Statistics

Method: spencer
Number of Valid Surfaces: 10683
Number of Invalid Surfaces: 8773
Error Codes:
Error Code -101 reported for 113 surfaces
Error Code -103 reported for 44 surfaces
Error Code -108 reported for 234 surfaces
Error Code -111 reported for 2318 surfaces
Error Code -112 reported for 2428 surfaces
Error Code -113 reported for 1052 surfaces
Error Code -1000 reported for 2584 surfaces

Error Codes

The following errors were encountered during the computation:

-101 = Only one (or zero) surface / slope intersections.

-103 = Two surface / slope intersections, but one or more surface / nonslope external polygon intersections lie between them. This usually occurs when the slip surface extends past the bottom of the soil region, but may also occur on a benched slope model with two sets of Slope Limits.

-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).

-111 = safety factor equation did not converge

-112 = The coefficient M-Alpha = cos(alpha)(1+tan(alpha)tan(phi)/F) < 0.2 for the final iteration of the safety factor calculation. This screens out some slip surfaces which may not be valid in the context of the analysis, in particular, deep seated slip surfaces with many high negative base

angle slices in the passive zone.

-113 = Surface intersects outside slope limits.

-1000 = No valid slip surfaces are generated at a grid center. Unable to draw a surface.

Section E-E
Construction 3 Stability
Circular Analysis

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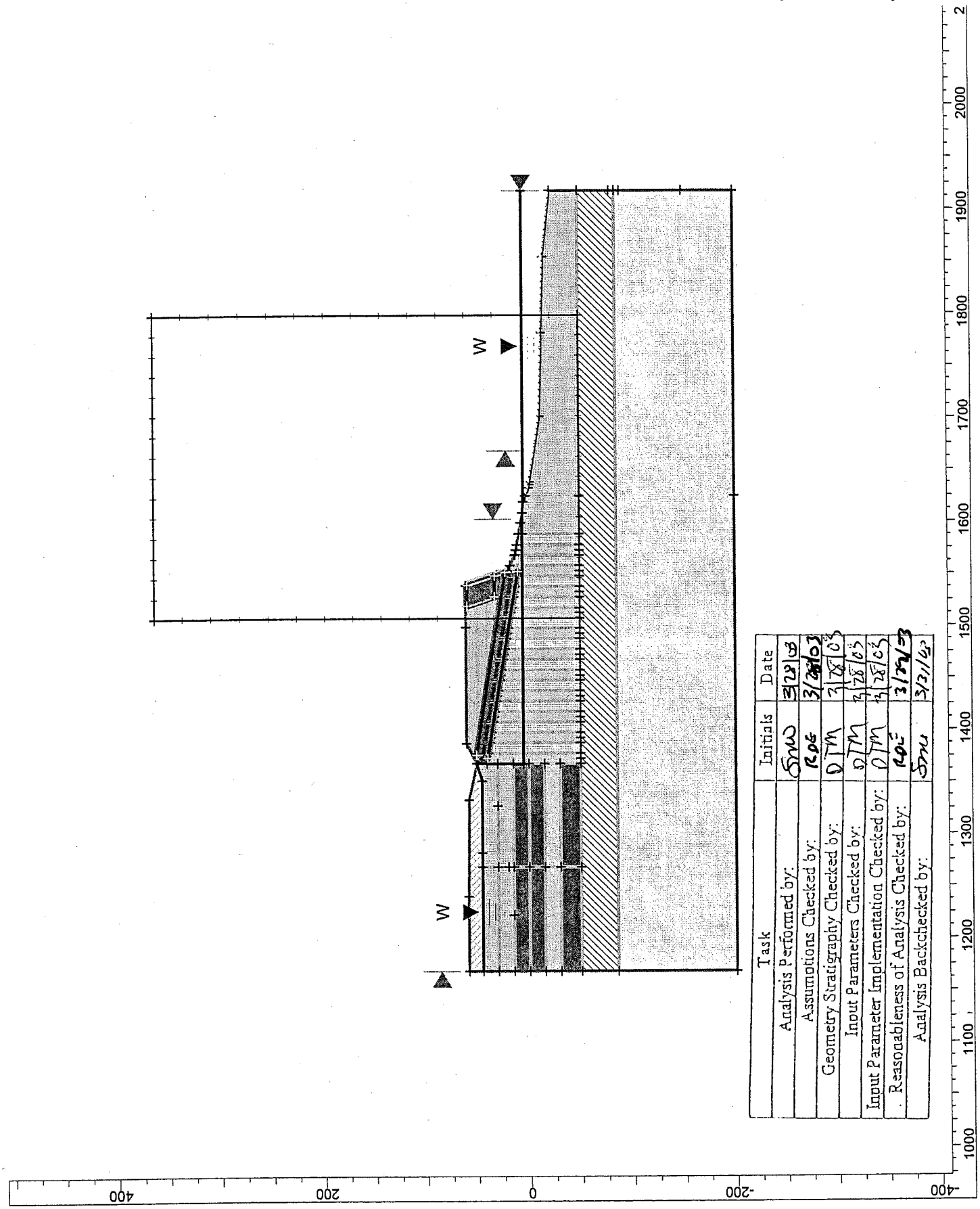
Section E-E
Construction 4 Stability
Circular Analysis



Task	Initials	Date
Analysis Performed by:	SMW	3/28/03
Assumptions Checked by:	RDE	3/28/03
Geometry Stratigraphy Checked by:	DTM	3/28/03
Input Parameters Checked by:	DTM	3/28/03
Input Parameter Implementation Checked by:	DTM	3/28/03
Reasonableness of Analysis Checked by:	RDE	3/28/03
Analysis Backchecked by:	SMW	3/31/03

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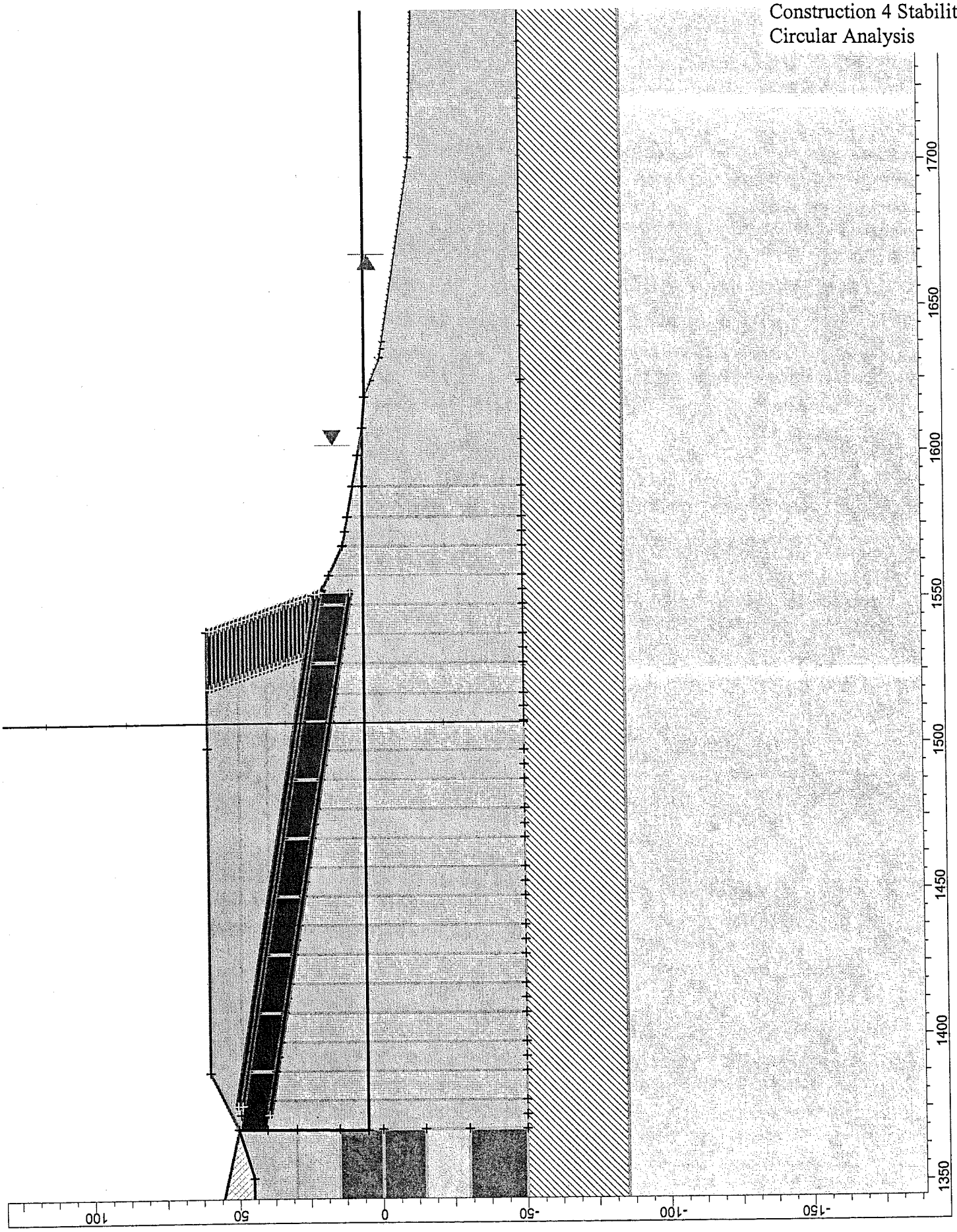
Section E-E
Construction 4 Stability
Circular Analysis



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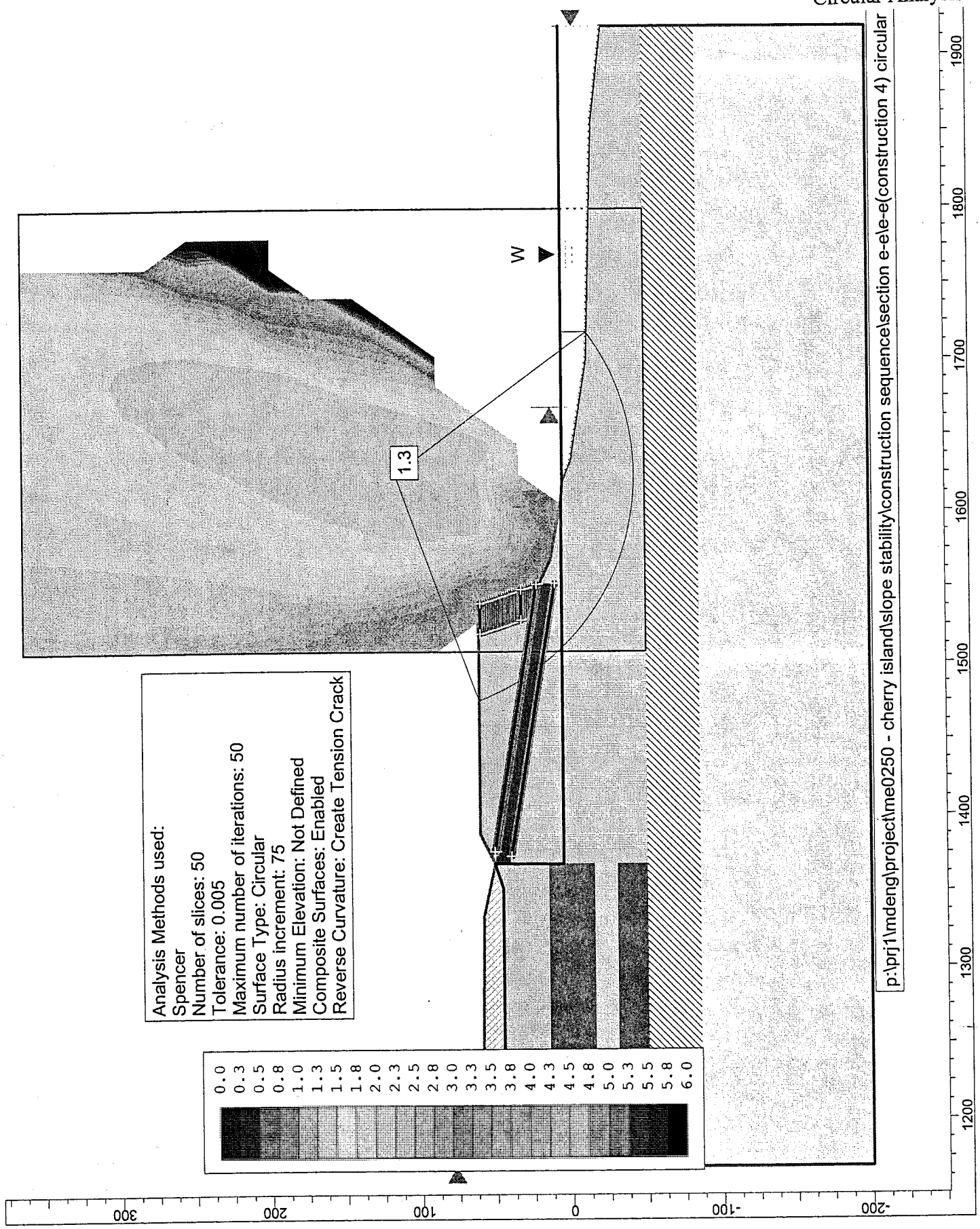
Section E-E
Construction 4 Stability
Circular Analysis



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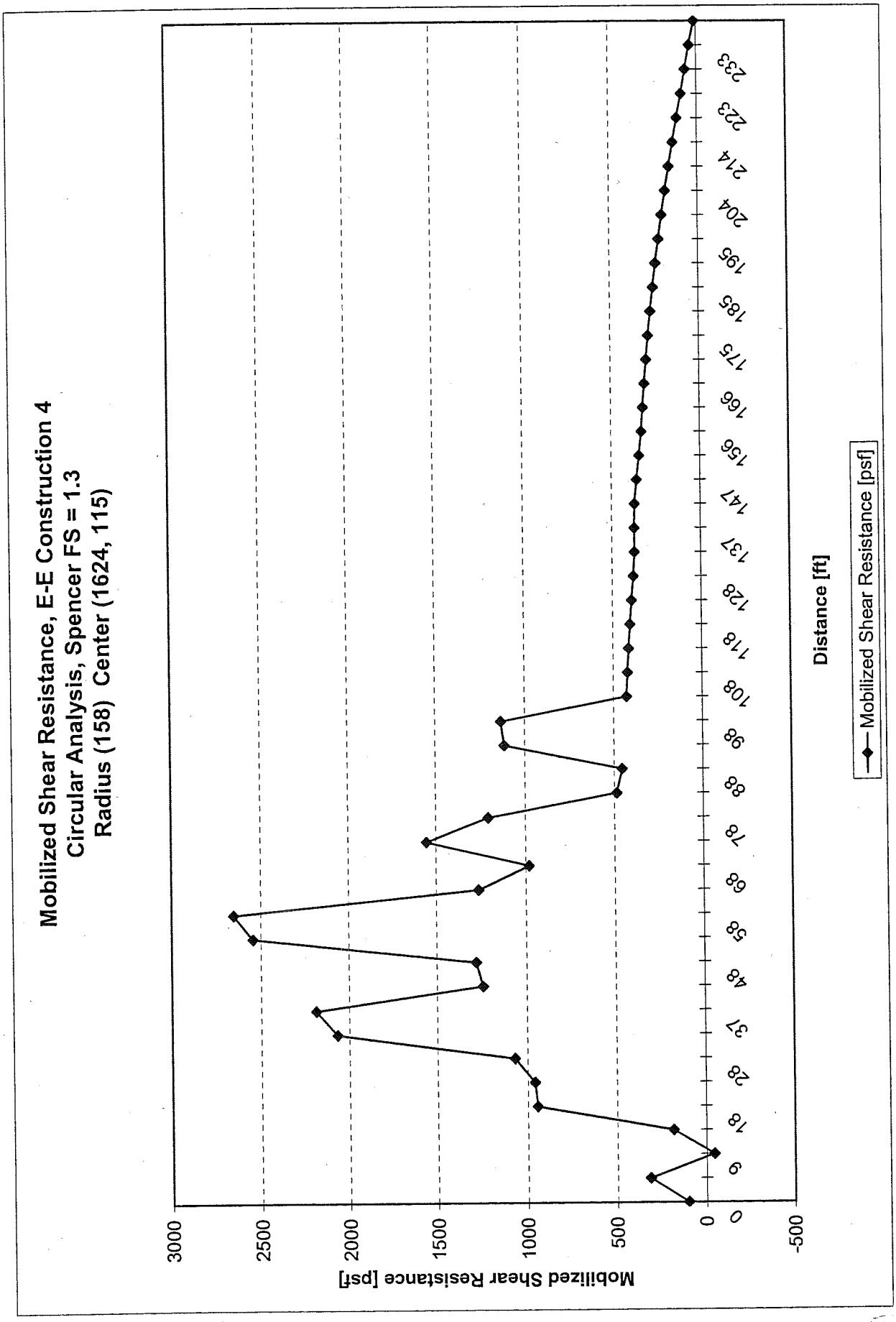
Section E-E
Construction 4 Stability
Circular Analysis



PRJ1/ME0250/SlopeStability/ConstructionSequence/Mobilized Shear Strength E Const

ECI-22

Slide Analysis Information

Document Name

File Name: e-e(construction 4) circular 50% spacing

Project Settings

Project Title: SLIDE - An Interactive Slope Stability Program
Failure Direction: Left to Right
Units of Measurement: Imperial Units
Pore Fluid Unit Weight: 62.4 lb/ft3
Groundwater Method: Water Surfaces
Data Output: Standard

Analysis Methods

Analysis Methods used:
Spencer

Number of slices: 50
Tolerance: 0.005
Maximum number of iterations: 50

Surface Options

Surface Type: Circular
Radius increment: 75
Minimum Elevation: Not Defined
Composite Surfaces: Enabled
Reverse Curvature: Create Tension Crack

Loading

Seismic Load Coefficient (Horizontal): 0
Seismic Load Coefficient (Vertical): 0

Material Properties

Material: Potomac Formation
Strength Type: Undrained
Unit Weight: 120 lb/ft3
Cohesion Type: Function of Depth
Cohesion (Top): 4500 psf
Cohesion Change: 14.4 psf/ft
Cutoff: 10000 psf
Water Surface: None

Material: Waste (0 to 20)
Strength Type: Mohr-Coulomb
Unit Weight: 60 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Undrained PVD Area
Strength Type: Strength=F(overburden)
Unit Weight: 85 lb/ft3
Tau/Sigma Ratio: 0.29
Water Surface: Water Table
Custom Hu value: 1

Material: d11
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 200 psf
Water Surface: None

Material: d12
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 400 psf
Water Surface: None

Material: d13
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 600 psf
Water Surface: None

Material: d14
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 800 psf
Water Surface: None

Material: River Sediments
Strength Type: Strength=F(overburden)
Unit Weight: 85 lb/ft3
Tau/Sigma Ratio: 0.29
Water Surface: Water Table
Custom Hu value: 1

Section E-E
Construction 4 Stability
Circular Analysis

EC1.25

Material: Columbia Formation
Strength Type: Mohr-Coulomb
Unit Weight: 125 lb/ft3
Cohesion: 0 psf
Friction Angle: 40 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: MSE Wall Soil
Strength Type: Mohr-Coulomb
Unit Weight: 90 lb/ft3
Cohesion: 0 psf
Friction Angle: 29 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Drained PVD Area
Strength Type: Shear Normal function
Unit Weight: 85 lb/ft3
Water Surface: Water Table
Custom Hu value: 1

Material: Strucural Fill
Strength Type: Mohr-Coulomb
Unit Weight: 110 lb/ft3
Cohesion: 0 psf
Friction Angle: 35 degrees
Water Surface: Water Table
Custom Hu value: 1

Support Properties

Support: Geogrid
Support Type: GeoTextile
Force Application: Passive
Force Orientation: Bisector of Parallel and Tangent
Anchorage: Slope Face
Shear Strength Model: Linear
Strip Coverage: 100 percent
Tensile Strength: 5000 lb/ft
Pullout Strength Adhesion: 0 lb/ft2
Pullout Strength Friction Angle: 25 degrees

Support: Geogrid2
Support Type: GeoTextile
Force Application: Passive
Force Orientation: Bisector of Parallel and Tangent
Anchorage: Slope Face
Shear Strength Model: Linear
Strip Coverage: 100 percent
Tensile Strength: 21000 lb/ft
Pullout Strength Adhesion: 0 lb/ft2
Pullout Strength Friction Angle: 25 degrees

Global Minimums

Method: spencer
SF: 1.26443
Center: 1624.11, 115.331
Radius: 158.402
Left Slip Surface Endpoint: 1475.68, 60
Right Slip Surface Endpoint: 1717.94, -12.2891
Left Slope Intercept: 1475.68 60
Right Slope Intercept: 1717.94 4

Method Statistics

Method: spencer
Number of Valid Surfaces: 9942
Number of Invalid Surfaces: 9514
Error Codes:
Error Code -101 reported for 118 surfaces
Error Code -103 reported for 49 surfaces
Error Code -108 reported for 429 surfaces
Error Code -111 reported for 2315 surfaces
Error Code -112 reported for 3431 surfaces
Error Code -113 reported for 1120 surfaces
Error Code -1000 reported for 2052 surfaces

Error Codes

The following errors were encountered during the computation:

-101 = Only one (or zero) surface / slope intersections.

-103 = Two surface / slope intersections, but one or more surface / nonslope external polygon Intersections lie between them. This usually occurs when the slip surface extends past the bottom of the soil region, but may also occur on a benched slope model with two sets of Slope Limits.

-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).

-111 = safety factor equation did not converge

-112 = The coefficient M-Alpha = cos(alpha)(1+tan(alpha)tan(phi)/F) < 0.2 for the final iteration of the safety factor calculation. This screens out some slip surfaces which may not be valid in the context of the analysis, in particular, deep seated slip surfaces with many high negative base

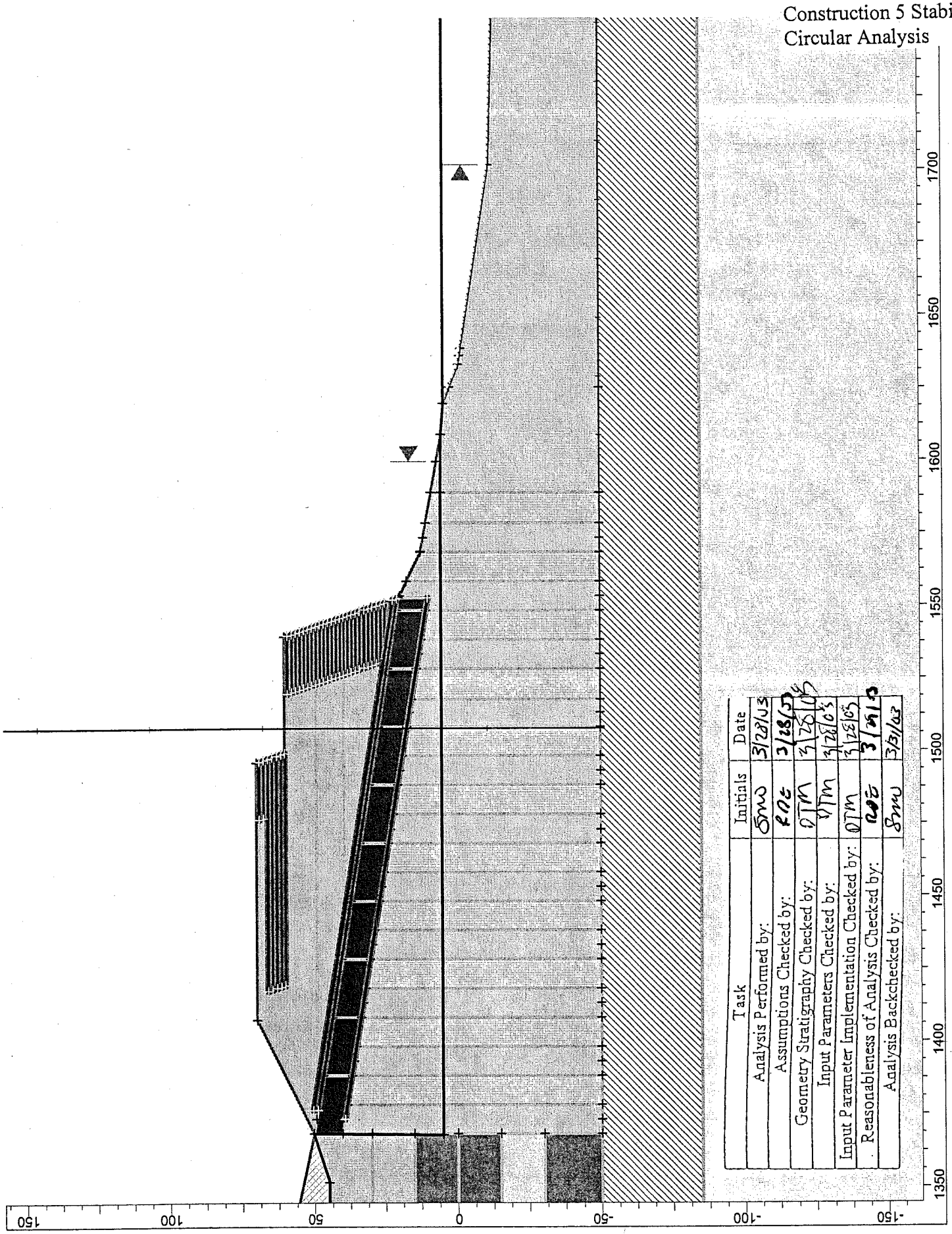
Section E-E
Construction 4 Stability
Circular Analysis

angle slices in the passive zone.

-113 = Surface intersects outside slope limits.

-1000 = No valid slip surfaces are generated at a grid center. Unable to draw a surface.

Section E-E
Construction 5 Stability
Circular Analysis



Task	Initials	Date
Analysis Performed by:	SMW	3/28/03
Assumptions Checked by:	RAE	3/28/03
Geometry Stratigraphy Checked by:	DTM	3/28/03
Input Parameters Checked by:	DTM	3/28/03
Input Parameter Implementation Checked by:	DTM	3/28/03
Reasonableness of Analysis Checked by:	RAE	3/28/03
Analysis Backchecked by:	SMW	3/31/03

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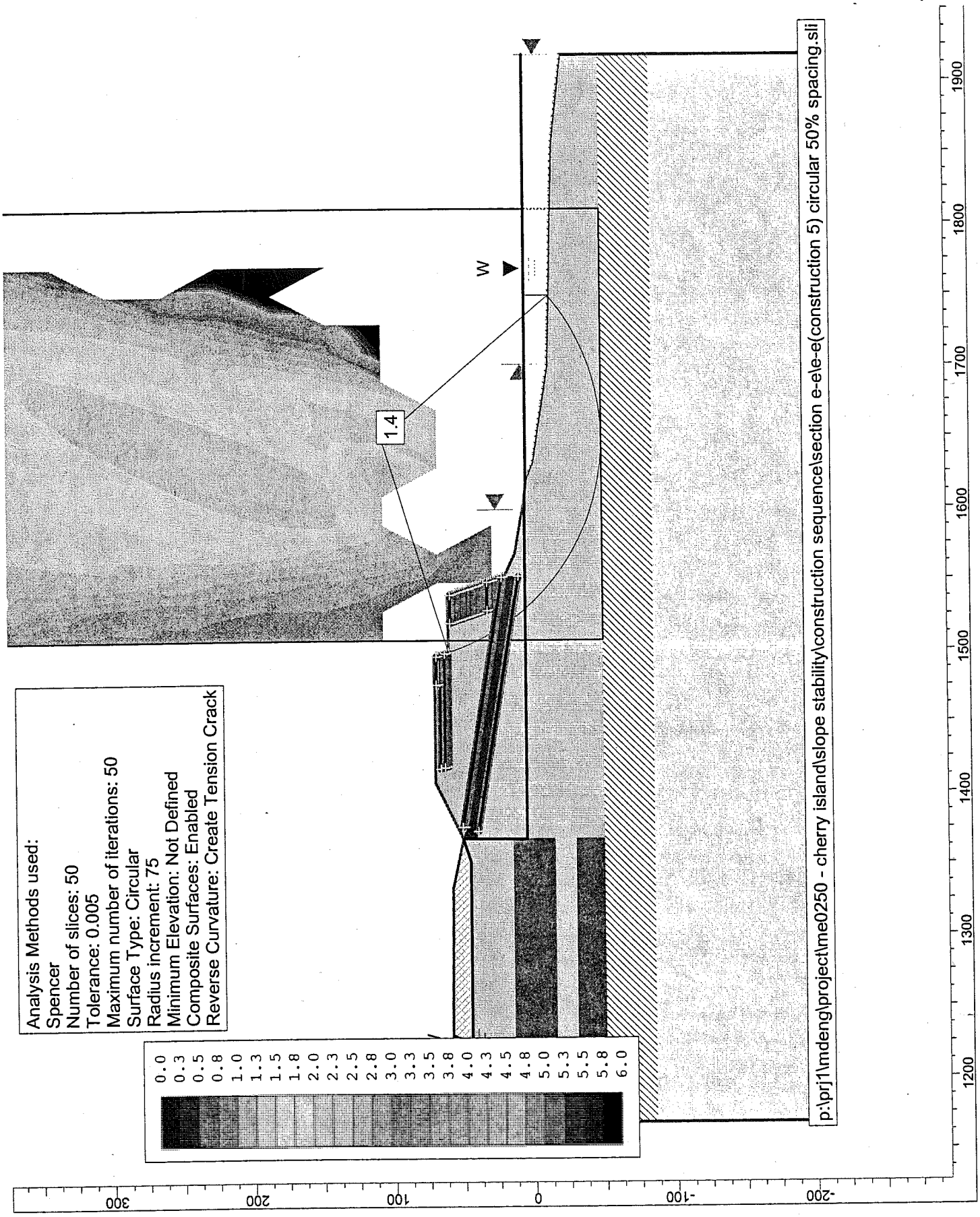
Section E-E
Construction 5 Stability
Circular Analysis



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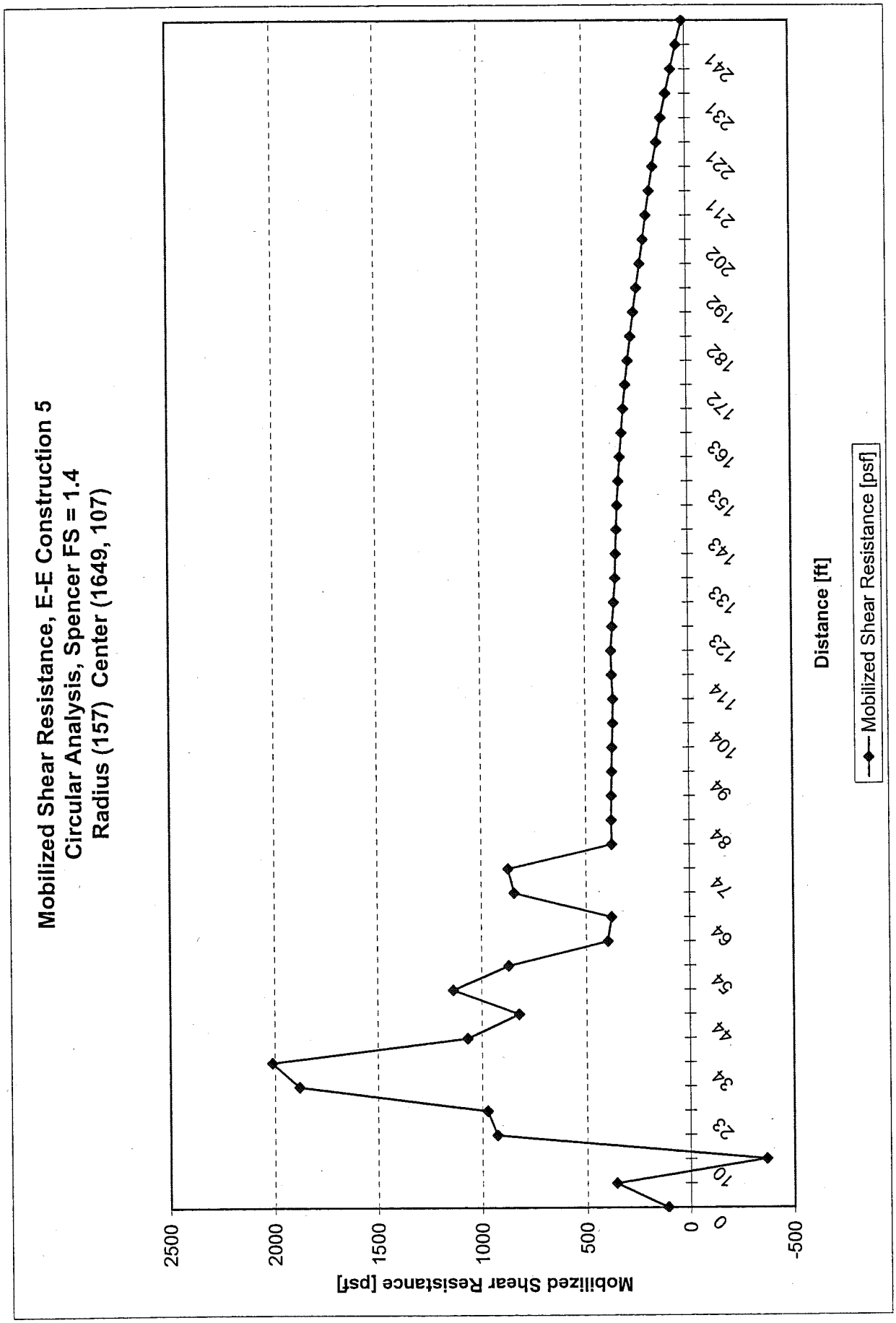
Section E-E
Construction 5 Stability
Circular Analysis



PRJ1/ME0250/SlopeStability/ConstructionSequence/Mobilized Shear Strength E Const

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Slide Analysis Information

Document Name

File Name: e-e(construction 5) circular 50% spacing

Project Settings

Project Title: SLIDE - An Interactive Slope Stability Program
Failure Direction: Left to Right
Units of Measurement: Imperial Units
Pore Fluid Unit Weight: 62.4 lb/ft3
Groundwater Method: Water Surfaces
Data Output: Standard

Analysis Methods

Analysis Methods used:
Spencer

Number of slices: 50
Tolerance: 0.005
Maximum number of iterations: 50

Surface Options

Surface Type: Circular
Radius increment: 75
Minimum Elevation: Not Defined
Composite Surfaces: Enabled
Reverse Curvature: Create Tension Crack

Loading

Seismic Load Coefficient (Horizontal): 0
Seismic Load Coefficient (Vertical): 0

Material Properties

Material: Potomac Formation
Strength Type: Undrained
Unit Weight: 120 lb/ft3
Cohesion Type: Function of Depth
Cohesion (Top): 4500 psf
Cohesion Change: 14.4 psf/ft
Cutoff: 10000 psf
Water Surface: None

Material: Waste (0 to 20)
Strength Type: Mohr-Coulomb
Unit Weight: 60 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Undrained PVD Area
Strength Type: Strength=F(overburden)
Unit Weight: 85 lb/ft3
Tau/Sigma Ratio: 0.29
Water Surface: Water Table
Custom Hu value: 1

Material: d11
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 200 psf
Water Surface: None

Material: d12
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 400 psf
Water Surface: None

Material: d13
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 600 psf
Water Surface: None

Material: d14
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 800 psf
Water Surface: None

Material: River Sediments
Strength Type: Strength=F(overburden)
Unit Weight: 85 lb/ft3
Tau/Sigma Ratio: 0.29
Water Surface: Water Table
Custom Hu value: 1

Section E-E
Construction 5 Stability
Circular Analysis

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Material: Columbia Formation
Strength Type: Mohr-Coulomb
Unit Weight: 125 lb/ft3
Cohesion: 0 psf
Friction Angle: 40 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: MSE Wall Soil
Strength Type: Mohr-Coulomb
Unit Weight: 90 lb/ft3
Cohesion: 0 psf
Friction Angle: 29 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Drained PVD Area
Strength Type: Shear Normal function
Unit Weight: 85 lb/ft3
Water Surface: Water Table
Custom Hu value: 1

Material: Strucural Fill
Strength Type: Mohr-Coulomb
Unit Weight: 110 lb/ft3
Cohesion: 0 psf
Friction Angle: 35 degrees
Water Surface: Water Table
Custom Hu value: 1

Support Properties

Support: Geogrid
Support Type: GeoTextile
Force Application: Passive
Force Orientation: Bisector of Parallel and Tangent
Anchorage: Slope Face
Shear Strength Model: Linear
Strip Coverage: 100 percent
Tensile Strength: 5000 lb/ft
Pullout Strength Adhesion: 0 lb/ft2
Pullout Strength Friction Angle: 25 degrees

Support: Geogrid2
Support Type: GeoTextile
Force Application: Passive
Force Orientation: Bisector of Parallel and Tangent
Anchorage: Slope Face
Shear Strength Model: Linear
Strip Coverage: 100 percent
Tensile Strength: 21000 lb/ft
Pullout Strength Adhesion: 0 lb/ft2
Pullout Strength Friction Angle: 25 degrees

Global Minimums

Method: spencer
SF: 1.37518
Center: 1648.92, 106.684
Radius: 156.663
Left Slip Surface Endpoint: 1499.38, 60
Right Slip Surface Endpoint: 1749.9, -13.0941
Left Slope Intercept: 1499.38 60
Right Slope Intercept: 1749.9 4

Method Statistics

Method: spencer
Number of Valid Surfaces: 10558
Number of Invalid Surfaces: 8898
Error Codes:
Error Code -101 reported for 148 surfaces
Error Code -103 reported for 60 surfaces
Error Code -108 reported for 234 surfaces
Error Code -109 reported for 1 surface
Error Code -111 reported for 2090 surfaces
Error Code -112 reported for 2705 surfaces
Error Code -113 reported for 1304 surfaces
Error Code -1000 reported for 2356 surfaces

Error Codes

The following errors were encountered during the computation:

-101 = Only one (or zero) surface / slope intersections.

-103 = Two surface / slope intersections, but one or more surface / nonslope external polygon intersections lie between them. This usually occurs when the slip surface extends past the bottom of the soil region, but may also occur on a benched slope model with two sets of Slope Limits.

-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).

-109 = Soiltype for slice base not located. This error should occur very rarely, if at all. It may occur if a very low number of slices is combined with certain soil geometries, such that the midpoint of a slice base is actually outside the soil region,even though the slip surface is wholly within the soil region.

-111 = safety factor equation did not converge

-112 = The coefficient M-Alpha = cos(alpha)(1+tan(alpha)tan(phi)/F) < 0.2 for the final iteration of the safety factor calculation. This screens out some slip surfaces which may not be valid in the context of the analysis, in particular, deep seated slip surfaces with many high negative base angle slices in the passive zone.

-113 = Surface intersects outside slope limits.

-1000 = No valid slip surfaces are generated at a grid center. Unable to draw a surface.

Section E-E
Construction 5 Stability
Circular Analysis

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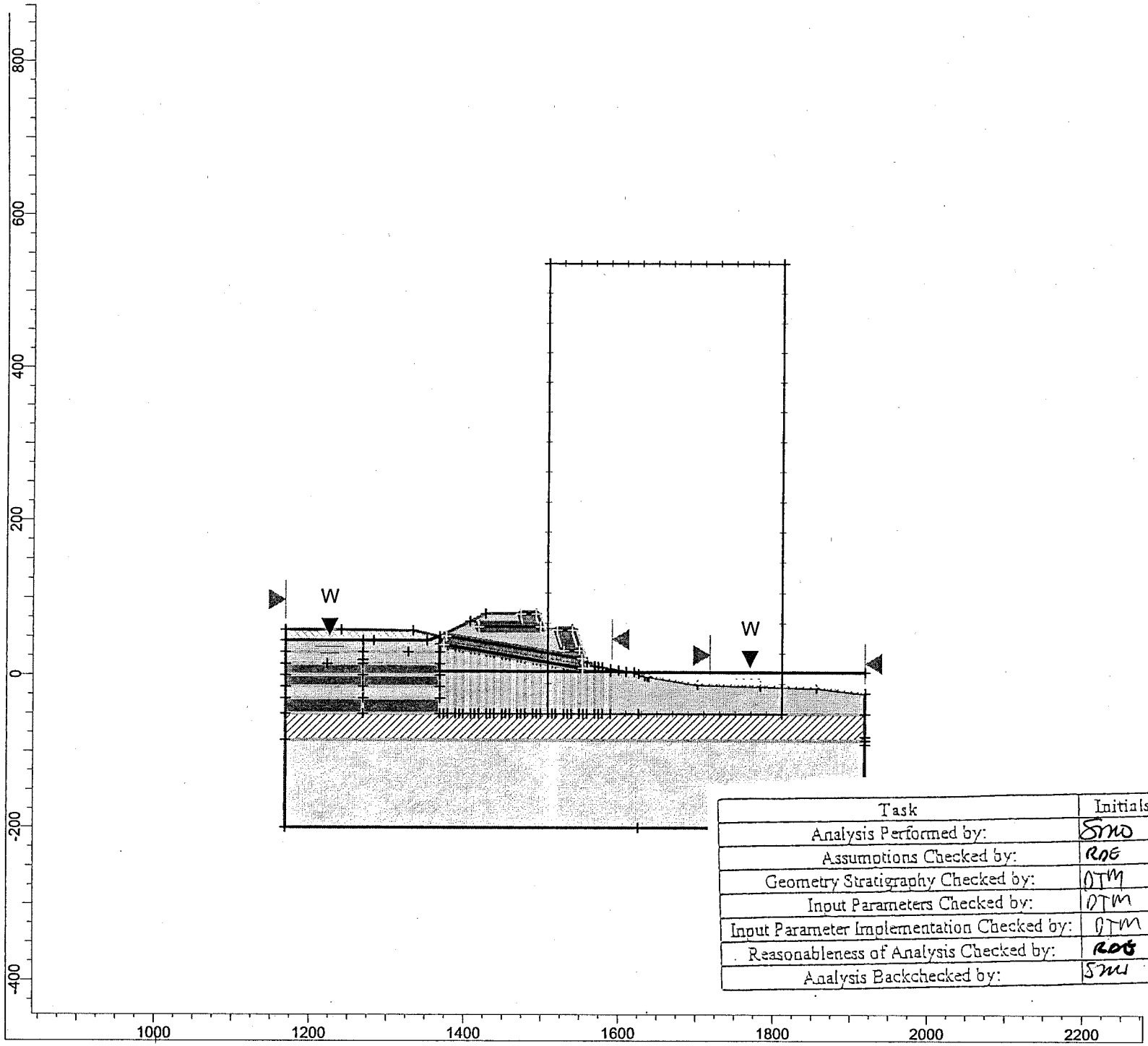
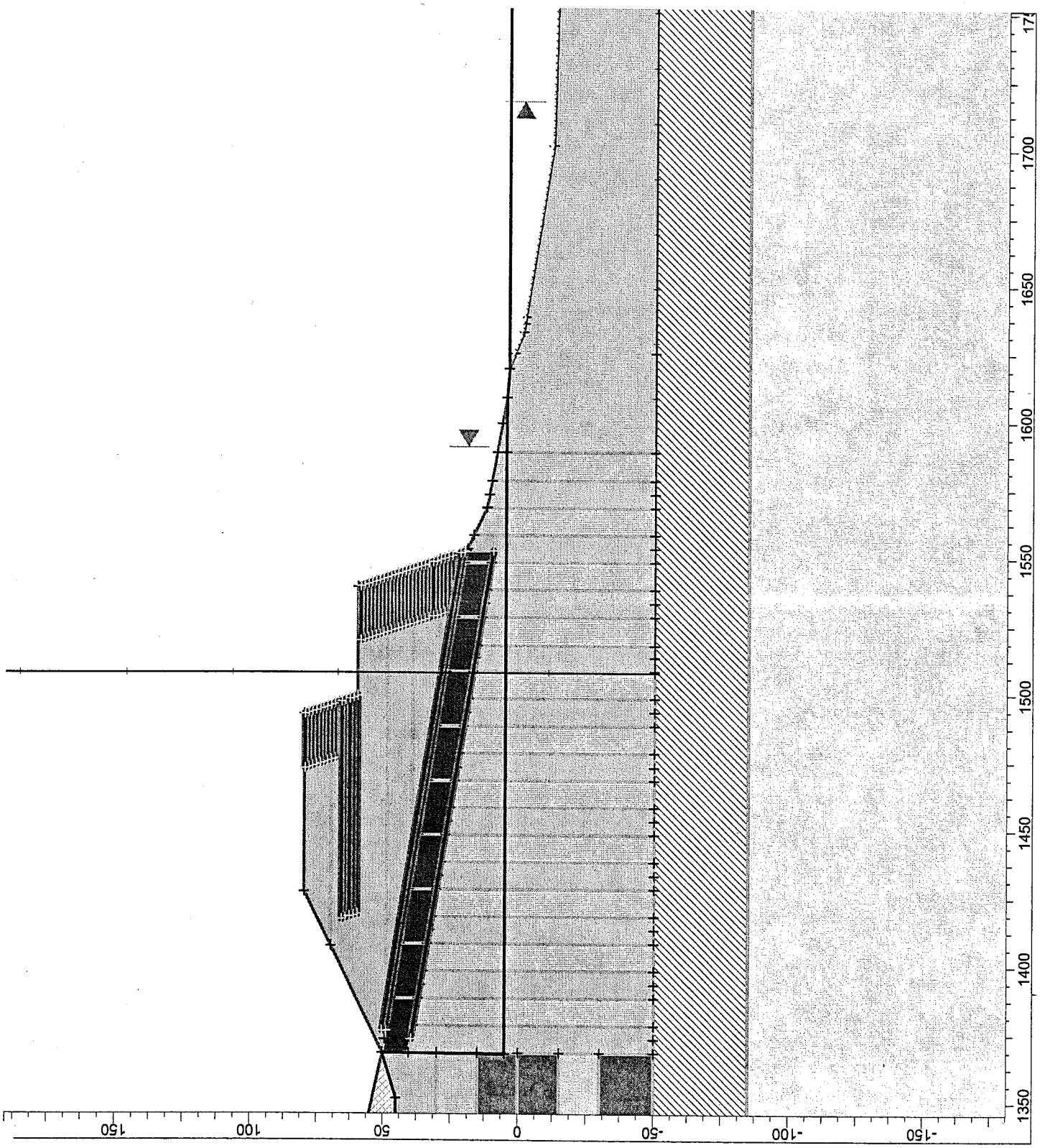
Section E-E
Construction 6 Stability
Circular Analysis



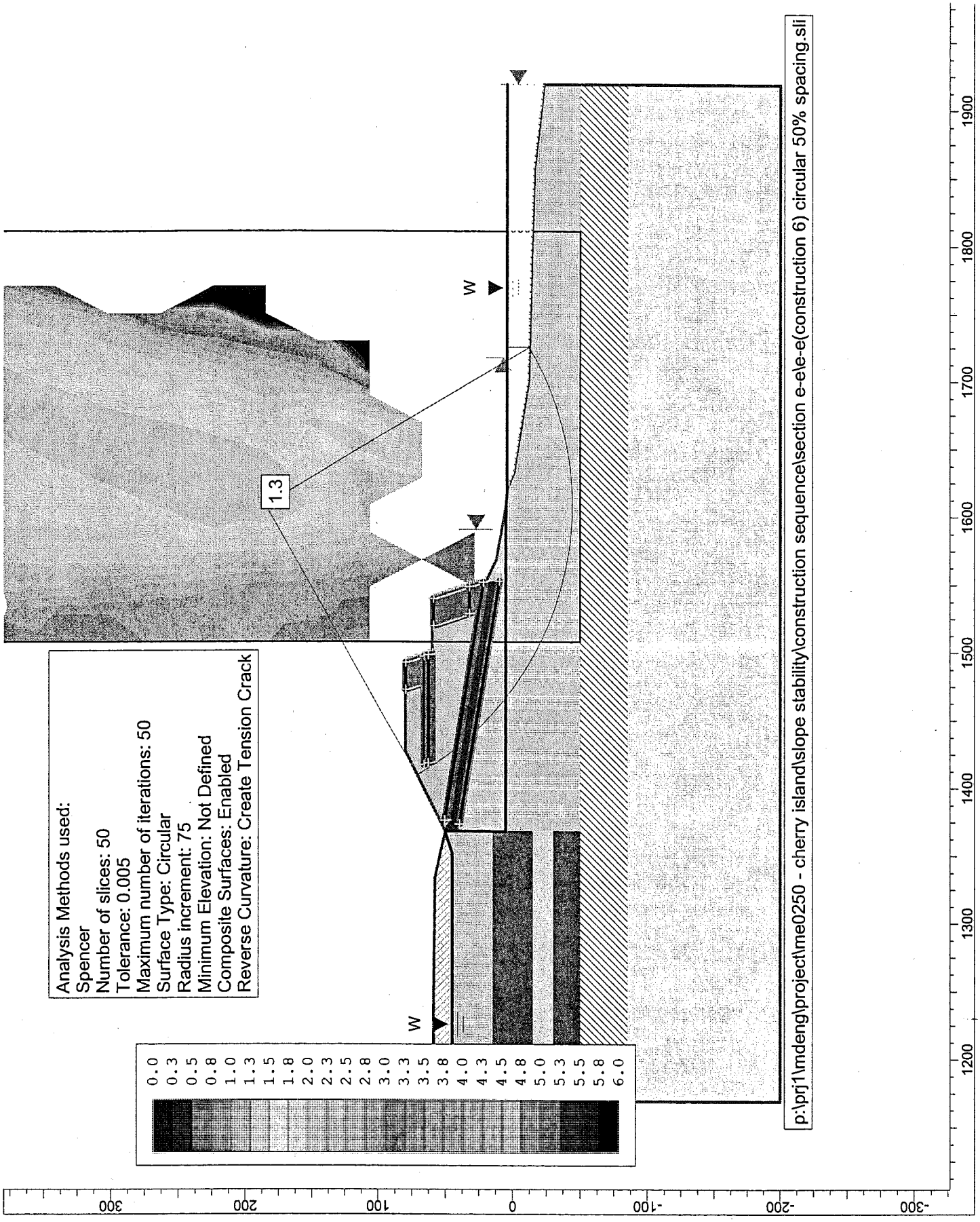
Task	Initials	Date
Analysis Performed by:	SMO	3/28/03
Assumptions Checked by:	RDE	3/28/03
Geometry Stratigraphy Checked by:	DTM	3/28/03
Input Parameters Checked by:	DTM	3/28/03
Input Parameter Implementation Checked by:	DTM	3/28/03
Reasonableness of Analysis Checked by:	RDE	3/27/03
Analysis Backchecked by:	SMO	3/31/03

Section E-E
Construction 6 Stability
Circular Analysis



ECT-31

Section E-E
Construction 6 Stability
Circular Analysis



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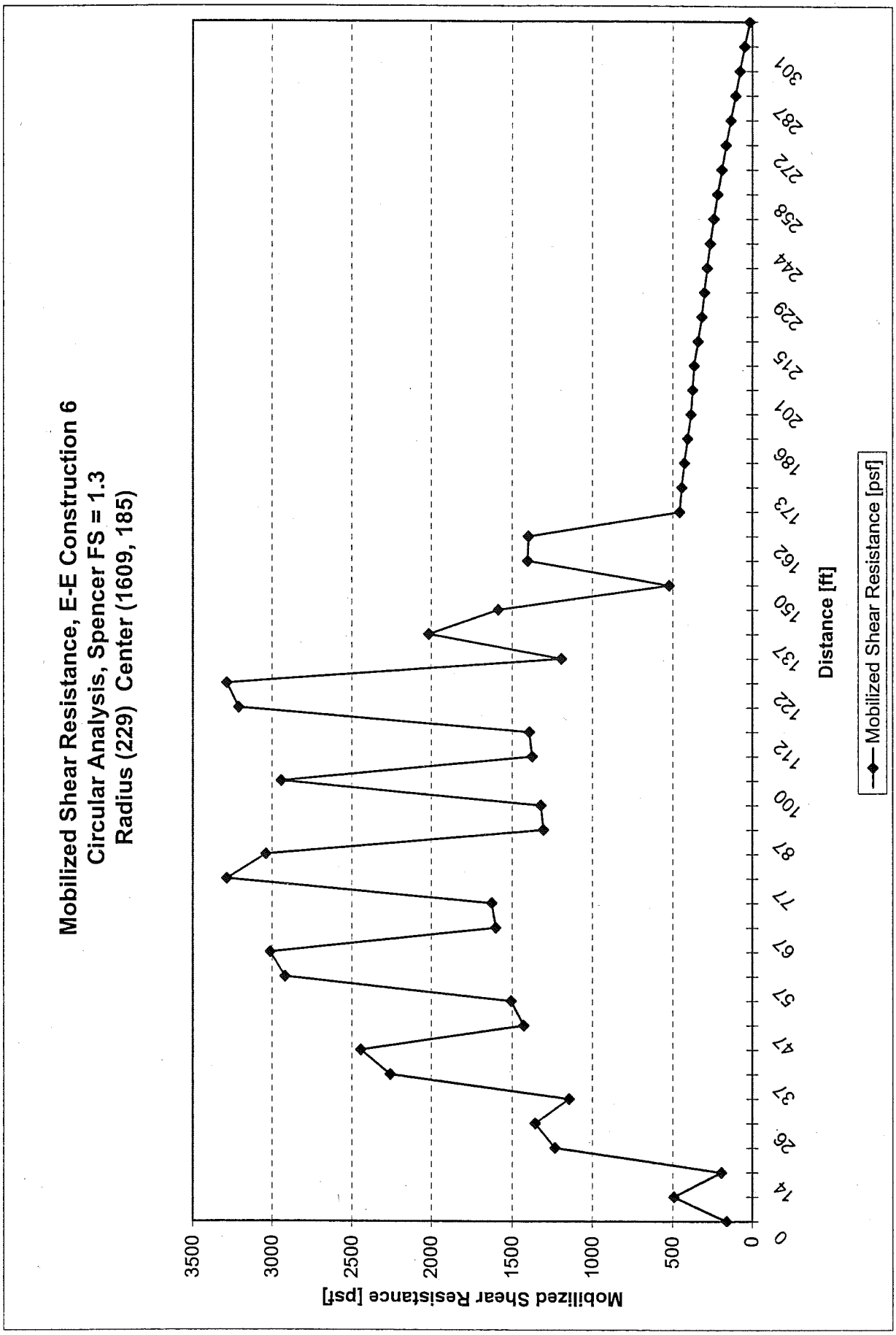
Section E-E
Construction 6 Stability
Circular Analysis



PRJ1/ME0250/SlopeStability/Mobilized Shear Strength E Const

ECT-33

Slide Analysis Information

Document Name

File Name: e-e(construction 6) circular 50% spacing

Project Settings

Project Title: SLIDE - An Interactive Slope Stability Program
Failure Direction: Left to Right
Units of Measurement: Imperial Units
Pore Fluid Unit Weight: 62.4 lb/ft3
Groundwater Method: Water Surfaces
Data Output: Standard

Analysis Methods

Analysis Methods used:
Spencer

Number of slices: 50
Tolerance: 0.005
Maximum number of iterations: 50

Surface Options

Surface Type: Circular
Radius increment: 75
Minimum Elevation: Not Defined
Composite Surfaces: Enabled
Reverse Curvature: Create Tension Crack

Loading

Seismic Load Coefficient (Horizontal): 0
Seismic Load Coefficient (Vertical): 0

Material Properties

Material: Potomac Formation
Strength Type: Undrained
Unit Weight: 120 lb/ft3
Cohesion Type: Function of Depth
Cohesion (Top): 4500 psf
Cohesion Change: 14.4 psf/ft
Cutoff: 10000 psf
Water Surface: None

Material: Waste (0 to 20)
Strength Type: Mohr-Coulomb
Unit Weight: 60 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Undrained PVD Area
Strength Type: Strength=F(overburden)
Unit Weight: 85 lb/ft3
Tau/Sigma Ratio: 0.29
Water Surface: Water Table
Custom Hu value: 1

Material: d11
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 200 psf
Water Surface: None

Material: d12
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 400 psf
Water Surface: None

Material: d13
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 600 psf
Water Surface: None

Material: d14
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 800 psf
Water Surface: None

Material: River Sediments
Strength Type: Strength=F(overburden)
Unit Weight: 85 lb/ft3
Tau/Sigma Ratio: 0.29
Water Surface: Water Table
Custom Hu value: 1

Section E-E
Construction 6 Stability
Circular Analysis

ECI-34

Material: Columbia Formation
Strength Type: Mohr-Coulomb
Unit Weight: 125 lb/ft3
Cohesion: 0 psf
Friction Angle: 40 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: MSE Wall Soil
Strength Type: Mohr-Coulomb
Unit Weight: 90 lb/ft3
Cohesion: 0 psf
Friction Angle: 29 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Drained PVD Area
Strength Type: Shear Normal function
Unit Weight: 85 lb/ft3
Water Surface: Water Table
Custom Hu value: 1

Material: Strucural Fill
Strength Type: Mohr-Coulomb
Unit Weight: 110 lb/ft3
Cohesion: 0 psf
Friction Angle: 35 degrees
Water Surface: Water Table
Custom Hu value: 1

Support Properties

Support: Geogrid
Support Type: GeoTextile
Force Application: Passive
Force Orientation: Bisector of Parallel and Tangent
Anchorage: Slope Face
Shear Strength Model: Linear
Strip Coverage: 100 percent
Tensile Strength: 5000 lb/ft
Pullout Strength Adhesion: 0 lb/ft2
Pullout Strength Friction Angle: 25 degrees

Support: Geogrid2
Support Type: GeoTextile
Force Application: Passive
Force Orientation: Bisector of Parallel and Tangent
Anchorage: Slope Face
Shear Strength Model: Linear
Strip Coverage: 100 percent
Tensile Strength: 21000 lb/ft
Pullout Strength Adhesion: 0 lb/ft2
Pullout Strength Friction Angle: 25 degrees

Global Minimums

Method: spencer
SF: 1.3043
Center: 1608.58, 185.026
Radius: 229.2
Left Slip Surface Endpoint: 1409.74, 71.021
Right Slip Surface Endpoint: 1724.9, -12.4643
Left Slope Intercept: 1409.74 71.021
Right Slope Intercept: 1724.9 4

Method Statistics

Method: spencer
Number of Valid Surfaces: 10573
Number of Invalid Surfaces: 8883
Error Codes:
Error Code -101 reported for 111 surfaces
Error Code -103 reported for 23 surfaces
Error Code -105 reported for 1 surface
Error Code -108 reported for 231 surfaces
Error Code -111 reported for 1903 surfaces
Error Code -112 reported for 2725 surfaces
Error Code -113 reported for 1305 surfaces
Error Code -1000 reported for 2584 surfaces

Error Codes

The following errors were encountered during the computation:

-101 = Only one (or zero) surface / slope intersections.

-103 = Two surface / slope intersections, but one or more surface / nonslope external polygon intersections lie between them. This usually occurs when the slip surface extends past the bottom of the soil region, but may also occur on a benched slope model with two sets of Slope Limits.

-105 = More than two surface / slope intersections with no valid slip surface.

-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).

-111 = safety factor equation did not converge

-112 = The coefficient M-Alpha = cos(alpha)(1+tan(alpha)tan(phi)/F) < 0.2 for the final iteration of the safety factor calculation. This screens out some slip surfaces which may not be valid in the context of the analysis, in particular, deep seated slip surfaces with many high negative base angle slices in the passive zone.

-113 = Surface intersects outside slope limits.

-1000 = No valid slip surfaces are generated at a grid center. Unable to draw a surface.

Section E-E
Construction 6 Stability
Circular Analysis

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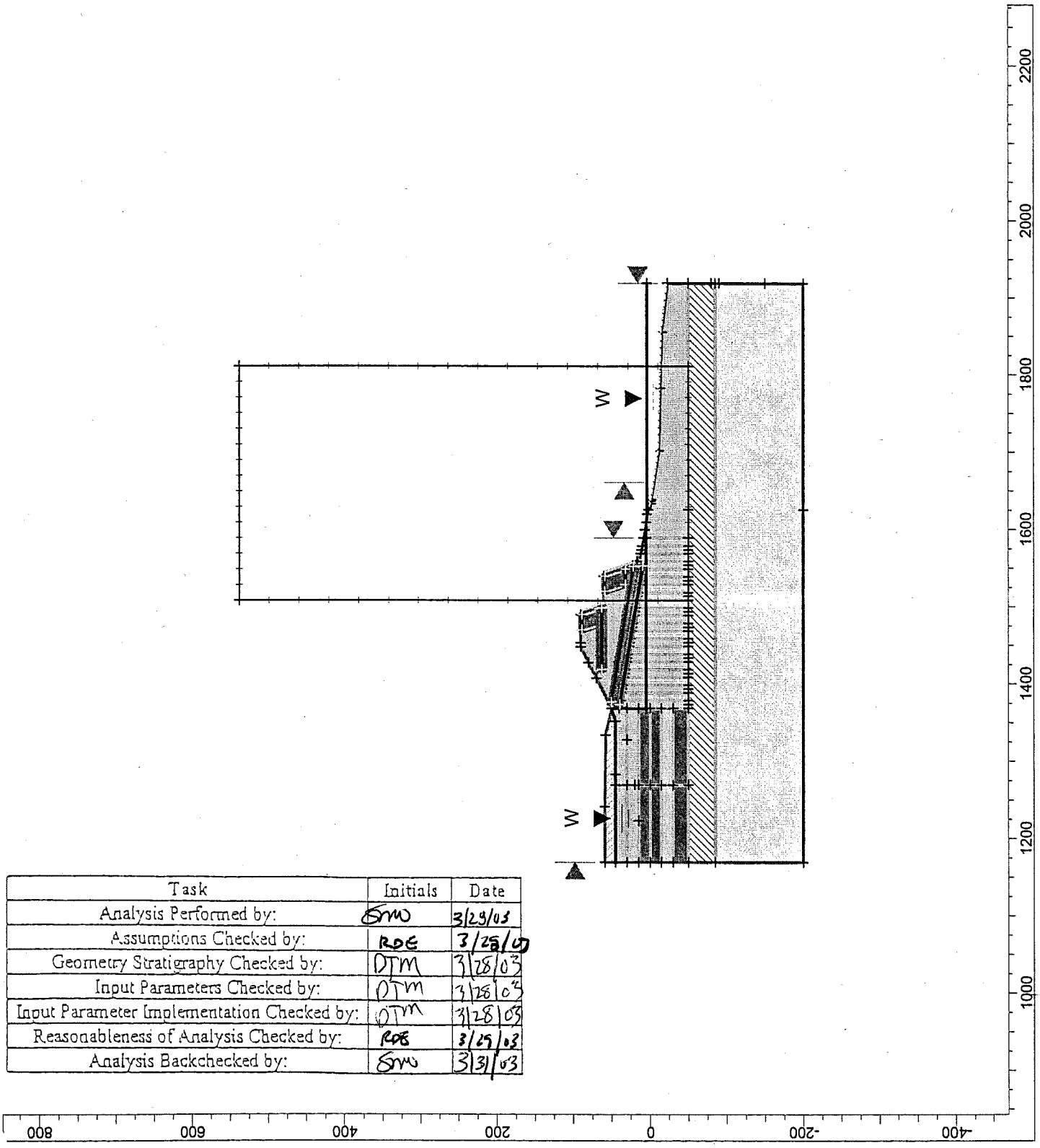
Section E-E
Construction 7 Stability
Circular Analysis



Task	Initials	Date
Analysis Performed by:	SMW	3/29/03
Assumptions Checked by:	RDE	3/28/03
Geometry Stratigraphy Checked by:	DTM	3/28/03
Input Parameters Checked by:	DTM	3/28/03
Input Parameter Implementation Checked by:	DTM	3/28/03
Reasonableness of Analysis Checked by:	RDE	3/29/03
Analysis Backchecked by:	SMW	3/31/03

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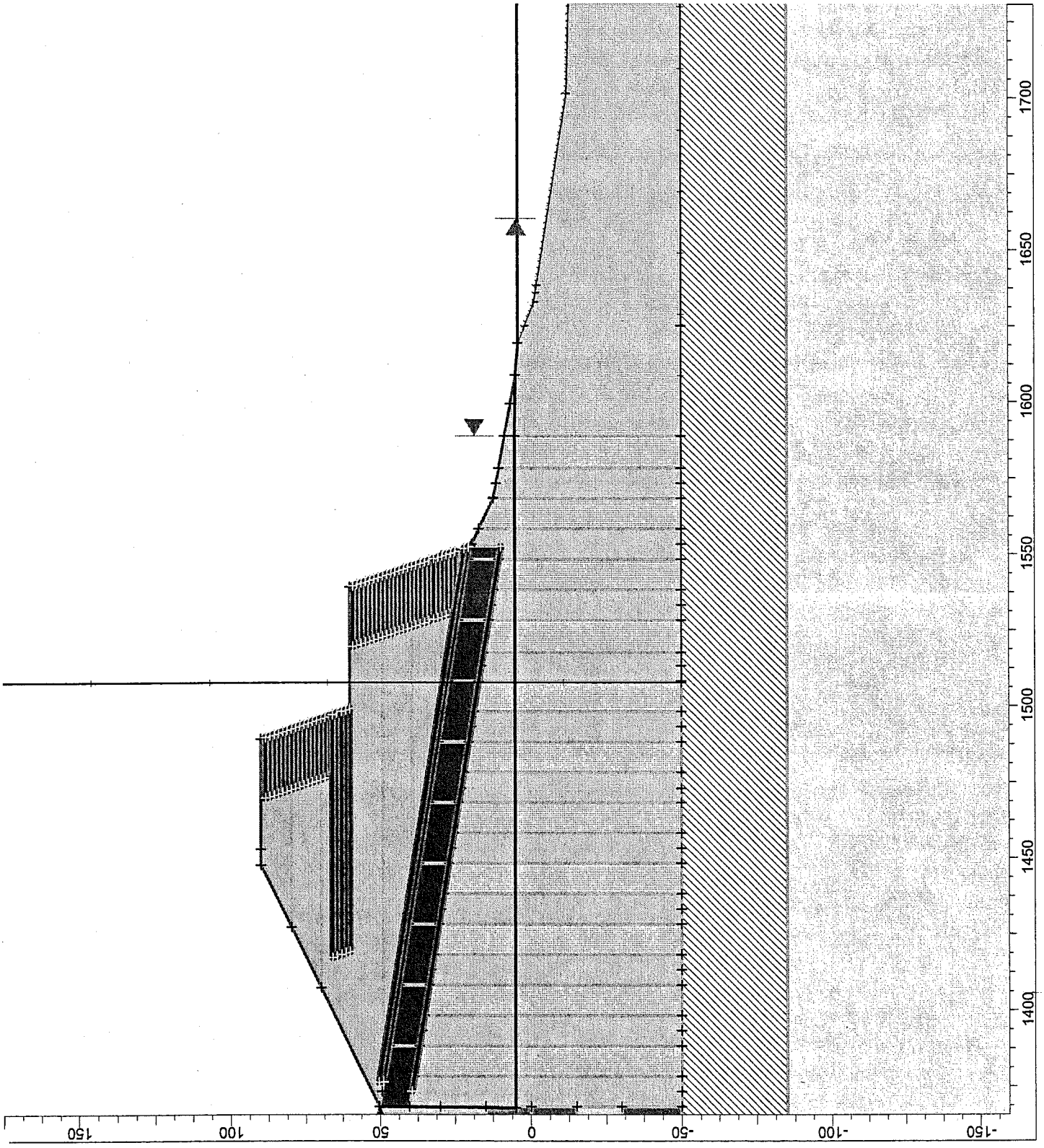
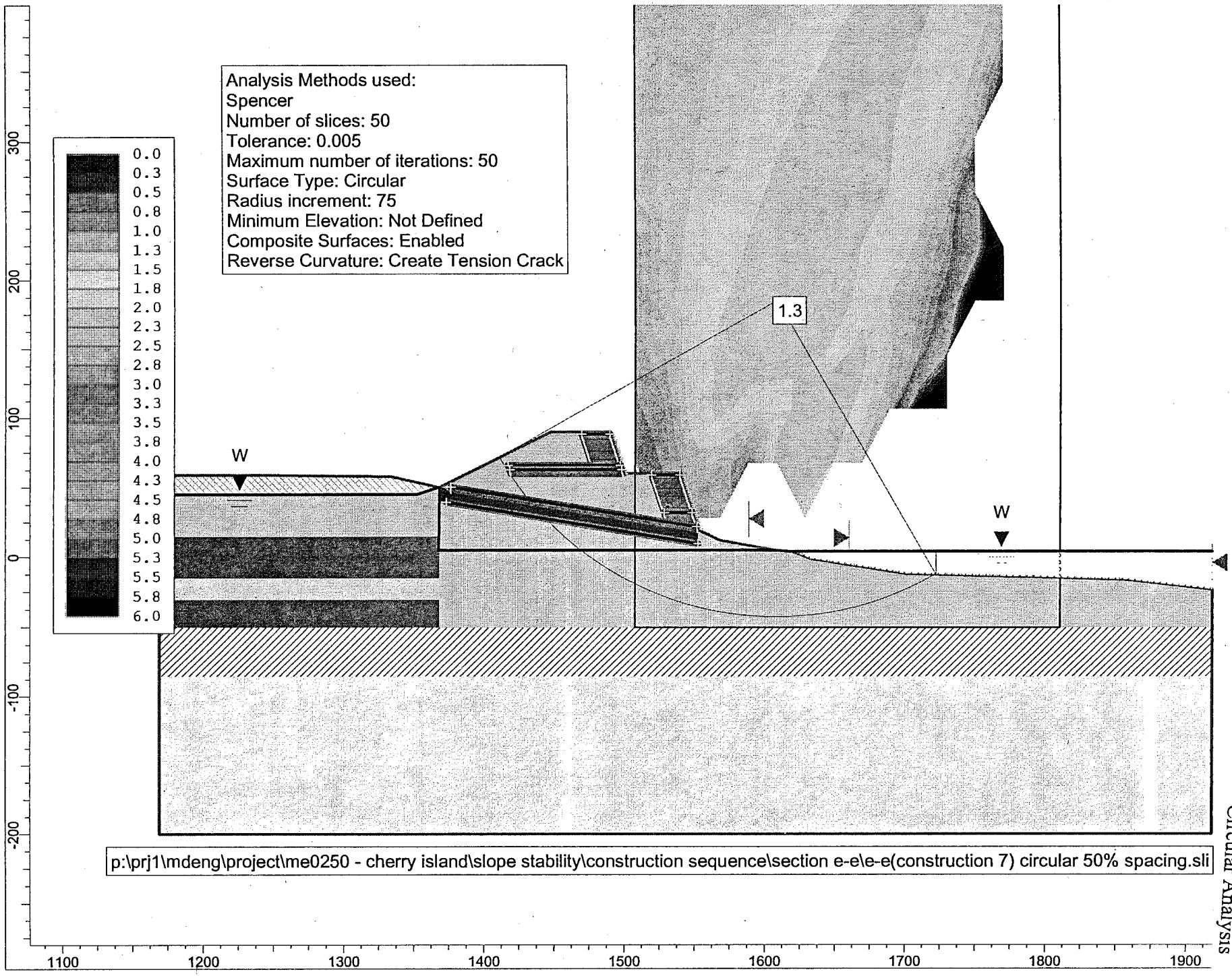
Section E-E
Construction 7 Stability
Circular Analysis



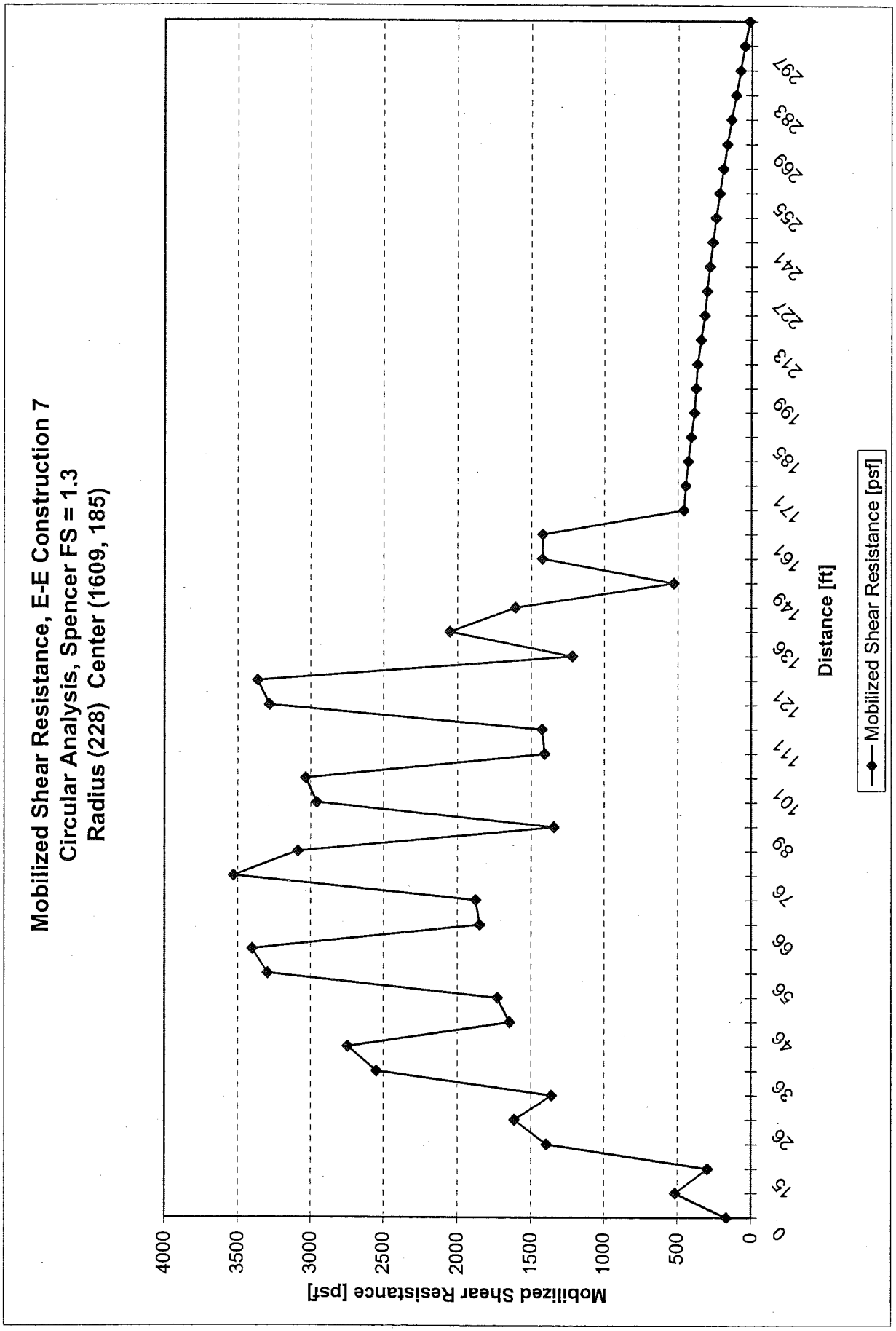
GCT-57



Section E-E
Construction 7 Stability
Circular Analysis

ECF-58

Section E-E
Construction 7 Stability
Circular Analysis



PRJ1/ME0250/SlopeStability/Mobilized Shear Strength E Const

ECT-51

Slide Analysis Information

Document Name

File Name: e-e(construction 7) circular 50% spacing

Project Settings

Project Title: SLIDE - An Interactive Slope Stability Program
Failure Direction: Left to Right
Units of Measurement: Imperial Units
Pore Fluid Unit Weight: 62.4 lb/ft3
Groundwater Method: Water Surfaces
Data Output: Standard

Analysis Methods

Analysis Methods used:
Spencer

Number of slices: 50
Tolerance: 0.005
Maximum number of iterations: 50

Surface Options

Surface Type: Circular
Radius increment: 75
Minimum Elevation: Not Defined
Composite Surfaces: Enabled
Reverse Curvature: Create Tension Crack

Loading

Seismic Load Coefficient (Horizontal): 0
Seismic Load Coefficient (Vertical): 0

Material Properties

Material: Potomac Formation
Strength Type: Undrained
Unit Weight: 120 lb/ft3
Cohesion Type: Function of Depth
Cohesion (Top): 4500 psf
Cohesion Change: 14.4 psf/ft
Cutoff: 10000 psf
Water Surface: None

Material: Waste (0 to 20)
Strength Type: Mohr-Coulomb
Unit Weight: 60 lb/ft3
Cohesion: 0 psf
Friction Angle: 33 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Undrained PVD Area
Strength Type: Strength=F(overburden)
Unit Weight: 85 lb/ft3
Tau/Sigma Ratio: 0.29
Water Surface: Water Table
Custom Hu value: 1

Material: d11
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 200 psf
Water Surface: None

Material: d12
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 400 psf
Water Surface: None

Material: d13
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 600 psf
Water Surface: None

Material: d14
Strength Type: Undrained
Unit Weight: 85 lb/ft3
Cohesion Type: Constant
Cohesion: 800 psf
Water Surface: None

Material: River Sediments
Strength Type: Strength=F(overburden)
Unit Weight: 85 lb/ft3
Tau/Sigma Ratio: 0.29
Water Surface: Water Table
Custom Hu value: 1

Section E-E
Construction 7 Stability
Circular Analysis

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Material: Columbia Formation
Strength Type: Mohr-Coulomb
Unit Weight: 125 lb/ft3
Cohesion: 0 psf
Friction Angle: 40 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: MSE Wall Soil
Strength Type: Mohr-Coulomb
Unit Weight: 90 lb/ft3
Cohesion: 0 psf
Friction Angle: 29 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Drained PVD Area
Strength Type: Shear Normal function
Unit Weight: 85 lb/ft3
Water Surface: Water Table
Custom Hu value: 1

Material: Strucural Fill
Strength Type: Mohr-Coulomb
Unit Weight: 110 lb/ft3
Cohesion: 0 psf
Friction Angle: 35 degrees
Water Surface: Water Table
Custom Hu value: 1

Support Properties

Support: Geogrid
Support Type: GeoTextile
Force Application: Passive
Force Orientation: Bisector of Parallel and Tangent
Anchorage: Slope Face
Shear Strength Model: Linear
Strip Coverage: 100 percent
Tensile Strength: 5000 lb/ft
Pullout Strength Adhesion: 0 lb/ft2
Pullout Strength Friction Angle: 25 degrees

Support: Geogrid2
Support Type: GeoTextile
Force Application: Passive
Force Orientation: Bisector of Parallel and Tangent
Anchorage: Slope Face
Shear Strength Model: Linear
Strip Coverage: 100 percent
Tensile Strength: 21000 lb/ft
Pullout Strength Adhesion: 0 lb/ft2
Pullout Strength Friction Angle: 25 degrees

Global Minimums

Method: spencer
SF: 1.26454
Center: 1608.58, 185.026
Radius: 227.803
Left Slip Surface Endpoint: 1410.99, 71.647
Right Slip Surface Endpoint: 1722.24, -12.3973
Left Slope Intercept: 1410.99 71.647
Right Slope Intercept: 1722.24 4

Method Statistics

Method: spencer
Number of Valid Surfaces: 10686
Number of Invalid Surfaces: 8770
Error Codes:
Error Code -101 reported for 112 surfaces
Error Code -103 reported for 21 surfaces
Error Code -108 reported for 319 surfaces
Error Code -111 reported for 1919 surfaces
Error Code -112 reported for 2528 surfaces
Error Code -113 reported for 1287 surfaces
Error Code -1000 reported for 2584 surfaces

Error Codes

The following errors were encountered during the computation:

-101 = Only one (or zero) surface / slope intersections.

-103 = Two surface / slope intersections, but one or more surface / nonslope external polygon intersections lie between them. This usually occurs when the slip surface extends past the bottom of the soil region, but may also occur on a benched slope model with two sets of Slope Limits.

-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).

-111 = safety factor equation did not converge

-112 = The coefficient M-Alpha = cos(alpha)(1+tan(alpha)tan(phi)/F) < 0.2 for the final iteration of the safety factor calculation. This screens out some slip surfaces which may not be valid in the context of the analysis, in particular, deep seated slip surfaces with many high negative base

angle slices in the passive zone.

-113 = Surface intersects outside slope limits.

-1000 = No valid slip surfaces are generated at a grid center. Unable to draw a surface.

Section E-E
Construction 7 Stability
Circular Analysis

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Appendix VIb-D.5

Assessment of Dredge/Alluvium Drained Conditions

GEOSYNTEC CONSULTANTS

COMPUTATION COVER SHEET

Client: DSWA **Project:** Cherry Island **Project/Proposal #:** ME0250 **Task #:** 2.2.5

TITLE OF COMPUTATIONS ASSESSMENT OF DREDGE/ALLUVIUM DRAINED CONDITIONS

COMPUTATIONS BY:
Signature
Printed Name and Title: R. David Espinoza, Senior Engineer
DATE: 3/28/03

ASSUMPTIONS AND PROCEDURES CHECKED BY:
(Peer Reviewer)
Signature
Printed Name and Title: Carlos Lazarte, Senior Engineer
DATE: 3/28/03

COMPUTATIONS CHECKED BY:
Signature
Printed Name and Title: David Espinoza, Senior Engineer
DATE: 3/28/03

COMPUTATIONS BACKCHECKED BY:
(Originator)
Signature
Printed Name and Title: Carlos A. Lazarte, Senior Engineer
DATE: 3/29/03

APPROVED BY:
(PM or Designate)
Signature
Printed Name and Title: David Espinoza
DATE: 3/30/03

APPROVAL NOTES:

REVISIONS (Number and initial all revisions)

NO.	SHEET	DATE	BY	CHECKED BY	APPROVAL

ASSESSMENT OF DREDGE/ALLUVIUM DRAINED CONDITIONS

1. GENERAL

The assumption of drained conditions of the dredge/alluvium with PVDs during perimeter of the mechanically stabilized earth (MSE) berm and waste placement is an important consideration in the stability analysis. Drained conditions can be assumed if the loading rates are slow enough that the resulting excess pore pressures generated during MSE berm construction/waste placement is dissipated. In this section, the assumption of drained conditions for the dredge/alluvium in the PVD area is evaluated. The evaluation consists of the following steps: (i) selection of a pore pressure generation model; (ii) prediction of the pore pressure generation during waste placement; and (iii) evaluation of pore pressure as a result of continuous dissipation. In what follows, each of these steps is described.

2. PORE PRESSURE GENERATION MODEL

2.1 Introduction

A model that predicted excess pore pressure during undrained loading in a triaxial apparatus was proposed by Skempton [1954]. A more general relationship for the excess pore pressures (Δu) was proposed by Henkel [1960]:

$$\Delta u = B\left[\frac{\Delta\sigma_1 + \Delta\sigma_2 + \Delta\sigma_3}{3}\right] + \frac{a}{3}\sqrt{(\Delta\sigma_1 - \Delta\sigma_3)^2 + (\Delta\sigma_2 - \Delta\sigma_3)^2 + (\Delta\sigma_1 - \Delta\sigma_2)^2} \qquad (1)$$

where a and B are the pore pressure coefficients, and $\Delta\sigma_1$, $\Delta\sigma_2$, and $\Delta\sigma_3$ are the stress increments along three orthogonal directions. For the case when two of the stress increments are equal ($\Delta\sigma_2 = \Delta\sigma_3$), Equation (1) can be expressed as:

$$\Delta u = B\left[\frac{\Delta\sigma_1 + 2\Delta\sigma_2}{3}\right] + \frac{a}{3}\sqrt{2(\Delta\sigma_1 - \Delta\sigma_3)^2} \qquad (2)$$

or

$$\Delta u = B\Delta\sigma_p + \frac{a}{3}\sqrt{2\Delta\sigma_d^2} \qquad (3)$$

where the term $\Delta\sigma_p$ is the increment of hydrostatic pressure, $\Delta\sigma_d$ is increment of deviatoric stress which can also be expressed in terms of the increment of maximum shear stress ($\Delta\tau_{max}$) as:

$$\Delta\sigma_d = 2\Delta\tau_{max} \tag{4}$$

Replacing Equations (4) in (3) and considering that the parameter B is equal to 1 for saturated soils (as it is the case of the dredge/alluvium under water), Equation (3) can be rewritten as:

$$\Delta u = \Delta\sigma_p + \frac{2a\sqrt{2}}{3}\Delta\tau_{max} \tag{5}$$

2.2 Evaluation of Henkel's Parameter

The parameter a is not a constant and depends on the stress path during loading, strain magnitude, overconsolidation ratio of the material, and material anisotropy. Equation (5) can be used to calculate the parameter a from measured pore pressures and shear strength obtained from direct simple shear (DSS) tests. In a DSS, only shear stresses are applied. Hence, the change of volumetric pressure is zero (i.e., $\Delta\sigma_p = 0$). Hence, from Equation (5), the Henkel's parameter (a) can be written as:

$$a = \frac{3}{2\sqrt{2}}\left(\frac{\Delta u}{\Delta\tau_{max}}\right) \tag{6}$$

The Mohr circle corresponding to the initial conditions in a DSS test (dashed line) is shown in Figure 1. The principal stresses represent the initial maximum and minimum stresses (σ_{1o} and σ_{3o}, respectively) at the end of k_o consolidation. During a DSS test, as shear (τ) is applied, the principal maximum stress increases to σ_1 whereas the minimum stress decreases an equal amount to σ_3, thus keeping the center of circle unchanged. The Mohr circle during shearing (solid line) is also shown in Figure 1. The initial maximum shear stress ($\tau_{max\text{-}o}$) in a DSS test is equal to the radius of the Mohr circle (r) for the initial conditions (Figure 1) and it is calculated as:

$$\tau_{max\text{-}o} = r = \sigma_{10} - \sigma_{10}\left(\frac{1+k_o}{2}\right) = \sigma_{10}\left(\frac{1-k_o}{2}\right) \tag{7}$$

Where k_o is the at-rest earth pressure coefficient. The maximum shear stress (τ_{max}) during shearing in a DSS test is equal to the radius (R) of the Mohr circle (Figure1) and it is equal to:

$$\tau_{max} = R = \left[\tau^2 + r^2\right]^{1/2} = \left[\tau^2 + \sigma_{10}^2\left(\frac{1-k_o}{2}\right)^2\right]^{1/2} \tag{8a}$$

or

$$\tau_{max} = \sigma_{10}\sqrt{\left(\frac{\tau}{\sigma_{10}}\right)^2 + \left(\frac{1-k_o}{2}\right)^2} \tag{8b}$$

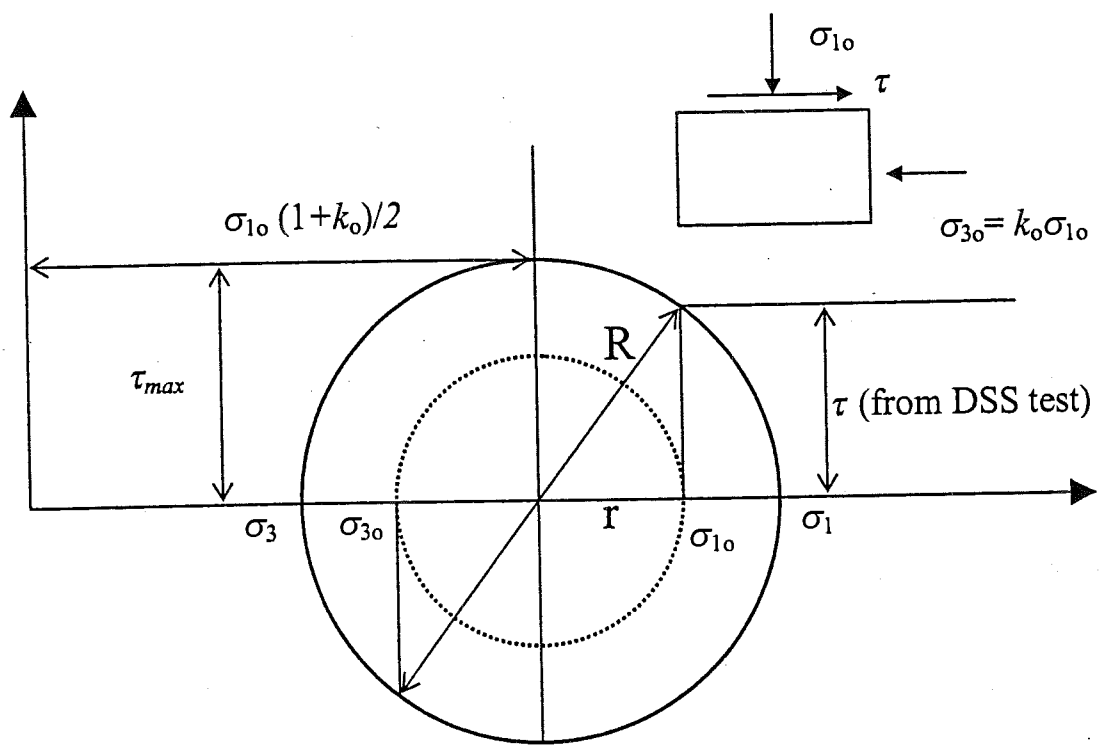


Figure 1 – Mohr Circle for DSS Test

The change in maximum shear stress in a DSS test can then be obtained as follows:

$$\Delta\tau_{max} = R - r = \sigma_{10}\left\{\sqrt{\left(\frac{\tau}{\sigma_{10}}\right)^2 + \left(\frac{1-k_o}{2}\right)^2} - \left(\frac{1-k_o}{2}\right)\right\} \tag{9}$$

Replacing equation (9) into Equation (6), an expression for Henkel's parameter (a) is obtained as a function of the change in normalized shear-induced pore pressures ($\Delta u/\sigma_{1o}$), the normalized applied shear stresses (τ/σ_{1o}), and the at-rest earth pressure coefficient (k_o):

$$a = \frac{3}{2\sqrt{2}}\left(\frac{\Delta u}{\sigma_{10}}\right)\left\{\sqrt{\left(\frac{\tau}{\sigma_{10}}\right)^2 + \left(\frac{1-k_o}{2}\right)^2} - \left(\frac{1-k_o}{2}\right)\right\}^{-1} \tag{10}$$

Figure 2 shows plots of normalized shear stress (τ/σ_{1o}) vs. shear strain and normalized shear-induced pore pressures ($\Delta u/\sigma_{1o}$) vs. shear strain for eight (8) DSS tests for three normal loads (2,500 psf, 5,000 psf, and 10,000 psf). The results of a DSS test (i.e., τ/σ_{1o} and $\Delta u/\sigma_{1o}$ for a given shear strain) can be used along with Equation (10) to evaluate the a parameter at different shear strains. Henkel's parameter was calculated for normalized shear at failure (Figure 2) and mobilized shear stress (Figure 3) were used for this evaluation.

The normalized shear stress at failure (τ_f/σ_{1o}) corresponds to the peak shear stress measured in a DSS test (Figure 2). The normalized shear-induced pore pressure at failure ($\Delta u_f/\sigma_{1o}$) corresponds to the measured shear strain at failure. Table 1 shows the measured normalized shear stresses at failure and corresponding shear-induced pore pressures for each of the eight DSS tests performed. The values of Henkel's parameter at failure (a_f) for two different values of at-rest earth pressure coefficients (0.5 and 0.7) are shown in Table 1.

The normalized mobilized shear stress (τ_m/σ_{1o}) corresponds to the peak shear stress measured in a DSS test divided by a factor of safety (Figure 3). Hence, the normalized mobilized shear stress is calculated as:

$$\frac{\tau_m}{\sigma_{1o}} = \frac{1}{FS}\left(\frac{\tau_f}{\sigma_{1o}}\right) \tag{11}$$

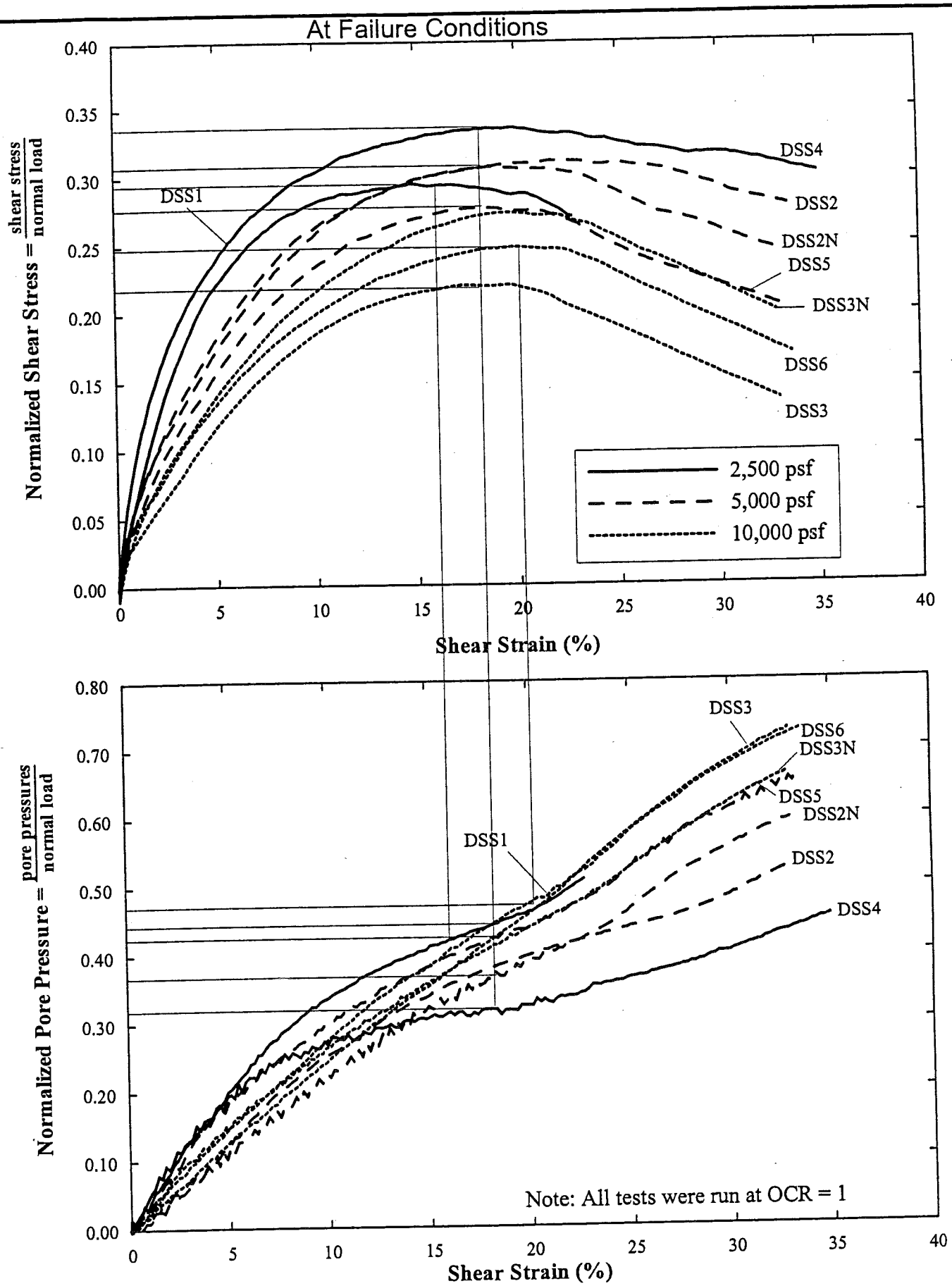


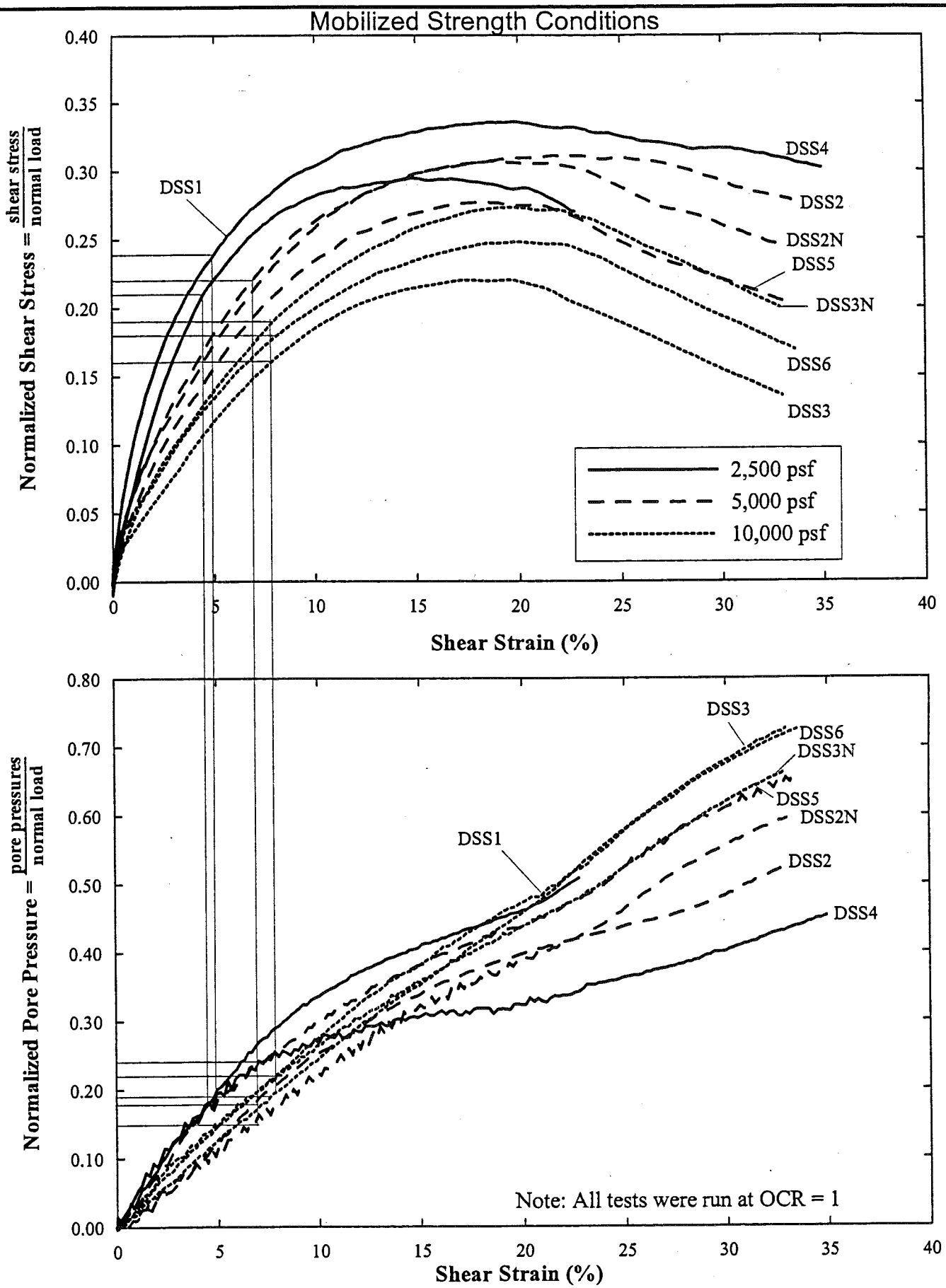
Figure3.grf

GEOSYNTEC CONSULTANTS
10015 Old Columbia Road, Suite A-200
Columbia, Maryland 21046

Direct Simple Shear Tests Normalized Shear Stress and Shear-Induced Pore Pressure with Shear Strain

FIGURE 2

PROJECT: ME0250
Cherry Island



Summary of DSS-one.grf

GEOSYNTEC CONSULTANTS
10015 Old Columbia Road, Suite A-200
Columbia, Maryland 21046

Direct Simple Shear Tests Normalized Shear Stress and Shear-Induced Pore Pressure with Shear Strain

FIGURE 3

PROJECT: ME0250
Cherry Island

where FS is the factor of safety used for design (i.e., 1.4). The normalized shear-induced mobilized pore pressure ($\Delta u_m/\sigma_{1o}$) corresponds to the measured mobilized shear strain. Table 1 also shows the mobilized normalized shear stresses and corresponding shear-induced pore pressures for each of the eight DSS tests performed. The values of Henkel's parameter for two different values of at-rest earth pressure coefficients (i.e., k_o = 0.5 and 0.7) are shown in Table 1. As shown in Table 1, the average values of a_f corresponding to k_o of 0.5 and 0.7 are 2.6 to 3.5, respectively. Similarly, average values of a for the design mobilized shear strength corresponding to k_o of 0.5 and 0.7 are 2.2 and 3.1, respectively. For the assessment of the alluvium/dredge drained condition during waste placement, the parameter a is assumed equal to 3.5. Thus, Equation (5) can be written as:

$$\Delta u = \Delta\sigma_p + 3.3\Delta\tau_{max} \tag{12}$$

Typical values of the Skempton pore pressure parameter (A) at failure (A_f) in triaxial compression for normally consolidated clays vary from 0.7 to 1.3 [Skempton, 1954]. For comparison purposes, the Skempton parameter for the dredge alluvium is calculated and shown in Table 1. Henkel's parameter a_f is approximately twice of Skemptons's parameter A_f. For sensitive clays, A_f varies from 1.2 to 2.5. As shown in Table 1, the Skempton parameter at failure (A_f) for the dredge/alluvium varies from 1.6 to 2.0. These values are in agreement with those reported for sensitive clays. It is noted that Henkel's a-parameter obtained from DSS tests is for axisymmetric conditions (i.e., $\Delta\sigma_2 = \Delta\sigma_3$), whereas the stresses under the MSE berm (MSEB) are likely to approach plan strain conditions. For this analysis, the parameter a is assumed to be independent of the stress path.

3. PORE PRESSURE GENERATION DURING LOADING

3.1 Introduction

Use MSE

To correlate the pore pressure increments estimated above with the pore pressures that may be generated during waste placement in the PVD area, the volumetric and shear stresses that are likely to be generated under the MSEB must be calculated. Changes in effective stresses under the perimeter berm (i.e., toe of the waste slope) as a result of waste placement can be estimated using elastic theory. Assuming that the stresses under the berm approach plain strain conditions, the increment of horizontal stress orthogonal to the xy plane ($\Delta\sigma_z$) for elastic conditions can be calculated as:

use AMO

$$\Delta\sigma_z = \upsilon\left(\Delta\sigma_x + \Delta\sigma_y\right) \tag{13a}$$

where:

$k_o = \dfrac{\Delta\sigma_x' - \Delta u}{\Delta\sigma_y' - \Delta u}$ effective

$$\upsilon = \frac{k_o}{1+k_o} \tag{13b}$$

$k_o = 0.7 \rightarrow \nu = 0.41$

$k_o = 0.5 \quad \nu = 0.33$

$\Delta\sigma_x$ and $\Delta\sigma_y$ are the total horizontal and vertical stress increments, respectively and υ is the dredge/alluvium Poisson's ratio. It follows that the increment of hydrostatic pressure can be estimated as:

$$\Delta\sigma_p = \frac{1+\upsilon}{3}\left(\Delta\sigma_y + \Delta\sigma_x\right) \tag{14}$$

3.2 Pore Pressures due to MSE Berm construction

Pore pressure due to embankment loading measured in the field shows good agreement with those calculated using elastic theory (D'Appolonia et al., 1971). Prior to local yielding, excess pore pressures can be estimated as $\Delta u = \Delta\sigma_p$. Assuming that $k_o = 0.7$; $\Delta\sigma_y = \gamma\Delta H$, and $\Delta\sigma_x = 0.7\gamma\Delta H$, and replacing these values in Equation (14), the excess pore pressure due to embankment loading is $\Delta u = 0.8\gamma\Delta H$; where ΔH and γ are the berm lift thickness and the MSE berm unit weight, respectively.

Assuming an average unit weight of MSE berm of 120 pcf, and a lift of 10 ft, the estimated change in pore pressures for each waste placement increment is estimated to be 960 psf. This corresponds to an additional hydraulic head of approximately 15.4 ft. Thus, if the MSE berm is placed at a constant rate of 30 ft/yr (assuming that the MSE berm is built in two years), it will generate approximately a maximum of 46.2 ft/yr of excess pore pressure.

3.3 Pore Pressures due to Waste Placement

The stresses under the perimeter berm during waste placement can be conservatively estimated as a function of waste lift as follows (Attachment A):

$$\Delta\sigma_x = 0.35\ \gamma_{waste}\ \Delta H_{waste} \tag{15a}$$

$$\Delta\sigma_y = 0.32\,\gamma_{waste}\ \Delta H_{waste} \tag{15b}$$

$$\Delta\tau_{max} = 0.32\gamma_{waste}\,\Delta H_{waste} \tag{15c}$$

where ΔH_{waste} and γ_{waste} are the waste lift thickness and the waste unit weight, respectively. It is noted that the maximum stress increments $\Delta\sigma_x$, $\Delta\sigma_y$ and $\Delta\tau_{max}$ do no occur at the same point. Therefore, using these values in Equation (12) is conservative. Replacing Equations (15a) and (15b) into Equation (13a), assuming $k_o = 0.7$, yields:

$$\Delta\sigma_p = \frac{0.7}{1.7}(0.35 + 0.32)\gamma_{waste}\,\Delta H_{waste} = 0.28\gamma_{waste}\,\Delta H_{waste} \tag{16a}$$

Replacing Equation (16a) and (15c) into Equation (12), yields:

$$\Delta u = (0.32 + 3.3 \times 0.32)\gamma_{waste}\,\Delta H_{waste} = 1.4\gamma_{waste}\,\Delta H_{waste} \tag{16}$$

Assuming an average unit weight of waste of 85 pcf, and a lift of 10 ft, the estimated change in pore pressures for each waste placement increment is estimated to be 1,130 psf. This corresponds to an additional hydraulic head of approximately 18.1 ft. Thus, if waste is placed at a constant rate of 10 ft/yr (the maximum estimated waste placement rate in Section 4.2.3), it will generate approximately a maximum of 18.1 ft/yr of excess pore pressure. As smaller waste placement rates occur during the initial period of waste filling (see Section 4.2.3 of the calculation package entitled: "Landfill Stability Analysis (Static) – Phases III to V"), smaller rates of pore pressure build up are expected.

4. PORE PRESSURE DISSIPATION MODEL

Based on radial flow, the compounded average degree of consolidation (U_r) versus time (t) for vertical sand drains (also applicable for PVDs) derived by Barron (1948) is given by:

$$U_r = 1 - \exp(-\alpha t) \tag{17}$$

where:

$$\alpha = \frac{2}{F_n}\left(\frac{c_v}{r_i^2}\right) \tag{18}$$

$$F_n = \frac{n^2}{n^2 - 1}\ln(n) - \frac{3n^2 - 1}{4n^2} \tag{19}$$

$$n = \frac{r_i}{r_e} \tag{20}$$

where C_v is the coefficient of consolidation; r_i is the radius of influence of the PVDs; r_e is the equivalent radius of the PVD. Equation (17) is a practical extension to the basic approach of Terzaghi 1-D consolidation and successfully used for design of PVD spacing. Applications of Barron's equation can be found in Olson (1977); Rixner (1986); and Holtz et. al. (1991).

It follows from Equation (17) that the remaining average excess pore pressure in the field (u_r) can be assumed to follow an exponential decay function (see Figure 4):

$$u_r(t) = \Delta u_o e^{-\alpha t} \tag{21}$$

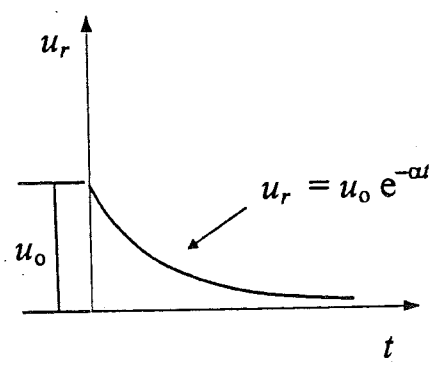


Figure 4 – Average pore pressure dissipation function

Values of α calculated for different PVD spacings assuming C_v = 0.07 ft^2/day, r_e = 1.4 in., are presented in the table below.

PVD Spacing (ft), $2r_i$	F_n	α (1/yr)
2	1.46	34.9
2.8	1.78	12.3
4	2.14	5.98
6	2.54	2.24
8	2.82	1.13
10	3.04	0.67

For a loading rate that is linear with time (i.e., equal lifts are placed at the same time intervals), it follows from Equation (16) that the excess pore pressures generated by waste placement (Δu_w) will be also generated at a linear rate and can be represented as:

$$\Delta u_w(t) = r\,t \tag{22}$$

where r (ft/yr) is the rate of excess pore pressure generation as a result of waste placement. While the continuous placement of waste generates additional pore pressures, the on-going radial consolidation dissipates a portion of the excess pore pressures. Figure 5 shows a schematic representation of this process. In what follows, an analysis of the combined opposite effects is presented below.
Inevitable

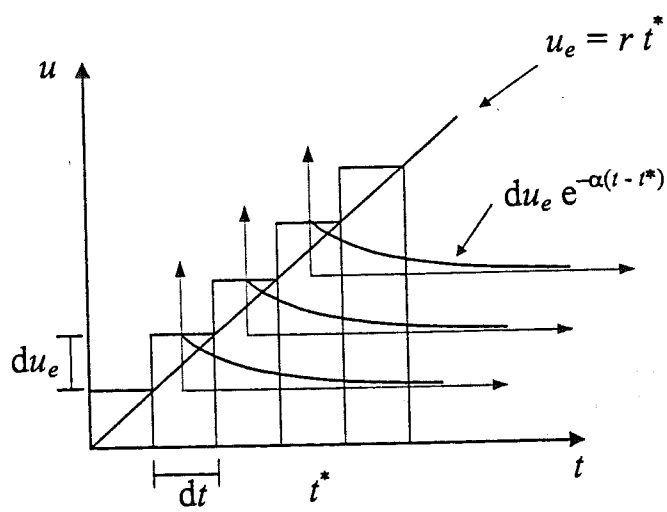


Figure 5 – Pore pressure dissipation model

The incremental excess pore pressure (du_e) as a result of loading is:

$$du_e = rdt^* \tag{23}$$

The dissipated pore pressure for each incremental excess pore pressure is:

$$du = du_e e^{-\alpha(t-t^*)} = rdt^* e^{-\alpha(t-t^*)} \tag{24}$$

The total excess pore pressure is the sum of all the incremental pore pressures dissipation, that is:

$$u = \int re^{-\alpha(t-t^*)} dt^* \tag{25}$$

integration of Equation (25) yields:

$$u(t) = \frac{r}{\alpha}\left[1 - e^{-\alpha t}\right] \tag{26}$$

The equation above shows that for the expected waste placement rate and the relatively rapid pore pressure decay due to the presence of PVDs, the excess pore pressures will follow an increasing function that quickly reaches a maximum value given by:

$$u_{\max} = \frac{r}{\alpha} \tag{27}$$

5. MAXIMUM PORE PRESSURE

5.1 During Berm Construction

Based on the maximum rate of pore pressure generation calculated in Section 3.2 (i.e., 46.2 ft/yr), the expected maximum excess pore pressure at any given time during MSE berm construction for the different PVD spacings are:

PVD Spacing (ft), $2r_i$	α (1/yr)	u_{max} (ft)
2	34.9	1.3
2.8	14.9	3.1
4	5.98	7.7
6	2.24	20.6
8	1.13	40.9
10	0.67	69.0

A pilot test has been implemented at the CIL site by GeoSyntec to evaluate the performance of the various PVD spacings and asses their effect of magnitude and rate of pore pressure dissipation. PVDs were installed in a square pattern at 4-ft, 6-ft, and 8-ft spacing in three test areas approximately 60 ft by 80 ft. A 15-ft high berm was constructed over these test areas over a period of two months (i.e., from mid-October 2002 to mid-December 2002). Preliminary results from the pilot test study indicate that PVDs allowed construction of the 15-ft high berm in a relatively short period of time without inducing slope failure through the dredge. Although, settlements and pore pressures dissipation are still undergoing in all test areas, it appears that the rate of both settlements and excess pore pressures for the 4 ft spacing are diminishing. This is in agreement with the theoretical calculations using radial consolidation (Table 2). A report with results and analysis of the pilot test will be provided separately. Preliminary results of the pilot test are presented in Attachment B.

5.1 During Waste Placement

Based on the maximum rate of pore pressure generation calculated in Section 3.3 (i.e., 19.1 ft/yr), the expected maximum excess pore pressure at any given time during waste placement for the different PVD spacings are:

PVD Spacing (ft), $2r_i$	α (1/yr)	u_{max} (ft)
2	34.9	0.55
4	5.98	3.1
6	2.24	8.1
8	1.13	16.0
10	0.67	27.0

6. DISCUSSION

Based on these approximations, assuming that 90 percent of the excess pore pressures dissipate within approximately 4 months for the 4-ft spacing, the expected maximum pore pressures is 7.7 and 3.1 ft throughout MSE berm construction and waste placement, respectively.

The additional excess pore pressure in the wicked area has negligible influence in the calculated factors of safety during waste placement. Therefore, the assumption of drained parameters for the dredge alluvium is material with PVDs during waste placement is considered reasonable. It is also noted that the calculated pore pressure generation during waste placement was calculated making very conservative assumptions.

During berm construction, the radius of influence that corresponds to a maximum excess of 3.1 ft is 1.4 ft. The area of a radius of influence of 1.4 ft (i.e., $\pi(1.4)^2$=6.16 ft^2) corresponds to a 50 percent of the total area of a 4-ft PVD (i.e., $\pi(2)^2$=12.56 ft^2). Thus, for a 4-ft PVD spacing, and the anticipated MSE berm construction rate, 50 percent of the area can be assumed drained and the remaining partially drained.

7. REFERENCES

Barron, R.A. (1948). "*Consolidation of Fined-Grained Soils by Drain Wells*". ASCE Trans, paper 2346, V. 113, 718-724.

D'Appolonia, J.D., Lambe, T.W., and Poulos, H (1971). Evaluation of Pore Pressures Beneath an Embankment. Proceedings of the ASCE, Vol. 97, No. SM6, pp. 881-897.

Henkel, D.J. (1960). *"The Shear Strength of Remolded Clays,"* Proceedings of the ASCE research conference on shear strength of cohesive soils, Boulder, pp. 535-554.

Olson, R.E. (1977). *"Consolidation under Time-Dependant Loading,"* Journal of Geotechnical Engineering Division, American Society of Civil Engineers, 103, GT1, pp 55-59.

Skempton (1954). *"The Pore-Pressure Coefficients A and B,"* Geotechnique, Vol. IV, pp 145-147.

Table 1 - Evaluation of Pore Pressure Parameter (A)
Design and Construction Inspection Services
Cherry Island Landfill

Sample ID	Normalized Pore Pressure u/σ_{10}	At-rest pressure coefficient K_o	Normalized Shear Strength τ/σ_{10}	Pore Pressure parameter a	Pore Pressure parameter A [1]	Comment
DSS3	0.45	0.50	0.22	5.75	3.04	At Failure
DSS6	0.45	0.50	0.25	4.61	2.51	
DSS3N	0.41	0.50	0.27	3.69	2.07	
DSS5	0.41	0.50	0.27	3.69	2.07	
DSS2	0.37	0.50	0.31	2.65	1.58	
DSS2N	0.37	0.50	0.31	2.65	1.58	
DSS4	0.30	0.50	0.33	1.94	1.25	
DSS1	0.41	0.50	0.29	3.27	1.88	
			Average:	**3.5**	**2.0**	
DSS3	0.45	0.70	0.22	4.11	2.27	At Failure
DSS6	0.45	0.70	0.25	3.37	1.92	
DSS3N	0.41	0.70	0.27	2.74	1.62	
DSS5	0.41	0.70	0.27	2.74	1.62	
DSS2	0.37	0.70	0.31	2.02	1.29	
DSS2N	0.37	0.70	0.31	2.02	1.29	
DSS4	0.30	0.70	0.33	1.50	1.04	
DSS1	0.41	0.70	0.29	2.46	1.49	
			Average:	**2.6**	**1.6**	
DSS3	0.21	0.50	0.16	4.92	2.65	Mobilized shear strength (FS=1.4)
DSS6	0.21	0.50	0.18	3.89	2.17	
DSS3N	0.20	0.50	0.19	3.23	1.85	
DSS5	0.22	0.50	0.19	3.55	2.01	
DSS2	0.19	0.50	0.22	2.40	1.46	
DSS2N	0.17	0.50	0.22	2.15	1.35	
DSS4	0.19	0.50	0.24	2.15	1.35	
DSS1	0.17	0.50	0.21	2.41	1.47	
			Average:	**3.1**	**1.8**	
DSS3	0.21	0.70	0.16	3.31	1.89	Mobilized shear strength (FS=1.4)
DSS6	0.21	0.70	0.18	2.68	1.60	
DSS3N	0.20	0.70	0.19	2.25	1.39	
DSS5	0.22	0.70	0.19	2.47	1.50	
DSS2	0.19	0.70	0.22	1.72	1.14	
DSS2N	0.17	0.70	0.22	1.54	1.06	
DSS4	0.19	0.70	0.24	1.56	1.07	
DSS1	0.17	0.70	0.21	1.71	1.14	
			Average:	**2.2**	**1.3**	

1 $$A = \frac{1}{3}\left(1 + a\sqrt{2}\right)$$

Table 2 - Time to Achieve 90% Consolidation for Dredge/Alluvium with PVDs

Cherry Island Landfill
Wilmington Delaware

Radius of drainage well (in)[1] r_e	Radius of influence (ft)[2] r_i	Ratio of Radii (r_i/r_e) [-] n	Coefficient of Consolidation (ft^2/day)[3] C_{vr}	Percentage of Radial Consolidation[4] U_r	Shape Factor Parameter[5] F_n	Elapsed Time (days)[5] t	Elapsed Time (years) t	Dredge Thickness (ft) D	Time Factor for Vertical T_v	Percentage of Vertical Consolidation U_v	Total Degree of Consolidation U
1.4	1	9	0.07	90%	1.46	24	0.1	100	0.0007	3%	90%
1.4	1.4	12	0.07	90%	1.78	57	0.2	100	0.0016	4%	90%
1.4	2	18	0.07	90%	2.14	141	0.4	100	0.0039	7%	91%
1.4	3	27	0.07	90%	2.54	375	1.0	100	0.0105	12%	91%
1.4	4	35	0.07	90%	2.82	743	2.0	100	0.0208	16%	92%
1.4	5	44	0.07	90%	3.04	1252	3.4	100	0.0350	21%	92%

1. The Radius of influence is calculateds as an equivalent radius $r_w = (a+b)/\pi$ where a=4in. and b = 0.25 in. are the length and with of the PVD, respectively
2. Corresponds to half of the PVD spacing.
3. Calculated from settlement plates at Phases III-V
4. Target consolidation
5. Equation implemented from Olson, R.E. (1977). Consolidation under time depending loading, Journal of the Geotechnical Engineering, ASCE, Vol. 103, GT1

$$F_n = \frac{n^2}{n^2-1}\ln(n) - \frac{3n^2-1}{4n^2}$$

$$U_r = 1 - \exp(\lambda)$$

$$\lambda = \frac{-8T_h}{F_n}$$

$$T_h = \frac{c_v t}{4 r_e^2}$$

Attachment A

Evaluation of the Maximum Stresses under the MSEB

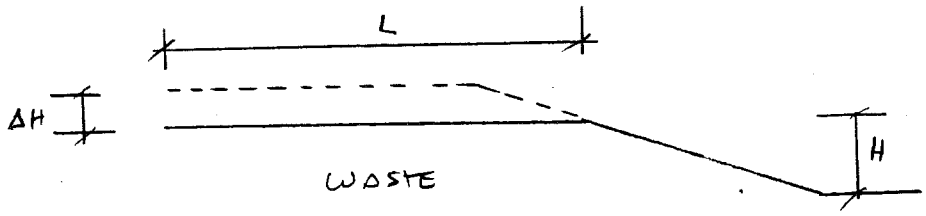
Written by: _____ Date: ___/___/___ (YY MM DD) Reviewed by: _____ Date: ___/___/___ (YY MM DD)

Client: _____ Project: _____ Project/Proposal No.: _____ Task No.: _____

Evaluation of stresses at toe of slope

Objective: to estimate the magnitude of stresses (vertical, horizontal and shear) at the toe of the slope (where the berm will be constructed) to estimate the excess pore pressures as a result of changes in stresses.

Method: use elastic solutions to approximate the geometry of the landfill. Because it is a elastic solution, the change in stresses can be calculated by superposition.



As the landfill grows L/H reduces. As shown in the attached figures, the stresses decrease as $\frac{L}{H}$ decreases. So it is conservative to assume $\frac{L}{H}$ remains constant throughout the life of the landfill.

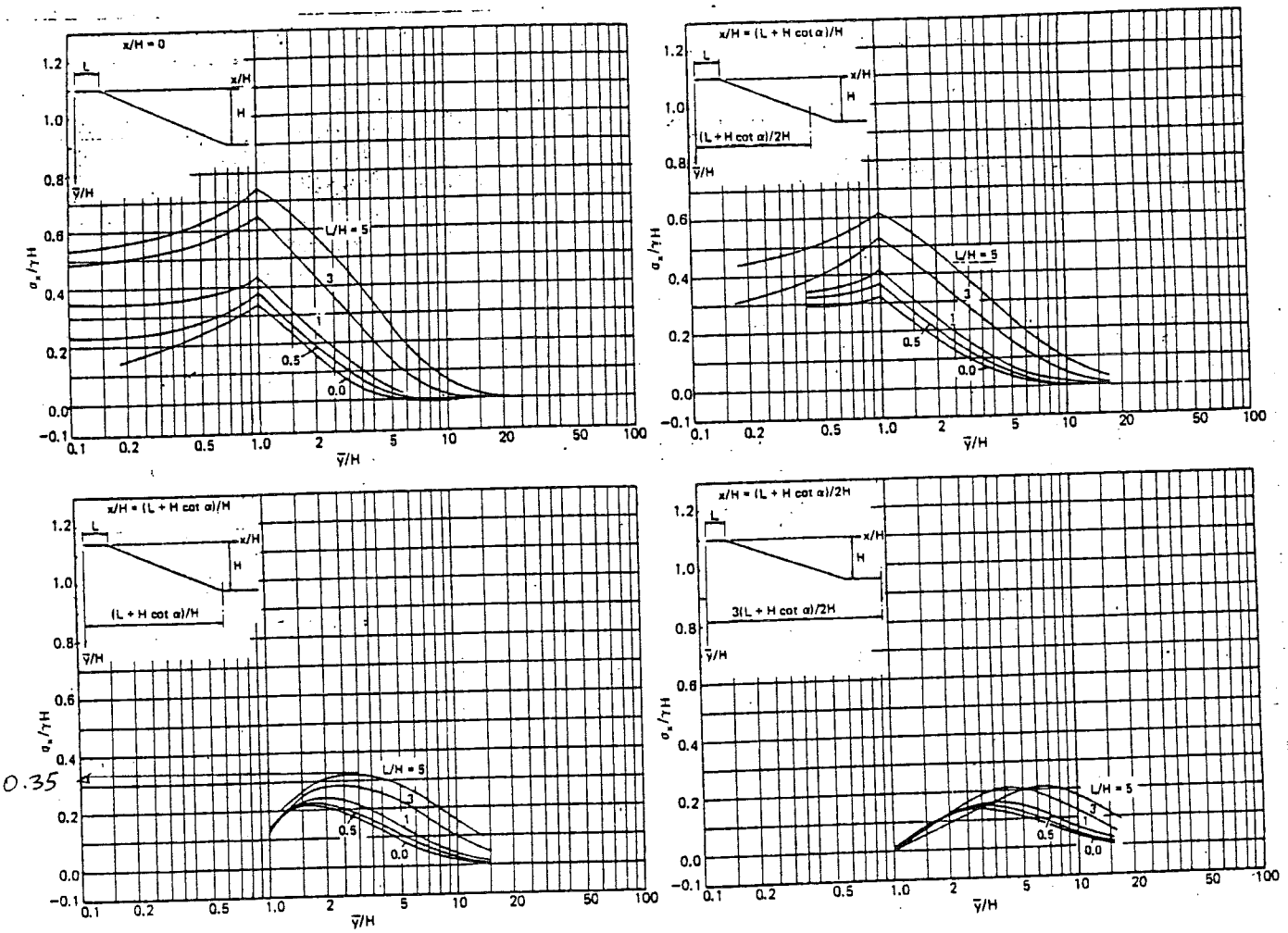


Fig. A.17—Influence diagrams for horizontal normal stress along selected vertical sections due to elastic embankment, $\mu = 0.3$, $\alpha = 15°$ (After Perloff, et al., 1967.)

Figure D.1

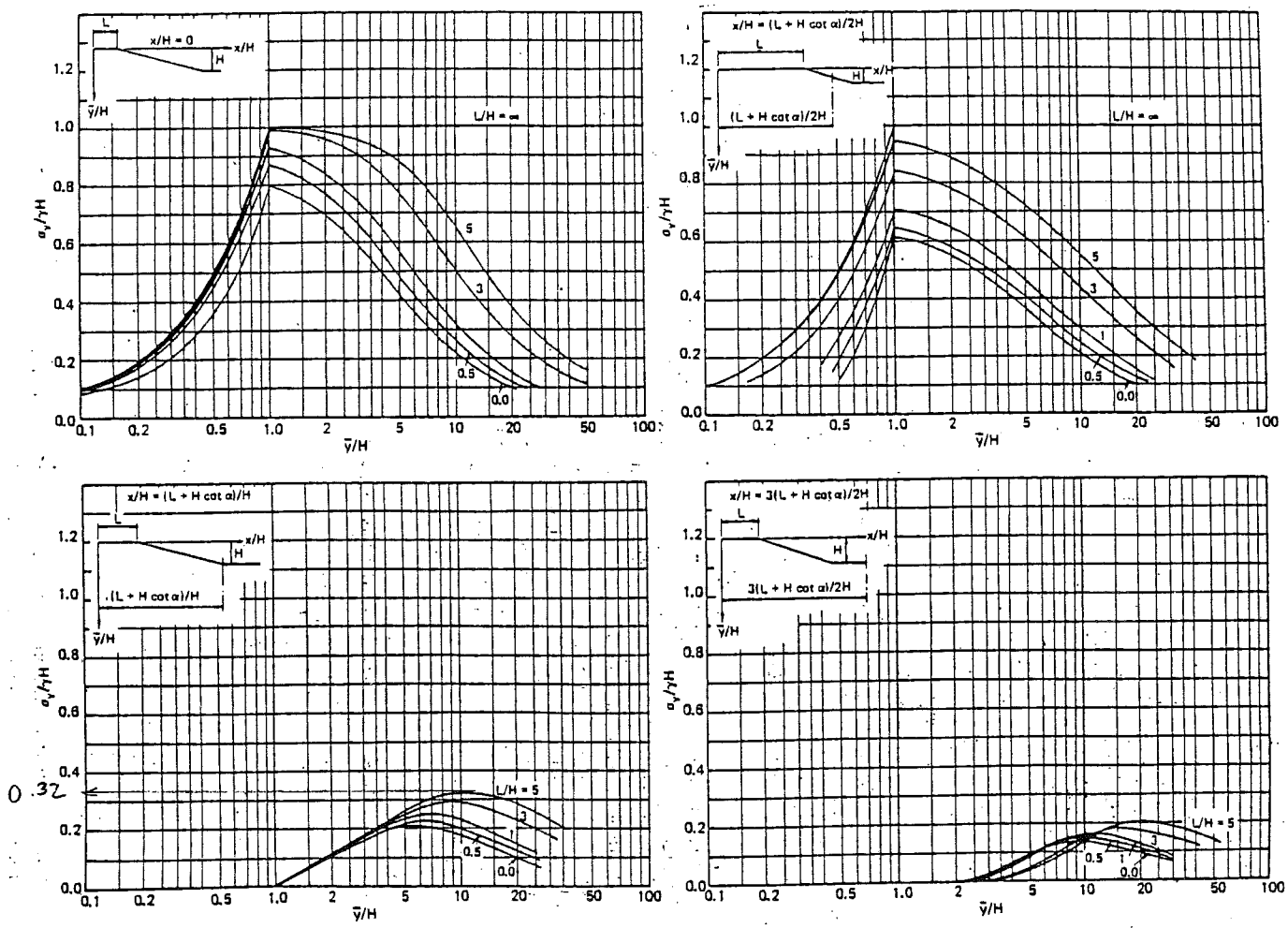


Fig. A.12—Influence diagrams for vertical normal stress along selected vertical sections due to elastic embankment, $\mu = 0.3$, $\alpha = 15°$. (After Perloff, et al., 1967.)

Figure D-2

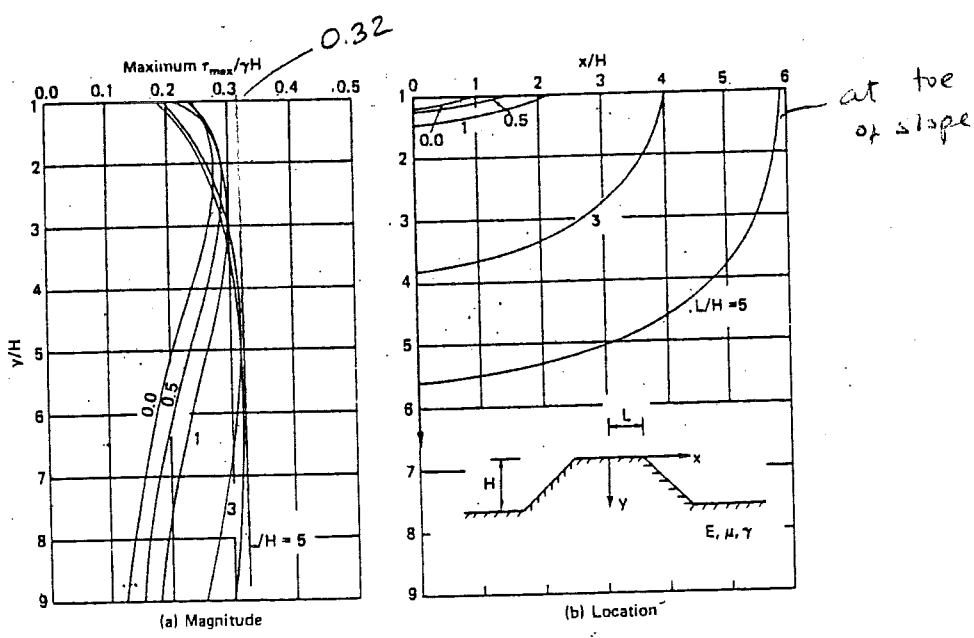
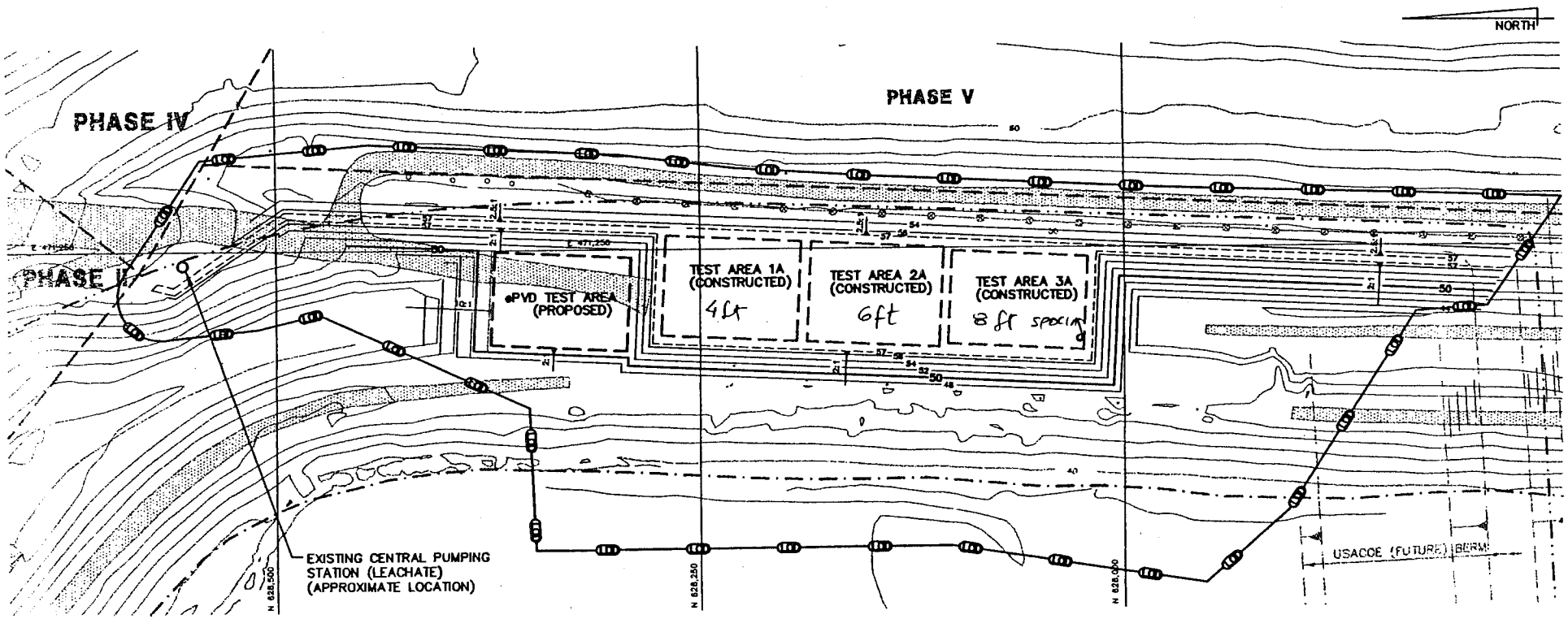


Fig. A.22—Magnitude and location of maximum ($\tau_{max}/\gamma H$) for elastic embankment, as a function of depth, $\mu = 0.3$, $\alpha = 15°$. (After Perloff, *et al.*, 1967.)

Figure D-3

Attachment B

Preliminary Results of Pilot Test CIL

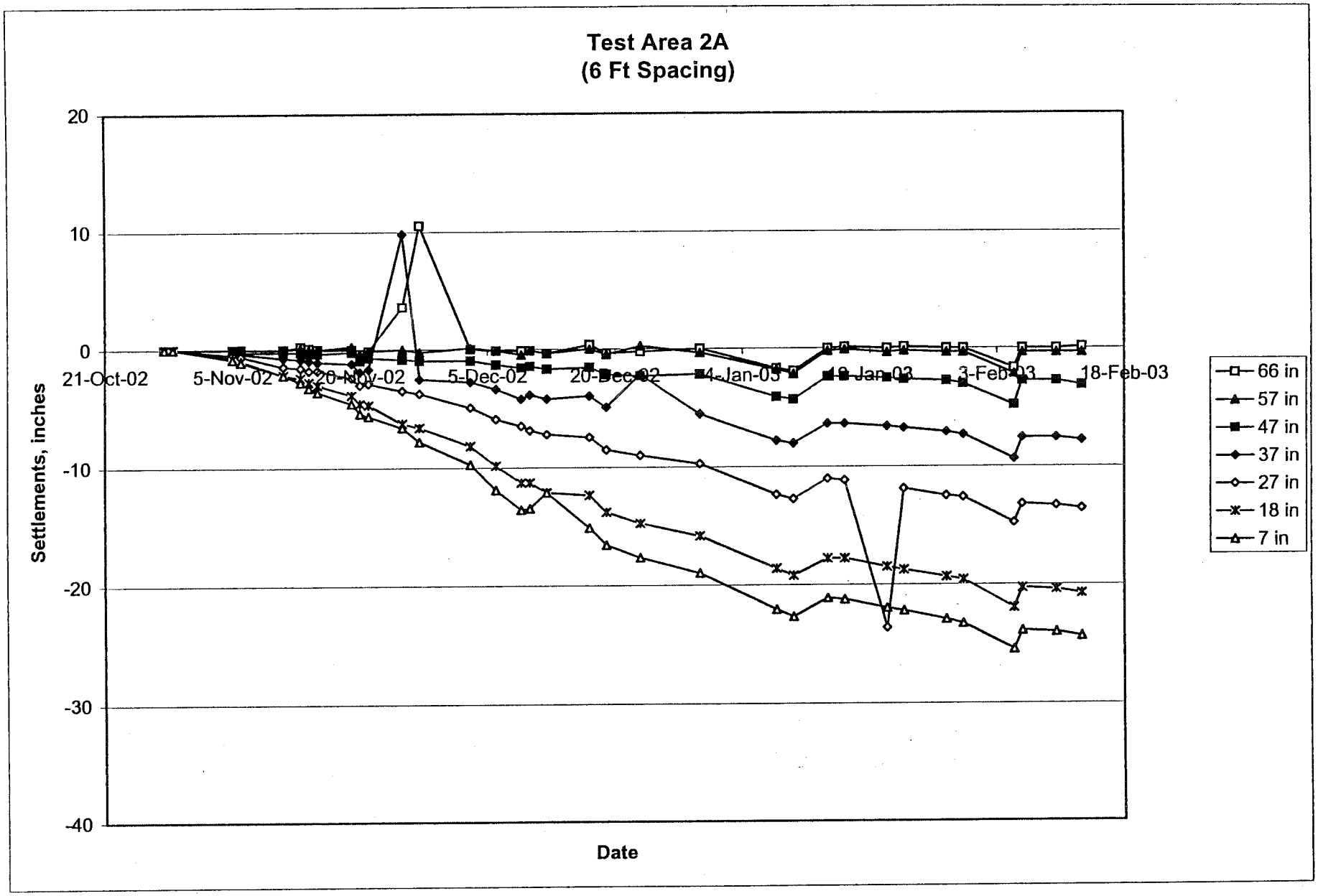


60 30 0 60
SCALE: 1" = 60'

ePVD TEST AREA LOCATION PLAN

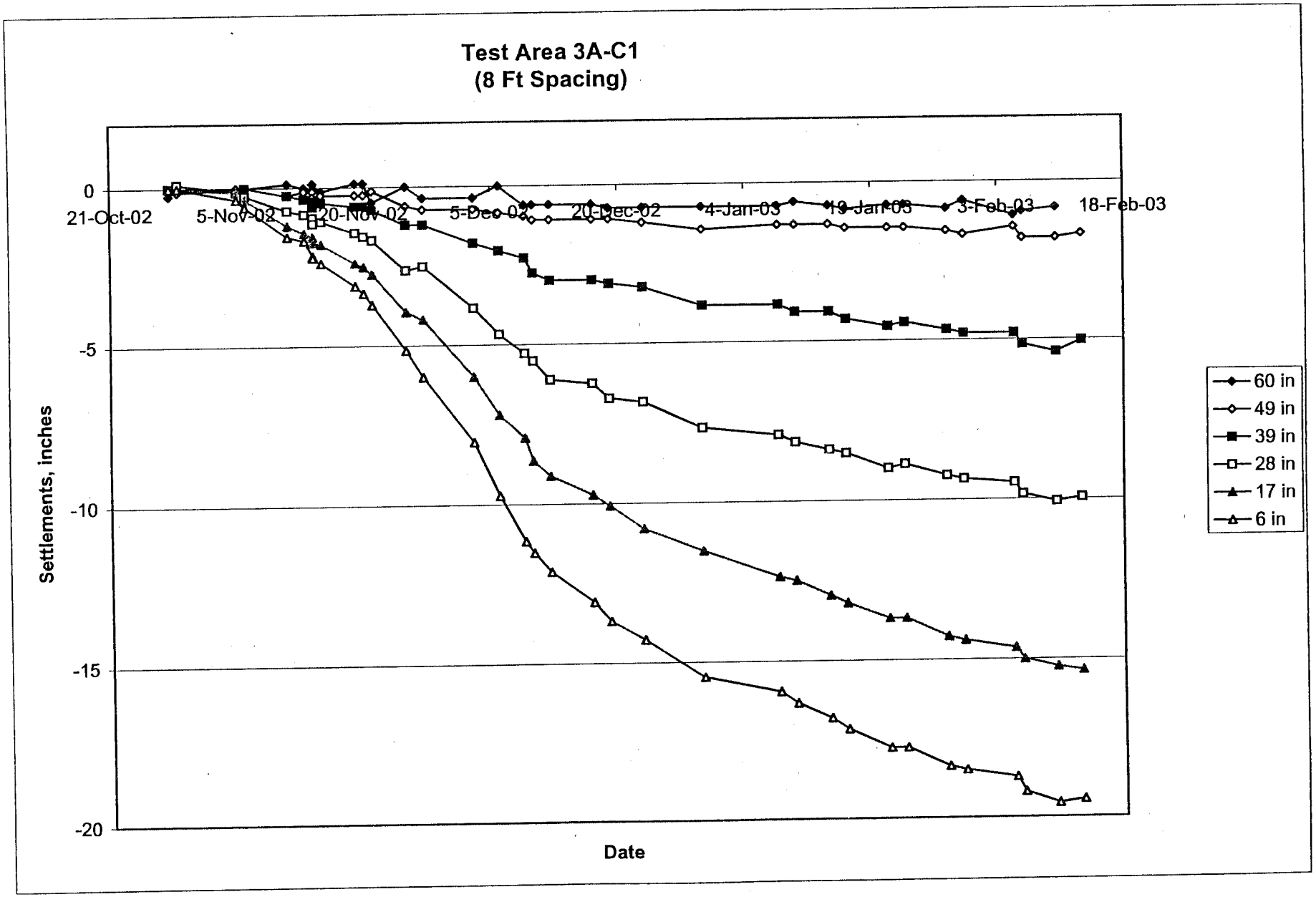
GEOSYNTEC CONSULTANTS
COLUMBIA, MARYLAND

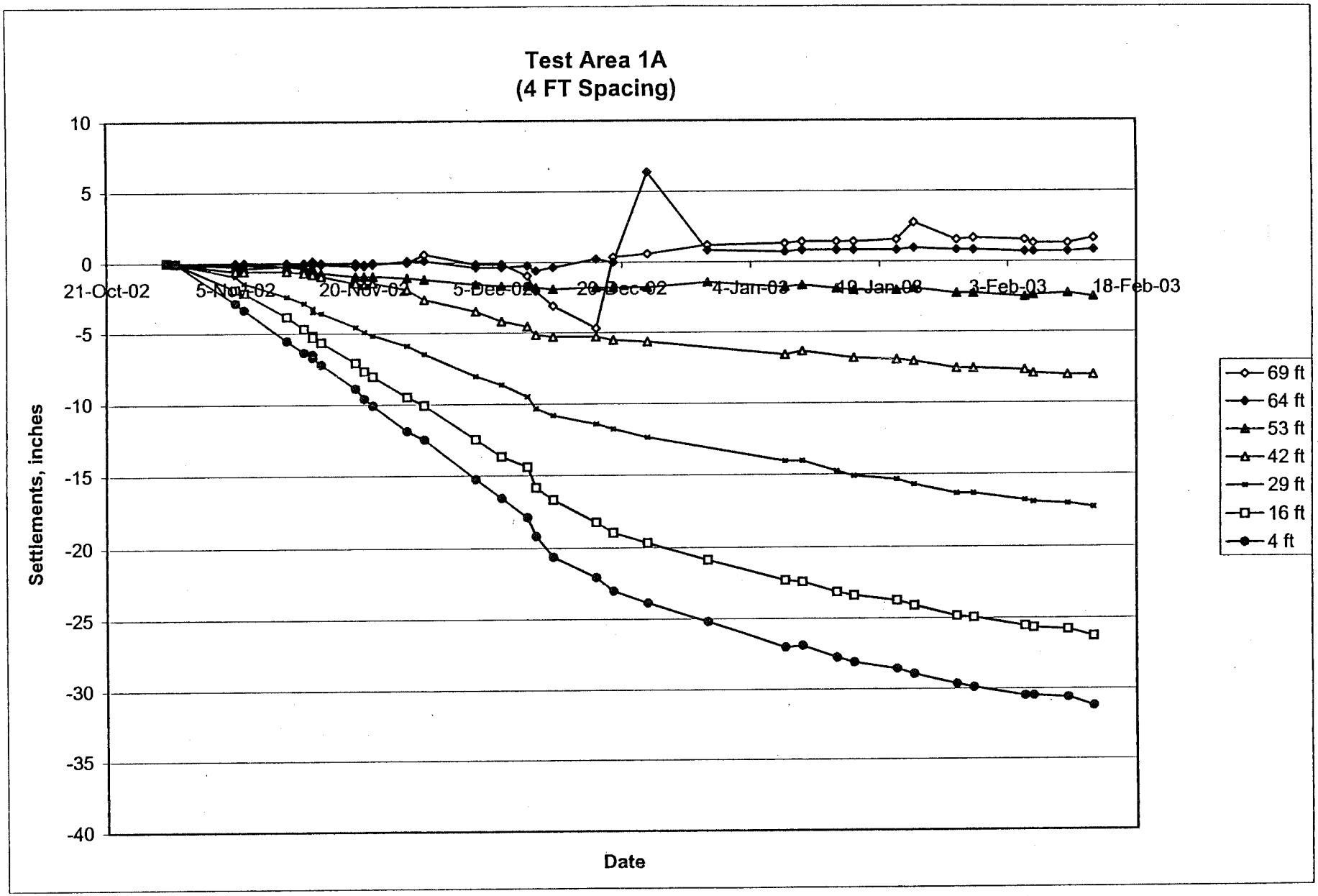
PROJECT NO.	ME0250	FILE NO.	0250F161
DOCUMENT NO.		FIGURE NO.	1



PRJ1/MENG/ME0250/SlopeStability/Figures/PZW_RSettlmt_Data_CILF02_26_03

3/20/2003


Test Area 3A-C1
(8 Ft Spacing)
Settlements, inches
0
-5
-10
-15
-20
21-Oct-02
5-Nov-02
20-Nov-02
5-Dec-02
20-Dec-02
4-Jan-03
19-Jan-03
3-Feb-03
18-Feb-03
Date
60 in
49 in
39 in
28 in
17 in
6 in



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3/20/2003

Appendix VIb-D.6

Prefabricated Vertical Drain Evaluation

GEOSYNTEC CONSULTANTS

COMPUTATION COVER SHEET

Client: DSWA **Project:** Cherry Island **Project/Proposal #:** ME0250 **Task #:** ____

TITLE OF COMPUTATIONS PREFABRICATED VERTICAL DRAIN EVALUATION

COMPUTATIONS BY:
Signature Carrie H. Pendleton — DATE 03/27/03
Printed Name and Title: Carrie H. Pendleton, Staff Engineer

ASSUMPTIONS AND PROCEDURES CHECKED BY:
(Peer Reviewer)
Signature [signature] — DATE 03/27/03
Printed Name and Title: R. David Espinoza, Senior Engineer

COMPUTATIONS CHECKED BY:
Signature Douglas T. Mandeville — DATE 3/28/03
Printed Name and Title: Douglas T. Mandeville, Senior Staff Engineer

COMPUTATIONS BACKCHECKED BY:
(Originator)
Signature Carrie H. Pendleton — DATE 03/31/03
Printed Name and Title: Carrie H. Pendleton, Staff Engineer

APPROVED BY:
(PM or Designate)
Signature [signature] — DATE 03/31/03
Printed Name and Title: R. David Espinoza, Senior Engineer

APPROVAL NOTES: ____

REVISIONS (Number and initial all revisions)

NO.	SHEET	DATE	BY	CHECKED BY	APPROVAL

Written by: Carrie Pendleton Date: 03/27/03 Reviewed by: Doug Mandeville Date: 03/28/03

Client: DSWA Project: Cherry Island Proj./Proposal No.: ME0250 Task No.:

PREFABRICATED VERTICAL DRAIN EVALUATION

1.0 PURPOSE

The purpose of this calculation package is to present and verify the adequacy of the design of the prefabricated vertical drains (PVD) to be installed under the mechanically stabilized earth (MSE) berm for the Cherry Island Landfill (CIL), Wilmington, Delaware. A PVD consists of two components:

- a plastic core; and
- a geotextile fabric surrounding the plastic core.

The purpose of the geotextile is to allow for free flow of water from the surrounding dredge/alluvium into the PVD and to prevent the migration of particles of the dredge/alluvium layer into the PVD core. The purpose of the PVD is to convey the liquids from the dredge/alluvium layer to the Columbia Formation. An important consideration for the foundation design is the ability of the PVD to remain effective over the long-run (i.e., 37 years). The main concerns that may reduce the ability of the PVDs to drain the pore water from the dredge/alluvium into the Columbia Formation are: (i) bending of the PVDs due to large expected settlement; (ii) clogging of the fabric filter with fines; and/or (iii) biological clogging. The PVD geotextile sleeve and plastic core are designed to address these concerns.

2.0 GEOTEXTILE COMPONENT

2.1 Introduction

The geotextile should be designed such that the hydraulic conductivity and apparent opening size are compatible with the dredge/alluvium.

Based on GeoSyntec's project experience and guidelines presented by Holtz et al. [1991], the following design criteria must be satisfied:

1. the geotextile must retain particles of the dredge/alluvium layer;
2. the geotextile must be permeable enough to allow free flow;
3. the geotextile must not clog during the design life of the facility; and
4. the geotextile must have sufficient mechanical properties to withstand bending due to large settlements.

2.2 Retention Criterion

From Holtz et al. [1991], the apparent opening size (AOS) of the geotextile of a PVD should meet the following design criteria:

$O_{95} \leq d_{85}$	(woven geotextile)
$O_{95} \leq 1.8\ d_{85}$	(non-woven geotextile)
AOS $\leq$ 0.3 mm	(woven & non-woven)

where O_{95} is the hole size for which 95% of the openings in the geotextile are smaller (it is for practical purposes equal to the AOS) and d_{85} is the particle size for the surrounding soil (i.e., dredge/alluvium) for which 85 percent of the particles by weight are finer. From Figure 1, d_{85} varies from 0.01 to 0.05 mm; therefore, O_{95} should be:

$O_{95} \leq$ 0.01 to 0.05 mm	(woven geotextile)
$O_{95} \leq$ 0.02 to 0.09 mm	(non-woven geotextile)

Given these restrictions, the AOS criteria will also be met.

2.3 Clogging Criterion

Soil Clogging

For fine grained soils with $k<10^{-5}$ cm/s long term filtration tests should be performed. For less critical projects the geotextile filter with the largest opening size (smallest AOS number) based on soil retention should be specified. The minimum porosity (η_g) recommended for non-woven geotextiles is $\eta_g > 30\%$, whereas for woven geotextiles the minimum porosity is $\eta_g > 4\%$. These property values can be met by most geotextiles.

Biological Clogging

For the PVDs to remain effective for a long time, their biochemical and physical stability and resistance to degradation and clogging of their geotextile filter component needs to be considered during design. Degradation or biochemical clogging of the geotextile filter could severely compromise the proper functioning of the drains.

To quantify the extent of biochemical clogging that could reasonably be expected for the PVDs, and the associated reduction factor (RF_{bc}) for flow of water through the PVD's geotextile filter, the environment in which they will be operating (indicated by the chemistry of pore water in the dredge material) was examined. Most work related to biochemical clogging of geotextile filters centers around

their use in landfill drainage systems in the aggressive environment found within landfills. In this situation, clogging is the result of a mobilization process involving fermentative bacteria, followed by precipitation processes involving primarily methanogenic and sulfate-reducing bacteria. The clog material typically comprises a soft (organic) and hard (predominantly calcium carbonate) component. The extent of biochemical clogging is highly dependent on leachate chemistry, especially pH, BOD, COD, TS (both dissolved and suspended), and calcium (Rowe, 1998; Holtz, 1991). Available dredge material pore water chemistry was compared to the leachate chemistry reported in published research studies for which values of RF_{bc} have been suggested.

The pore water chemistry data available for the dredge material is somewhat limited. Nevertheless, examination of data from 10 monitoring points reported for October 2002 (Table 4 of GeoSyntec, 2003; included as Table 1 of this calculation) indicates that COD ranges from 300 – 1,000 mg/l and TDS ranges from 1,400 – 3,000 mg/l. Bicarbonate loading is relatively high (300 – 1,100 mg/l), indicating that the pore water may be relatively alkaline, and sulfate concentrations in 3 of the 10 monitoring points were high, ranging from 700 – 1,000 mg/l. For comparison, Rowe (1998) reports that COD and TS loads in leachate that was found to cause significant biochemical clogging of geotextile filters ranged from 24,000 – 31,000 mg/l and 9,000 – 28,000 mg/l, respectively.

Table 2.12 of Koerner (1998) (Table 2 of this calculation) provides recommended values for RF_{bc} to be used for landfill filters and underdrain filters. Because the pore water chemistry is significantly milder than the above leachate chemistry reported by Rowe (1998), it is recommended that values for RF_{bc} relating to underdrain filters be used. However, because of the relatively high values for bicarbonate and sulfate, it is recommended that the upper-bound value from Table 2.12 be used, i.e., $RF_{bc} = 4.0$.

It should be noted that this recommendation is considered to be conservative and that accounting for biochemical clogging of geotextile filters in the dredge material may not be necessary. Degradation and clogging of geotextile filters is reported to be of minor importance except where they exist in high-pH environments, in contact with hazardous liquid wastes, or in oxygen-rich conditions such as exist in shallow (approximately 3 ft below ground surface), well-aerated, highly organic soils (Holtz, 1991). These conditions are not expected to exist in the dredge material.

2.4 Hydraulic Conductivity Criterion

It is recommended that the minimum hydraulic conductivity of the geotextile be greater than or equal to ten times the maximum hydraulic conductivity for the surrounding soil (i.e., dredge/alluvium layer) [Holtz et al., 1991].

$$k_{geoextile\text{-}min} > 10\, k_{dredge/alluvium}$$

If it is conservatively assumed that the maximum hydraulic conductivity of the dredge/alluvium layer material is 1 x 10^{-7} cm/s, then the minimum hydraulic conductivity of the geotextile ($k_{geotextile\text{-}min}$) must be greater than or equal to 1 x 10^{-6} cm/s.

From Koerner [1998] (see Table 2), the following equation can be used to apply a factor of safety to the required geotextile hydraulic conductivity:

$$k_{allow} = k_{geotextile-min}\left(\frac{1}{RF_{SCB} \times RF_{CR} \times RF_{IN} \times RF_{CC} \times RF_{BC}}\right)$$

where k_{allow} = allowable geotextile hydraulic conductivity,
RF_{SCB} = reduction factor for soil clogging and binding,
RF_{CR} = reduction factor for creep reduction of void space,
RF_{IN} = reduction factor for adjacent materials intruding into geotextile's void space,
RF_{CC} = reduction factor for chemical clogging, and
RF_{BC} = reduction factor for biological clogging.

For application to PVDs, the pertinent reduction factors are that for soil clogging and binding, chemical clogging, and biological clogging for underdrain filters. The maximum recommended factors for underdrain filters in Table 2.12 of Koerner [1998] are used in this calculation. The reduction factor for soil clogging and binding is already included in the factor recommended by Holtz [1991] and therefore is not considered here. The other factors are 1.5 for creep reduction of void space, 1.5 for chemical clogging, and 4.0 for biological clogging (se Section 2.3). This results in a total reduction factor of 9.0. Using the value calculated above, 1 x 10^{-6} cm/s, for $k_{geotextile\text{-}min}$, k_{allow} is calculated to be 9 x 10^{-6} cm/s. Typical permeability for geotextiles varies from 10 to 10^{-3} cm/s. Hence, the permeability criteria will be more than satisfied.

3.0 CORE COMPONENT

The hydraulic transmissivity of the core should be high enough so that the expected flows can be transmitted with an appropriate factor of safety. A typical plastic core is 0.16 inches (4-mm) thick by 4 inches (100-mm). Table 3 shows the expected flow for different radii of influence of the PVDs, and different settlement rates.

Expected Flow Condition (q_{req})

It is expected that the total settlement of the dredge/alluvium layer will be 12 ft. and will occur over 2 years (estimated rate of MSE berm construction). This results in a settlement rate of 6 ft/yr. The proposed PVD spacing is 4 ft, which results in a radius of influence of 2 ft. For these parameters, the calculated flowrate into each PVD is 75 ft^3/yr or 0.001 gpm. The core has to be able to transmit this flow with an appropriate factor of safety.

Worst-Case Flow Condition

The worst-case for which a flowrate is calculated is a settlement of 10 ft/yr and PVD spacing of 8 ft (4 ft radius of influence). The flowrate for this case is 503 ft^3/yr or 0.007 gpm. This condition is not feasible as the greater the PVD spacing, the smaller the settlement rate. However, it is used to provide an order of magnitude for flows.

Core Specifications

As discussed in Holtz et al. [1991], the flow through the PVD core depends upon the confining pressure and PVD compression strain. The core of the drain needs to be able to convey the expected flowrate for the hydraulic gradient and lateral pressure present at the site, and the expected compression due to large settlements. The site hydraulic gradient and lateral pressure are calculated in Attachment A. The hydraulic gradient (i) is calculated as 0.083 and the maximum lateral pressure is 10,976 psf (76 psi). Drain flow capacities are usually specified at a hydraulic gradient of 1.0. As shown in Table 4, hydraulic gradient and flow capacity of the drain have an approximately linear relationship, therefore the requirements for the core can be calculated as:

$$q_{core} = \frac{q_{req}}{i}$$

$$q_{core} = \frac{0.001 gpm}{0.083} = 0.012 \text{ gpm}$$

As shown in Table 5, a ten-fold reduction in flow capacity may be observed for very stiff cores. For flexible cores, this reduction is significantly less. Although a stiff to flexible core will be specified for this project, a reduction of ten will be used for this calculation. So:

$$q_{core} = 10 \times 0.012 \text{ gpm} = 0.12 \text{ gpm}$$

Using a factor of safety of 5, an acceptable drain will need to have a flow capacity of 0.6 gpm when tested with a hydraulic gradient of 1.0 at a lateral pressure of 76 psi. The factor of safety selected is considered appropriate as the quantity of flow was calculated using very conservative assumptions. After berm construction, the flow requirements will be significantly reduced.

4.0 REFERENCES

GeoSyntec Consultants (2003) "Environmental Assessment Report"

Holtz, R.D., Jamiolkowski, M.B., Lancellotta, R., and Pedroni, R. (1991) *Prefabricated Vertical Drains: Design and Performance.* CIRIA Ground Engineering Report: Ground Improvement.

Koerner, R.M. (1998) *Designing with Geosynthetics.* 4th ed.

Rowe (1998) Geosynthetics and the minimization of contaminant migration through barrier systems beneath solid waste. Proc. 6th Int. Conf. on Geosynthetics, 1998, pp. 27 – 102.

TABLE 4
SUMMARY OF INDICATOR PARAMETERS IN DREDGED MATERIAL PORE WATER

Environmental Assessment Report
Cherry Island Landfill Expansion Project
Wilmington, Delaware

Parameter	Units	October 2002 Dredged Material Pore Water Samples									
		DR-1	DR-2	DR-3	DR-4	DR-5	P4-4	P5-3A	P5-11A	P5-12A	P5-13A
Bicarbonate	mg/L	838	795	909	946	593	916	1050	306	778	333
COD	mg/L	301	318	122	368	303	209	423	62	296	88
Ammonia Nitrogen	mg/L	51.2	34.6	35	60.4	25.7	15.2	41.3	6.4	58.2	23.3
Organic Nitrogen	mg/L	14.3	12.1	18.5	14.5	11.1	12.6	8.2	2.3	18.9	10.9
Nitrate	mg/L	ND	ND	ND	ND	ND	ND	ND	0.41	ND	ND
Chloride	mg/L	463	343	300	1080	596	551	823	59	890	65.5
TDS	mg/L	1620	1500	1670	2730	2920	1960	2640	1850	2430	1460
Total Phosphates	mg/L	0.28	5.33	3.91	0.36	3.38	2.39	4.14	0.7	1.25	6.14
Sulfide	mg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	2.5
Sulfate	mg/L	0.63	ND	262	2.5	830	31	20.1	990	ND	710
TOC	mg/L	94.1	97.6	32.5	111	93.8	63.7	140	13.6	84.2	24.1

Notes: All concentrations in mg/L unless otherwise noted.

TABLE 1

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CAP

TABLE 2

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TABLE 2.12 RECOMMENDED REDUCTION FACTOR VALUES FOR USE IN EQ. (2.25a)

Application	Range of Reduction Factors				
	Soil Clogging and Blinding*	Creep Reduction of Voids	Intrusion into Voids	Chemical Clogging†	Biological Clogging
Retaining wall filters	2.0 to 4.0	1.5 to 2.0	1.0 to 1.2	1.0 to 1.2	1.0 to 1.3
Underdrain filters	5.0 to 10	1.0 to 1.5	1.0 to 1.2	1.2 to 1.5	2.0 to 4.0
Erosion-control filters	2.0 to 10	1.0 to 1.5	1.0 to 1.2	1.0 to 1.2	2.0 to 4.0
Landfill filters	5.0 to 10	1.5 to 2.0	1.0 to 1.2	1.2 to 1.5	5 to 10‡
Gravity drainage	2.0 to 4.0	2.0 to 3.0	1.0 to 1.2	1.2 to 1.5	1.2 to 1.5
Pressure drainage	2.0 to 3.0	2.0 to 3.0	1.0 to 1.2	1.1 to 1.3	1.1 to 1.3

*If stone riprap or concrete blocks cover the surface of the geotextile, use either the upper values or include an additional reduction factor.

†Values can be higher particularly for high alkalinity groundwater.

‡Values can be higher for turbidity and/or for microorganism contents greater than 5000 mg/l.

$$q_{\text{allow}} = q_{\text{ult}}\left(\frac{1}{\Pi\text{RF}}\right) \tag{2.25b}$$

where

q_{allow} = allowable flow rate,
q_{ult} = ultimate flow rate,
RF_{SCB} = reduction factor for soil clogging and blinding,
RF_{CR} = reduction factor for creep reduction of void space,
RF_{IN} = reduction factor for adjacent materials intruding into geotextile's void space,
RF_{CC} = reduction factor for chemical clogging,
RF_{BC} = reduction factor for biological clogging, and
ΠRF = value of cumulative reduction factors.

As with Eqs. (2.24) for strength reduction, this flow-reduction equation could also have included additional site-specific terms, such as blocking of a portion of the geotextile's surface by riprap or concrete blocks.

2.5 DESIGNING FOR SEPARATION

Application areas for geotextiles used for the separation function were given in Section 1.3.3. There are many specific applications, and it could be said, in a general sense, that geotextiles always serve a separation function. If they do not also serve this function, any other function, including the primary one, will not be served properly. This should not give the impression that the geotextile function of separation always plays a secondary role. Many situations call for separation only, and in such cases the geotextiles serve a significant and worthwhile function.

Ref: Koerner, 1998.

CHP
JTM

TABLE 3

PVD Volume Calcs (ft^3/year)			
Settlement/Yr (ft)	Radius of Influence (ft)		
	2	3	4
5	63	141	251
6	75	170	302
7	88	198	352
8	101	226	402
9	113	254	452
10	126	283	503

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PTM

TABLE 4

Table 25 The influence of hydraulic gradient on the measured discharge capacity for four prefabricated drains (data from ENEL–CRIS)

	Lateral pressure (kN/m²)	*Hydraulic gradient, i*	*Drain discharge capacity, q_w (m³/year)*	*q_w at i / q_w at i=1*
Mebradrain MD 7017	299	1	87	1
	299	0.5	50	0.57
	299	0.2	22	0.25
	492	1	21	1
	492	0.5	13	0.62
	492	0.2	5	0.24
	568	1	18	1
	568	0.5	9	0.50
	568	0.2	3.5	0.19
Mebradrain MD 7417	294	1	41	1
	294	0.5	15	0.37
	294	0.2	4	0.10
	491	1	8	1
	491	0.5	3.6	0.45
	491	0.2	1	0.13
	576	1	5.6	1
	576	0.5	2.9	0.52
	576	0.2	0.9	0.16
Mebradrain MD 7407	99	1	1163	1
	99	0.5	660	0.57
	99	0.2	281	0.24
	295	1	948	1
	295	0.5	506	0.53
	295	0.2	212	0.22
	578	1	768	1
	578	0.5	392	0.51
	578	0.2	154	0.20
Geodrain L (Filter 8A2)	102	1	1095	1
	102	0.5	567	0.52
	102	0.2	229	0.21
	197	1	862	1
	197	0.5	410	0.48
	197	0.2	168	0.20
	294	1	671	1
	294	0.5	341	0.51
	294	0.2	140	0.21

Ref: Holtz, 1991.

($\sim 3 \times 10^{-6}$ m³/s or 90 m³/year). This requirement is based on an allowable settlement of 40 mm/day for a 30 m long, 100 mm wide, drain. In 1982, the Dutch recommended a minimum q_w of 160 m³/year under a hydraulic gradient, i, of about 0.6 and confining pressure of 100 kN/m² (Kremer *et al.*, 1982). This is the same as their q_w requirement for sand drains. They recommended that testing for discharge capacity should also be performed on a sample of drain folded to a 'flattened-S configuration', and the capacity of the folded drain should be at least 30% of the minimum q_w, or 48 m³/year.

Later, Kremer *et al.* (1982) recommended a minimum drain discharge capacity of

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DTM

TABLE 5

Table 26 Discharge capacities of drains before and after being folded by 25% vertical compression

COLBOND CX 100 (very stiff drain)

Straight		Folded		$\frac{q_w\text{-straight}}{q_w\text{-folded}}$
σ_h (kN/m²)	q_w (m³/year)	σ_h (kN/m²)	q_w (m³/year)	
128	546	104	25	
305	456	197	55	
482	411	393	50	
591	401	586	43	→ 9.3

TECNODRAIN 3 (stiff drain)

Straight		Folded		
σ_h (kN/m²)	q_w (m³/year)	σ_h (kN/m²)	q_w (m³/year)	
103	714	106	151	
196	560	196	117	
296	504	294	125	
493	406	492	104	
590	379	593	88	→ 4.3

MEBRADRAIN (flexible drain)

Straight		Folded		
σ_h (kN/m²)	q_w (m³/year)	σ_h (kN/m²)	q_w (m³/year)	
99	1462	100	780	
196	1214	199	693	
295	1042	295	650	
492	872	493	507	
588	745	589	506	→ 1.5

Notes: σ_h = *total lateral stress.*
q_w = *discharge capacity.*

Ref: Holtz, 1991.

6.5.3 Siltation

Another possibility which could increase well resistance and decrease the discharge capacity is 'siltation', which occurs when very fine soil particles pass through the filter and into the core channels. There may be some circumstances in which the flow rates are sufficient to remove any fines which may have entered the core, e.g. very short drains or fully penetrating drains in which both upward and downward flow occurs. But the more common situation is one in which the hydraulic gradients and flow rates

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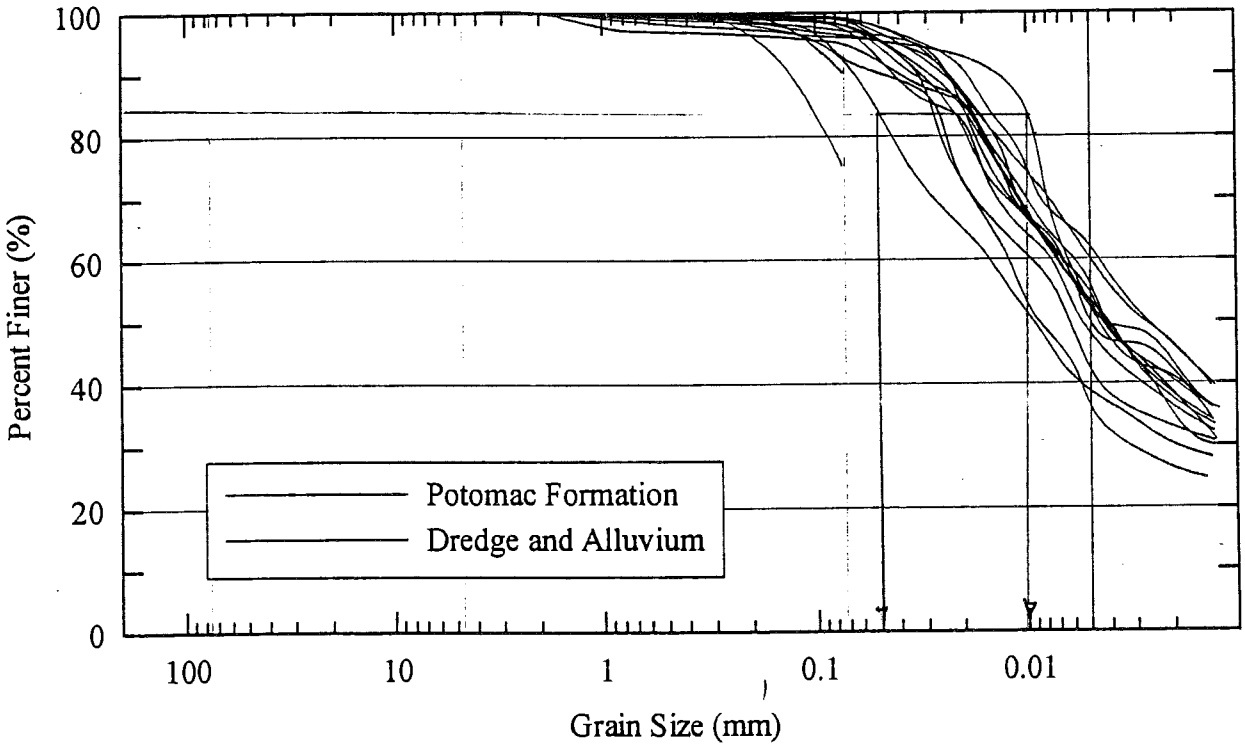
DTM

Cobbles	Gravel		Sand			Fines (Silt and Clay)
	Coarse	Fine	Coarse	Medium	Fine	
Size (mm)	19	4.75	2.0	0.425	0.075	
Sieve No.		#4	#10	#20#40	#60 #200	



Grain Size2(2).grf

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10015 Old Columbia Road, Suite A-200
Columbia, Maryland 21046

Particle Size Distribution of Dredge, Alluvium and Potomac Formation

FIGURE 1

PROJECT: ME0250
Cherry Island

Written by: Carrie Pendleton Date: 03/27/03 Reviewed by: Doug Mandeville Date: 03/28/03

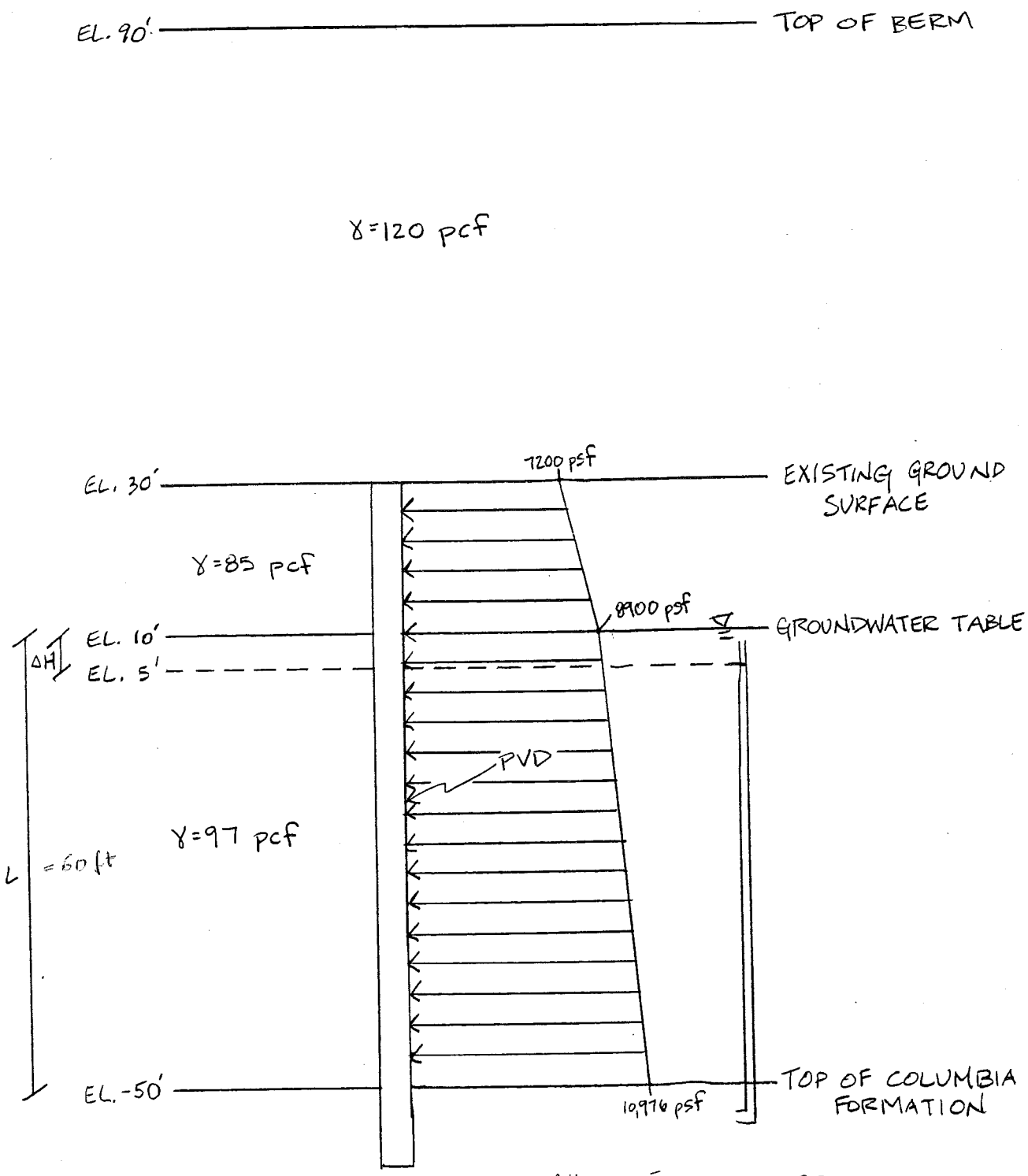
Client: DSWA Project: Cherry Island Proj./Proposal No.: ME0250 Task No.:

ATTACHMENT A

Written by: Carrie Pendleton Date: 03/03/27 (YY/MM/DD) Reviewed by: Doug Manderville Date: 03/03/28 (YY/MM/DD)

Client: DSWA Project: Cherry Island Project/Proposal No.: ME0250 Task No.:

ATTACHMENT A



$\Delta H = 5$ ft

$\gamma = \frac{\Delta H}{L} = \frac{5}{60} = 0.083$

APPENDIX VIb-E

MISCELLANEOUS

Appendix VIb-E.1

Evaluation of Navigation Beacon Tower

GEOSYNTEC CONSULTANTS

COMPUTATION COVER SHEET

Client: DSWA **Project:** Cherry Island **Project/Proposal #:** ME0250 **Task:** _____

TITLE OF COMPUTATIONS: STRUCTURAL STABILITY OF EXISTING NAVIGATION BEACON TOWER

COMPUTATATIONS BY:
Signature Carrie H. Pendleton — DATE 03/21/03
Printed Name and Title: Carrie H. Pendleton, Staff Engineer

ASSUMPTIONS AND PROCEDURES CHECKED BY:
(Peer Reviewer)
Signature — DATE 3/21/03
Printed Name and Title: R. David Espinoza, Senior Engineer

COMPUTATATIONS CHECKED BY:
Signature — DATE 3/21/03
Printed Name and Title: R. David Espinoza, Senior Engineer

COMPUTATIONS BACKCHECKED BY:
(Originator)
Signature Carrie H. Pendleton — DATE 03/21/03
Printed Name and Title: Carrie H. Pendleton, Staff Engineer

APPROVED BY:
(PM or Designate)
Signature — DATE 3/22/03
Printed Name and Title: R. David Espinoza, Senior Engineer

APPROVAL NOTES: _____

REVISIONS: (Number and initial all revisions)

NO.	SHEET	DATE	BY	CHECKED BY	APPROVAL

Written by: C. Pendleton Date: 03/21/03 Reviewed by: R. Espinoza Date: 03/21/03

Client: DSWA Project: Cherry Island Proj./Proposal No.: ME0250 Task No. _____

STRUCTURAL STABILITY OF EXISTING NAVIGATION BEACON TOWER

PURPOSE

The structural integrity and settlement potential of the existing navigation beacon tower located on the north side of Phase III needs to be assessed. Mechanically Stabilized Earth (MSE) berm construction and additional waste placement will cause settlement in the area around the tower. It is necessary to ensure that effective use of the tower will not be compromised by this settlement. In order to do this, it will be shown that the tower will not settle due to dredge and alluvium settlement in the same area.

DISCUSSION

The location of the navigation beacon tower is shown on Figure 1. In addition, Figure 1 shows the stationing for the stratigraphy cross sections of the site. We can see that the tower is located at approximately Station 35+00. The cross section from Station 25+00 to Station 50+00 is shown in Figure 2 (Figure 4-3 from the Geotechnical Characterization Report). For the tower not to be influenced by settlement of the surrounding MSE berm, its foundation needs to be anchored in the Columbia Formation. Figure 3 (obtained from Mr. Michael Baroco of the U.S. Coast Guard) shows the design drawings for the tower. Section A1 on Figure 3 shows that the total depth of the beacon below ground surface is approximately 68.5 ft. The existing ground elevation at the beacon is approximately 26 ft-msl. Therefore, the piles terminate at approximately -42.5 ft-msl. From Figure 2, we can see that the elevation of the top of the Columbia Formation at the location of the tower is approximately -30 ft-msl. Therefore, the tower piles will extend approximately 12.5 ft into the Columbia Formation. Hence, the beacon tower will not be influenced by surrounding settlements.

In addition, the dragdown forces applied to the steel pile will be:

$$F_d = 2\pi D C_v H$$

where:

D	= 18 in (pile diameter)
H	= 56 ft (length of pile in dredge)
C_v	≅ 300 psf (remolded shear strength)

$$F_d = 158{,}336 \text{ lbs}$$

$$\sigma_d = F_d / A = 158{,}336 \text{ lbs} / (2\pi)(18''/2)(0.5'') = 5{,}600 \text{ psi} << 36{,}000 \text{ psi}$$

Hence, the pile structural integrity will not be affected.

FIGURE 1

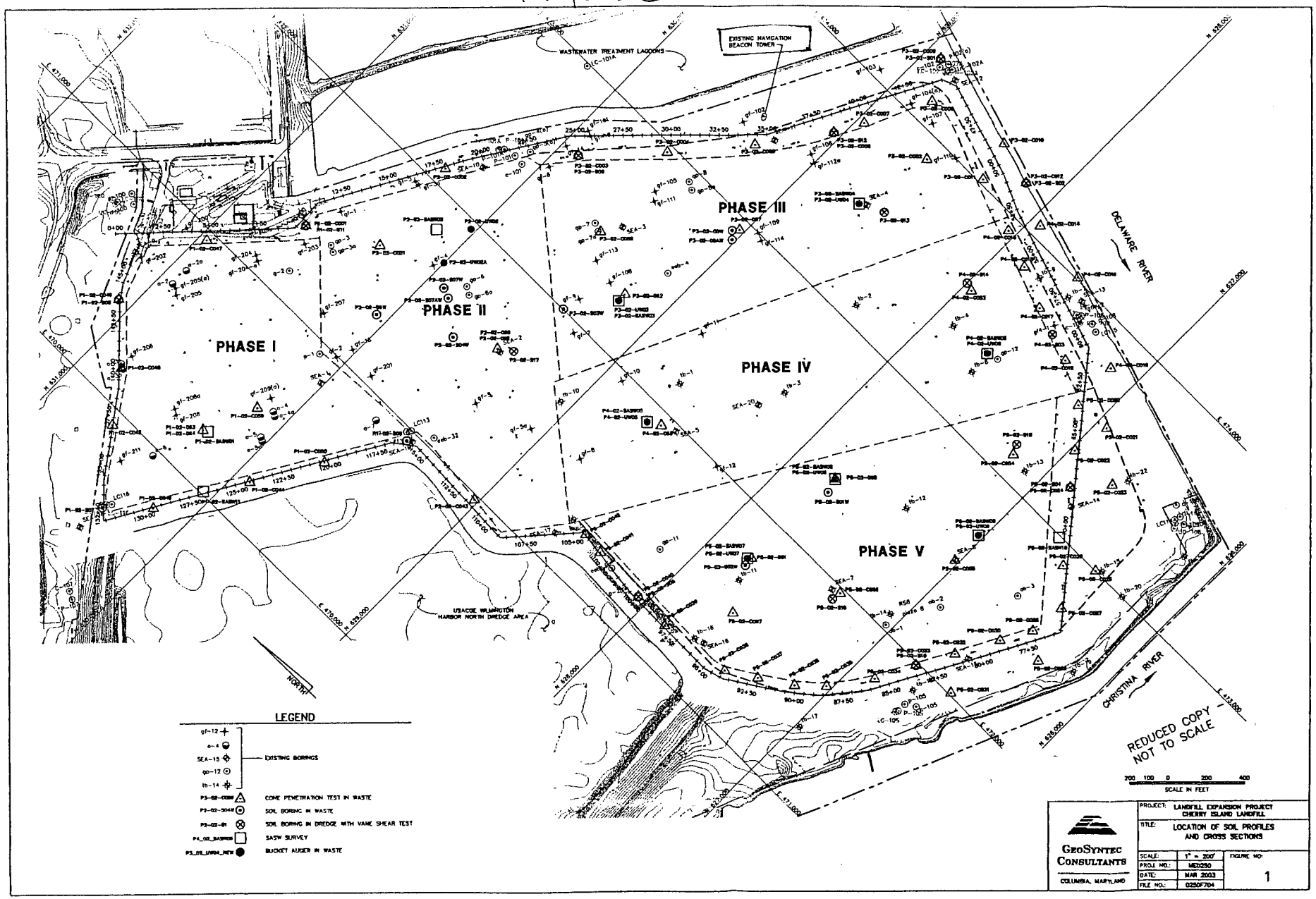
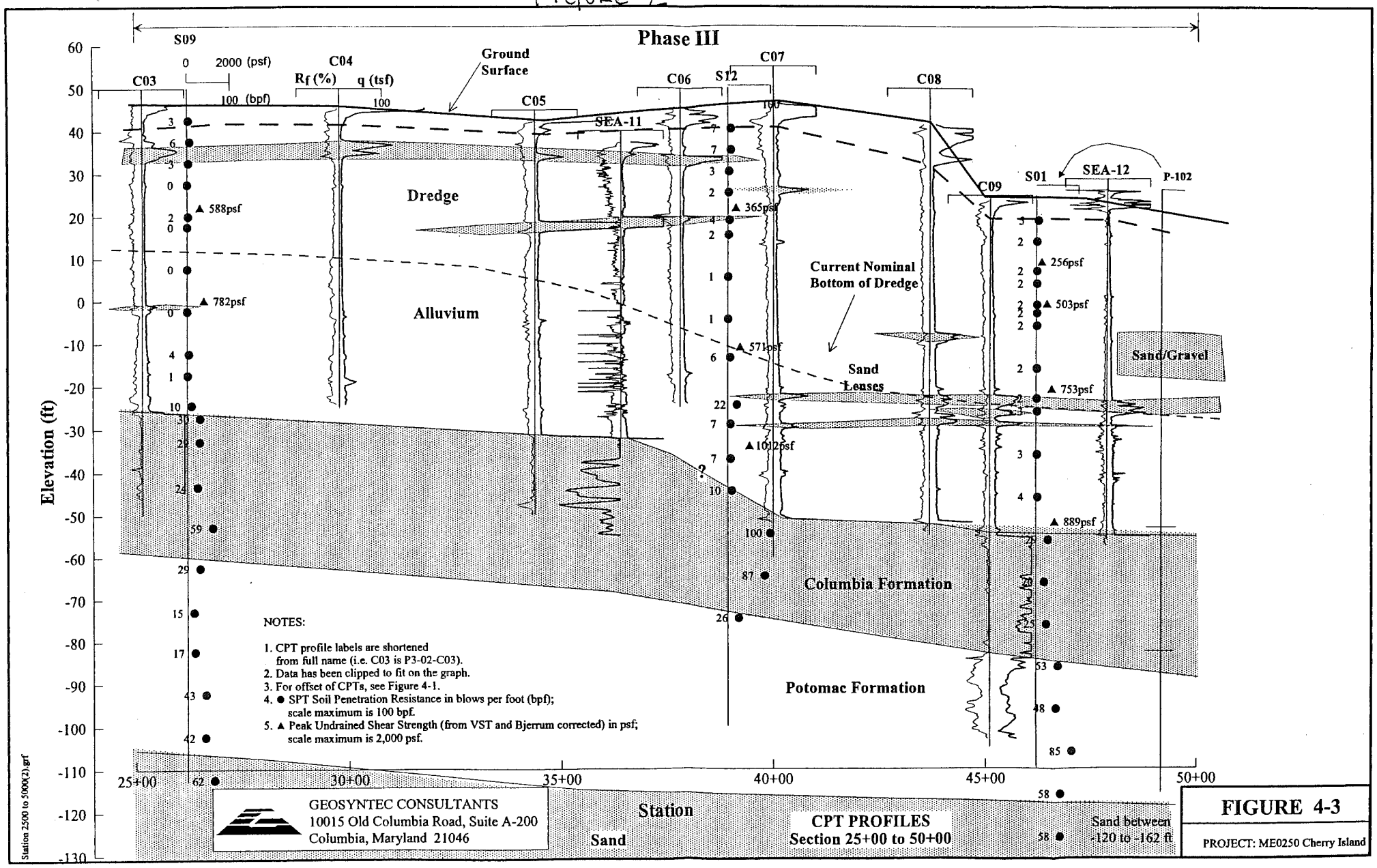

WASTEWATER TREATMENT LAGOONS
EXISTING NAVIGATION BEACON TOWER
PHASE I
PHASE II
PHASE III
PHASE IV
PHASE V
DELAWARE RIVER
CHRISTINA RIVER
USACOE WILMINGTON HARBOR NORTH DREDGE AREA
NORTH
LEGEND
EXISTING BORINGS
CONE PENETRATION TEST IN WASTE
SOIL BORING IN WASTE
SOIL BORING IN DREDGE WITH VANE SHEAR TEST
SASW SURVEY
BUCKET AUGER IN WASTE
REDUCED COPY NOT TO SCALE
SCALE IN FEET
GEOSYNTEC CONSULTANTS
COLUMBIA, MARYLAND
PROJECT: LANDFILL EXPANSION PROJECT CHERRY ISLAND LANDFILL
TITLE: LOCATION OF SOIL PROFILES AND CROSS SECTIONS
SCALE: 1" = 200'
PROJ. NO.: MEX250
DATE: MAR 2003
FILE NO.: 0250F704
FIGURE NO: 1

FIGURE 7


Phase III
S09
C03
C04
C05
C06
S12
C07
C08
C09
S01
SEA-11
SEA-12
P-102
0 2000 (psf)
100 (bpf)
Rf (%)
q (tsf)
Ground Surface
Dredge
Alluvium
Current Nominal Bottom of Dredge
Sand Leases
Sand/Gravel
Columbia Formation
Potomac Formation
588psf
782psf
365psf
571psf
1012psf
256psf
503psf
753psf
889psf
Elevation (ft)
Station
Sand
Sand between -120 to -162 ft
25+00
30+00
35+00
40+00
45+00
50+00
NOTES:
1. CPT profile labels are shortened from full name (i.e. C03 is P3-02-C03).
2. Data has been clipped to fit on the graph.
3. For offset of CPTs, see Figure 4-1.
4. ● SPT Soil Penetration Resistance in blows per foot (bpf); scale maximum is 100 bpf.
5. ▲ Peak Undrained Shear Strength (from VST and Bjerrum corrected) in psf; scale maximum is 2,000 psf.
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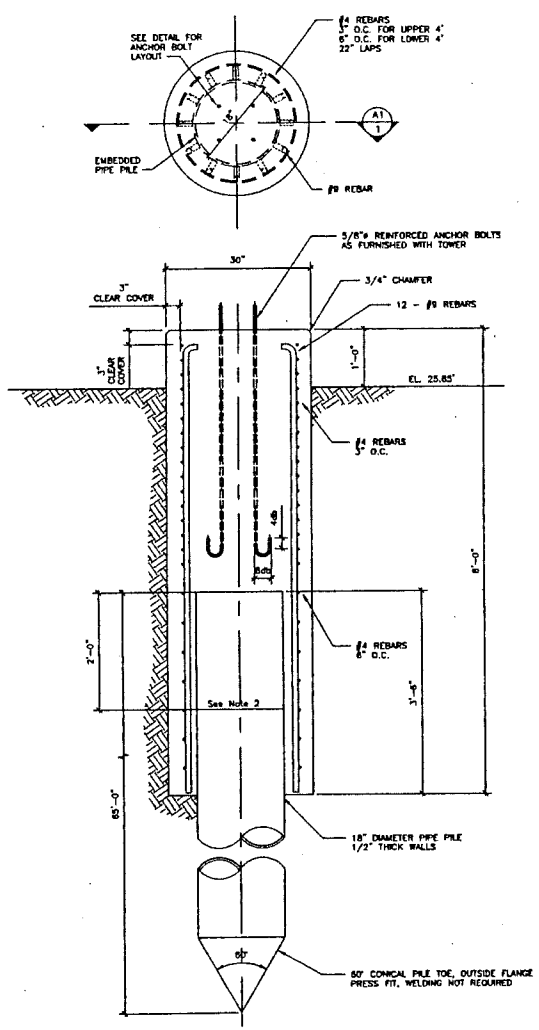
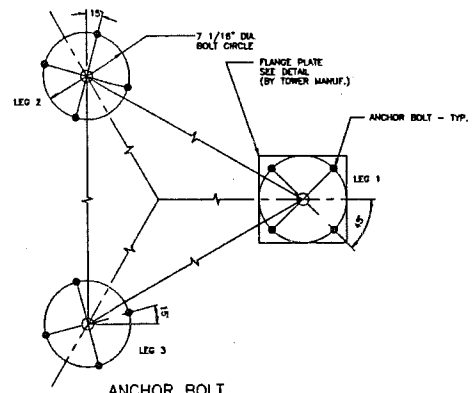
10015 Old Columbia Road, Suite A-200
Columbia, Maryland 21046
CPT PROFILES
Section 25+00 to 50+00
FIGURE 4-3
PROJECT: ME0250 Cherry Island
Station 2500 to 5000(2).grf

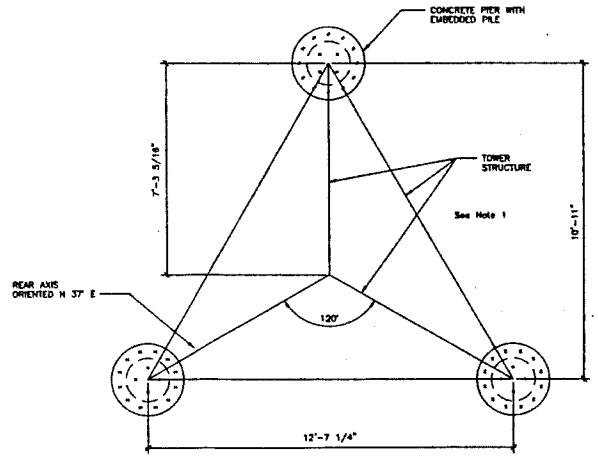
FIGURE 3



SECTION A1
SCALE: 1" = 1'-0"



ANCHOR BOLT PATTERN LAYOUT - DETAIL
SCALE: NTS



Notes
1. Coordinate tower foundation dimensions with tower supplier.
2. Install a 3/16" A36 steel plate (lock welded) in place.

TOWER ORIENTATION
SCALE: 1/2" = 1'-0"

DICHROMA, INCORPORATED
ALEXANDRIA, VIRGINIA
(703) 921-1440

CONSULTANTS

U. S. COAST GUARD
CIVIL ENGINEERING UNIT, CLEVELAND

USCG, CEU CLEVELAND
1240 EAST 9TH STREET
CLEVELAND, OH 44199-2060

MARK	DATE	DESCRIPTION
02	03/24/00	BW

A/E PROJECT NO: 090
CAD FILE NAME: C6433C01
DESIGNED BY: JPO
DRAWN BY: BW
EDITED BY:
CHECKED BY: 3-31-00

SCALE: AS SHOWN PLOT SCALE: 1" = 1'-0"

SHEET TITLE
BELLEVUE RANGE REAR
WILMINGTON DELEWARE

FOUNDATION DETAILS

REVIEWED BY: PROJECT ENG. REVIEWED BY: BRANCH CHIEF REVIEWED BY: TECH. DIRECTOR
R.E. MOBLEY APPROVING OFFICER 03/24/00 DATE

PROJECT NUMBER	DRAWING NUMBER
05-C0911	6433-D
DISCIPLINE/SHT NO	SHEET 1 OF 1
C-01	

APPENDIX VIb-F

LINER SYSTEM CALCULATIONS

Appendix VIb-F.1

Geomembrane Puncture Resistance-Liner

GEOSYNTEC CONSULTANTS

COMPUTATION COVER SHEET

Client: DSWA **Project:** Cherry Island Landfill **Project/Proposal #:** ME0250 **Task #:** ____

TITLE OF COMPUTATIONS GEOMEMBRANE PUNCTURE RESISTANCE - LINER

COMPUTATIONS BY:
Signature Carrie H. Pendleton — DATE 03/18/03
Printed Name and Title: Carrie H. Pendleton, Staff Engineer

ASSUMPTIONS AND PROCEDURES CHECKED BY:
(Peer Reviewer)
Signature [signature] — DATE 3/18/03
Printed Name and Title: R. David Espinoza, Senior Engineer

COMPUTATIONS CHECKED BY:
Signature Douglas T. Mandeville — DATE 3/21/03
Printed Name and Title: Douglas T. Mandeville, Senior Staff Engineer

COMPUTATIONS BACKCHECKED BY:
(Originator)
Signature Carrie H. Pendleton — DATE 03/27/03
Printed Name and Title: Carrie H. Pendleton, Staff Engineer

APPROVED BY:
(PM or Designate)
Signature [signature] — DATE 3/30/03
Printed Name and Title: R. David Espinoza, Senior Engineer

APPROVAL NOTES: The calculations presented herein are suitable for a landfill elevation of 195 ft-msl. As shown in this calculation package, the design was performed for a more conservative grading configuration than that shown in Drawing 78 entitled "Landfill Final Development and Grading Plan" (Appendix VIb-A).

RDE 6/10/04

REVISIONS (Number and initial all revisions)

NO.	SHEET	DATE	BY	CHECKED BY	APPROVAL

Written by: C. Pendleton Date: 03/17/03 Reviewed by: R. Espinoza Date: 03/17/03

Client: DSWA Project: Cherry Island Proj./Proposal No.: ME0250 Task No.: _____

GEOMEMBRANE PUNCTURE RESISTANCE - LINER

PURPOSE

The purpose of this analysis is to evaluate the puncture resistance of a 60-mil geomembrane. A 60-mil geomembrane material will be used as a liner component and will be in contact with a geosynthetic clay liner (GCL) and a leachate collection zone. In order for the geomembrane to work efficiently as a barrier layer, puncturing of the geomembrane should be minimized. Also presented in this calculation package is a bearing capacity calculation for failure of the overlying soil due to construction equipment.

METHOD

Figure 1 shows the liner system cross section. The puncture resistance will be evaluated for construction equipment working above the 60 mil geomembrane liner.

Geomembrane Allowable Pressures

The allowable vertical stresses on geomembranes are based on typical manufacturer puncture resistance [Geosynthetics Research Institute, 1999] and modified by factors presented by Narejo et at. [1996]. Modification factors are applied in the following manner to compute the allowable pressure on the geomembrane.

$$P_{allow} = \frac{P_{lab}}{MF_s \times MF_{pd} \times MF_a \times FS_{cr} \times FS_{cbd}}$$

Where:

P_{allow}	=	Allowable vertical stress on geomembrane
P_{lab}	=	Ultimate vertical stress from controlled laboratory tests
MF_s	=	Modification factor for protrusions
MF_{pd}	=	Modification factor for packing density
MF_a	=	Modification factor for arching
FS_{cr}	=	Factor of safety for creep
FS_{cbd}	=	Factor of safety against chemical and biological degradation

Values of the modification factors (MF) and factors of safety (FS) are taken from Tables 1 through 4 at the end of this calculation package. The modification factors are used to modify the laboratory puncture resistance according to how the expected field condition is modeled in the laboratory. Field conditions which are less harmful to the geomembrane than

laboratory testing conditions are conservatively assumed to have a modification factor of 1. The modification factors used in this calculation are shown in the following table:

	Liner System 60 mil HDPE Geomembrane	
	Factor	Comments
MF_s	1	Subgrade assumed angular
MF_{pd}	1	Protrusions possible (conservative)
MF_a	1	No arching effects assumed
FS_{cr}	2	Assume 6 mm protrusions with no geotextile
FS_{cbd}	1.5	Suggested value from Narejo et al.

Based on the factors listed in the previous table, the laboratory puncture resistances are modified to represent the allowable pressure used for design.

	Liner System (60 mil textured HDPE)
Puncture resistance(1) (lb.)	90
Puncture resistance(2) ,P_{lab} (psi)	7334
Puncture resistance, P_{allow} (psi)	2118

NOTES:

(1) Based on test method ASTM D 4833. (GRI, 1999)

(2) Test probe diameter of 1/8 inch (0.125 in) used to convert puncture resistance from lb. to psi.

Design Pressures

The total vertical stress on the geomembrane is calculated as the sum of the overlying soil pressure and the pressure exerted by the construction equipment.

Written by: C. Pendleton Date: 03/17/03 Reviewed by: R. Espinoza Date: 03/17/03

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$$p_{act} = (\gamma_{ave} \times T) + q_{eqp}$$

Where:

p_{act} = vertical stress on the geomembrane
γ_{ave} = average unit weight of the material above geomembrane
T = thickness of the soil material above geomembrane
q_{eqp} = equipment ground pressure

To evaluate the maximum pressure of a construction vehicle above the geomembrane, two typical dozers are assumed: (i) a CAT D6H, Series II, LGP; and (ii) a CAT D6H, Series II. For this evaluation, a minimum lift thickness of 1 foot of soil will be evaluated as the most conservative case. As the amount of soil above the geomembrane increases the allowable ground pressure of construction traffic increases. The following table lists the required information about the assumed construction equipment and the calculated design pressures.

Load Type	Contact Area(in^2)	Ground pressure q_{eqp} (psi)	Design pressure (2) p_{act} (psi)
CAT D6H, Series II(1)	4564	8.56	9.32
CAT D6H, Series II, LGP(1)	9255	4.71	5.47
Waste(3)	-	-	130

NOTES:
(1) Equipment data taken from Caterpillar Performance Handbook, 23 edition, Oct, 1992.
(2) including 1 foot of overlying soil with a unit weight 110 pcf.
(3) Assume waste thickness and unit weight of 250 ft and 75 pcf, respectively.

Factor of Safety against Puncture Failure

The factor of safety against puncture resistance for the load above the geomembrane is defined as:

$$FS = \frac{p_{allow}\ (psi)}{p_{act}\ (psi)}$$

Based on the pressures calculated, the factors of safety against puncture resistance for the cap and liner geomembrane are:

Load	60 mil Geomembrane Liner
CAT D6H, Series II	>100
CAT D6H, Series II, LGP	>100
Waste	16.3

Bearing Capacity

A factor of safety against bearing capacity failure of the soils overlying the geomembrane during construction is calculated. The construction equipments are the same as the ones in the previous section. The bearing capacity equation used for analysis is taken from NAV-FAC Design Manual 7.2 [1982] for a continuous strip footing.

$$q_{ult} = \left(\frac{1}{2}\gamma\ B\ N_\gamma\right) + \left(\gamma\ D_f\ N_q\right)$$

Where:

q_{ult}	=	ultimate capacity of the soil
B	=	footing width (Standard shoe width)
γ	=	unit weight of foundation soil
D_f	=	depth of the footing
N_γ, N_q	=	bearing capacity factors

Written by: C. Pendleton Date: 03/17/03 Reviewed by: R. Espinoza Date: 03/17/03

Client: DSWA Project: Cherry Island Proj./Proposal No.: ME0250 Task No.: _____

The construction equipment will work on the surface of the soil. Therefore, the footing depth in the second term of the bearing capacity equation will go to zero leaving only the first term. The bearing capacity factor Nγ is taken from the chart in Figure 2.

q_{ult} = 0.5(110 pcf) (22 in./12 in.) (18) (1 ft^2 / 144 in^2) = 20.6 (CAT D6H LGP, Series II)

q_{ult} = 0.5(110 pcf) (36 in./12 in.) (18) (1 ft^2 / 144 in^2) = 12.6 (CAT D6H, Series II)

The factor of safety for bearing capacity of the soil is calculated as the ratio of the ultimate bearing capacity, q_{ult}, to the applied ground pressure, q_{eqp}, of the construction equipment. The following table summarizes the ultimate bearing capacity of the ground and the calculated factor of safety against bearing capacity failure.

Equipment	Standard Shoe Width, B (inches)	n_γ (From Figure 2)	q_{ult} (1) (psi)	Ground Pressure, q_{eqp}, (psi)	Factor of safety, (q_{ult}/q_{eqp})
CAT D6H, Series II,	22	18	12.6	8.56	1.5
CAT D6H, Series II, LGP	36	18	20.6	4.71	4.4

NOTES:
(1) Soil unit weight assumed to be 110 pcf.

RESULTS

Based on the analysis presented here, the Caterpillar D6H Series II LGP and D6H Series II operating with a minimum of one foot of cover soil will not compromise the geomembrane puncture resistance or cause a bearing capacity failure of the overlying soil. Other vehicles with equal or lower ground pressures may also operate safely.

Written by: C. Pendleton Date: 03/17/03 Reviewed by: R. Espinoza Date: 03/17/03

Client: DSWA Project: Cherry Island Proj./Proposal No.: ME0250 Task No.:

REFERENCES

Caterpillar Performance Handbook, 23 edition, Oct. 1992.

"Foundations and Earth Structures Design Manual 7.2", Department of the Navy, Naval Facilities Engineering Command, Alexandria, Virginia, May 1982.

Geosynthetics Research Institute, GM13, 1999.

Narejo, D RM. Koerner and RF Wilson-Fahmy,"Puncture Protection of Geomembranes, Part II; Experimental", Geosynthetics International, Vol 3 No. 5 1996.

PHASE Va LINER DETAIL

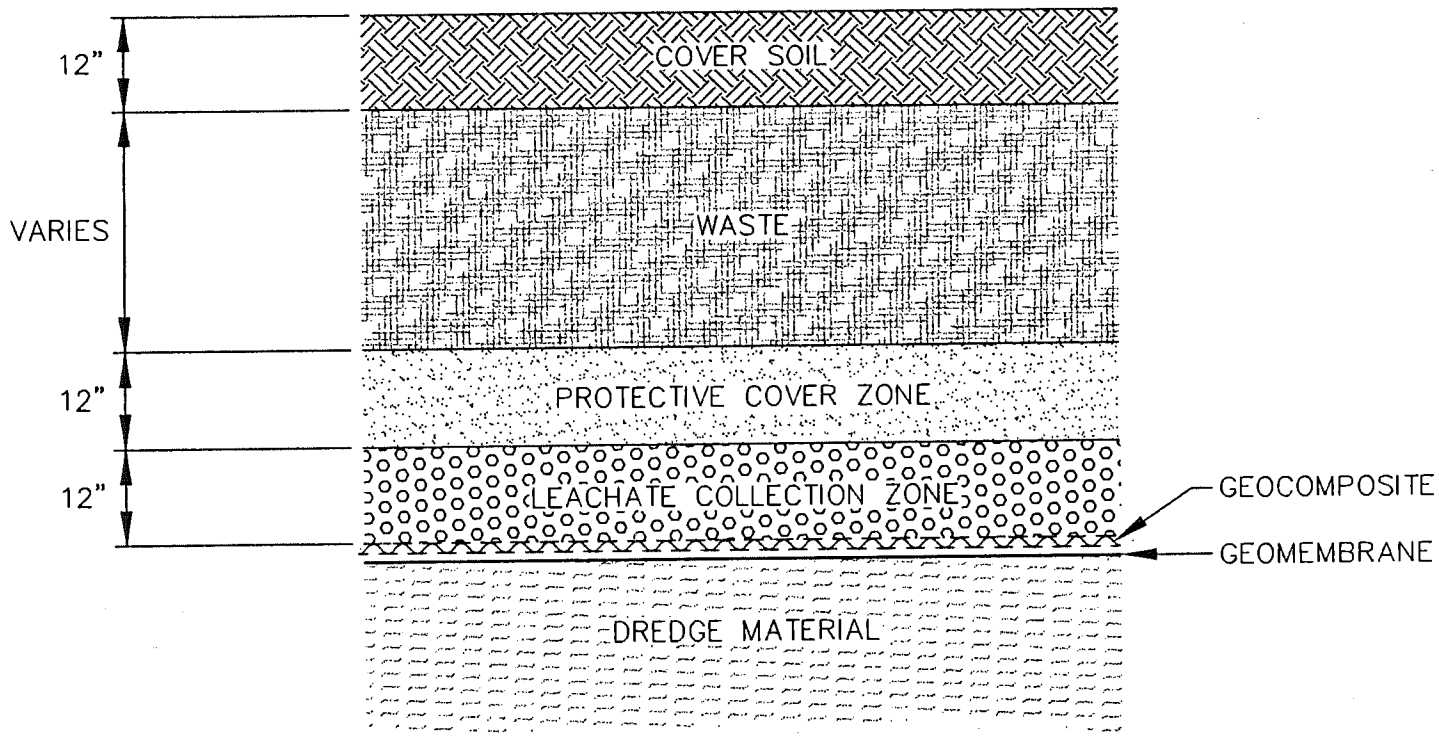

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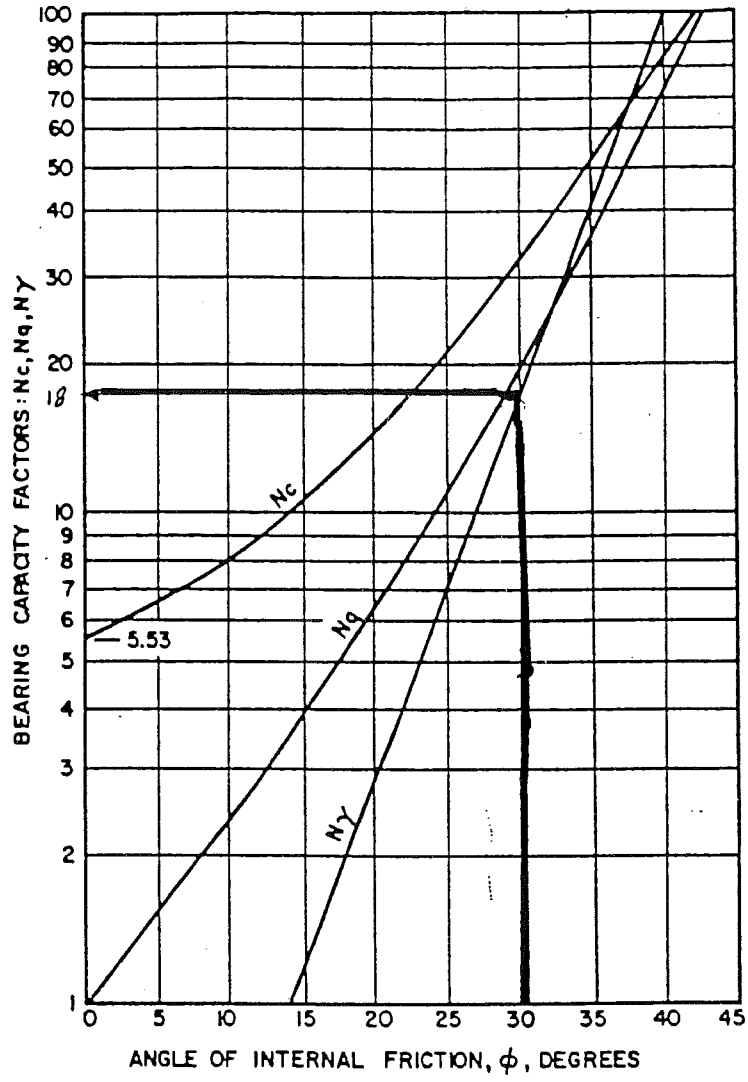
FIGURE NO.	1
PROJECT NO.	ME0250
DOCUMENT NO.	
FILE NO.	0250F701

7 of 10

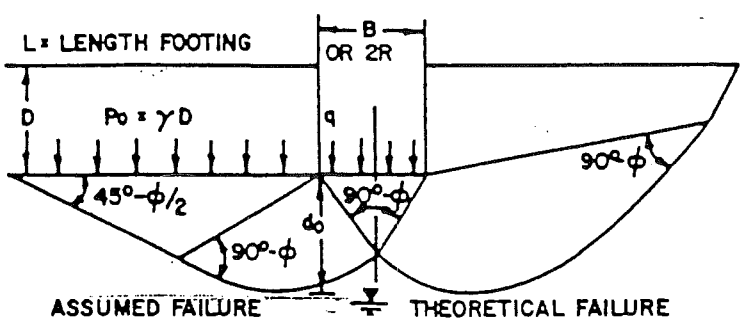


ULTIMATE BEARING CAPACITY = q_{ult}

FOR COHESIONLESS FOUNDATION SOILS (c = 0)

CONTINUOUS FOOTING:

$$q_{ult} = \gamma D N_q + \frac{\gamma B}{2} N_\gamma$$



ASSUMED CONDITIONS:

1. $D \leq B$
2. SOIL IS UNIFORM TO DEPTH $d_o > B$.
3. WATER LEVEL LOWER THAN d_o BELOW BASE OF FOOTING.
4. VERTICAL LOAD CONCENTRIC.
5. FRACTION AND ADHESION ON VERTICAL SIDES OF FOOTING ARE NEGLECTED.
6. FOUNDATION SOIL WITH PROPERTIES c, ϕ, γ

Figure 2

FIGURE 2
Ultimate Bearing Capacity of Shallow Footings With Concentric Loads

AFTER NAVFAC DM 7.2, 1982

Table 1 Modification factor for protrusion shape.

Stone shape	Modification factor, MF_S
Angular	1.00
Subrounded	0.50
Rounded	0.25

Table 2 Modification factors for packing density.

Protrusion arrangement	Modification factor, MF_{PD}
Isolated protrusions	1.00
Packed stones	0.50

Table 3 Modification factors for soil arching.

Soil arching effect	Modification factor, MF_A
None	1.00
Moderate	0.75
Maximum	0.50

Table 4 Partial factors of safety for creep.

Geotextile mass per unit area (g/m^2)	Partial factors of safety for creep			
	Protrusion height (mm)			
	38	25	12	6
No geotextile	N/R	N/R	N/R	>>1.5
270	N/R	N/R	>1.5	1.5
550	N/R	1.5	1.3	1.2
1100	1.3	1.2	1.1	1.0
>1100	~1.2	~1.1	~1.0	1.0

Note: N/R = not recommended.

Source Narejo, et al. 1996

ENGLISH UNITS

Table 2(a) - High Density Polyethylene (HDPE) Geomembrane - Textured

Property	Test Method	Test Value							Testing Frequency (minimum)
		30 mils	40 mils	50 mils	60 mils	80 mils	100 mils	120 mils	
hickness (min. ave.) • lowest individual for 8 out of 10 values • lowest individual for any of the 10 values	D 5994	nom. (-5%) -10% -15%	nom. (-5%) -10% -15%	nom. (-5%) -10% -15%	nom. (-5%) -10% -15%	nom. (-5%) -10% -15%	nom. (-5%) -10% -15%	nom. (-5%) -10% -15%	per roll
sperity Height (min. ave.) *(1)*	GM 12	10 mil	10 mil	10 mil	10 mil	10 mil	10 mil	10 mil	every 2nd roll *(2)*
ensity (min. ave.)	D 1505/D792	0.940 g/cc	0.940 g/cc	0.940 g/cc	0.940 g/cc	0.940 g/cc	0.940 g/cc	0.940 g/cc	200,000 lb
ensile Properties (min. ave.) *(3)* • yield stress • break stress • yield elongation • break elongation	D 638 Type IV	63 lb/in. 45 lb/in. 12% 100%	84 lb/in. 60 lb/in. 12% 100%	105 lb/in. 75 lb/in. 12% 100%	126 lb/in. 90 lb/in. 12% 100%	168 lb/in. 120 lb/in. 12% 100%	210 lb/in. 150 lb/in. 12% 100%	252 lb/in. 180 lb/in. 12% 100%	20,000 lb
ear Resistance (min. ave.)	D 1004	21 lb	28 lb	35 lb	42 lb	56 lb	70 lb	84 lb	45,000 lb
uncture Resistance (min. ave.)	D 4833	45 lb	60 lb	75 lb	90 lb	120 lb	150 lb	180 lb	45,000 lb
tress Crack Resistance *(4)*	D 5397 (App.)	200 hr.	200 hr.	200 hr.	200 hr.	200 hr.	200 hr.	200 hr.	per GRI-GM 10
arbon Black Content (range)	D 1603 *(5)*	2.0 - 3.0%	2.0 - 3.0%	2.0 - 3.0%	2.0 - 3.0%	2.0 - 3.0%	2.0 - 3.0%	2.0 - 3.0%	20,000 lb
arbon Black Dispersion	D 5596	note *(6)*	note *(6)*	note *(6)*	note *(6)*	note *(6)*	note *(6)*	note *(6)*	45,000 lb
xidative Induction Time (OIT) (min. ave.) *(7)* a) Standard OIT — or — b) High Pressure OIT	D 3895 D 5885	100 min. 400 min.	100 min. 400 min.	100 min. 400 min.	100 min. 400 min.	100 min. 400 min.	100 min. 400 min.	100 min. 400 min.	200,000 lb
ven Aging at 85°C *(7), (8)* a) Standard OIT (min. ave.) - % retained after 90 days — or — b) High Pressure OIT (min. ave.) - % retained after 90 days	D 5721 D 3895 D 5885	55% 80%	55% 80%	55% 80%	55% 80%	55% 80%	55% 80%	55% 80%	per each formulation
V Resistance *(9)* a) Standard OIT — or — b) High Pressure OIT (min. ave.) - % retained after 1600 hrs *(11)*	GM11 D 3895 D 5885	N.R. *(10)* 50%	N.R. *(10)* 50%	N.R. *(10)* 50%	N.R. *(10)* 50%	N.R. *(10)* 50%	N.R. *(10)* 50%	N.R. *(10)* 50%	per each formulation

1) Of 10 readings; 8 out of 10 must be ≥ 7 mil, and lowest individual reading must be ≥ 5 mil
2) Alternate the measurement side for double sided textured sheet
3) Machine direction (MD) and cross machine direction (XMD) average values should be on the basis of 5 test specimens each direction
Yield elongation is calculated using a gage length of 1.3 inches
Break elongation is calculated using a gage length of 2.0 inches
4) The SP-NCTL test is not appropriate for testing geomembranes with textured or irregular rough surfaces. Test should be conducted on smooth edges of textured rolls or on smooth sheets made from the same formulation as being used for the textured sheet materials.
The yield stress used to calculate the applied load for the SP-NCTL test should be the manufacturer's mean value via MQC testing.
(5) Other methods such as D 4218 (muffle furnace) or microwave methods are acceptable if an appropriate correlation to D1603 (tube furnace) can be established.
(6) Carbon black dispersion for 10 different views:
• all 10 in Categories 1 or 2
(7) The manufacturer has the option to select either one of the OIT methods listed to evaluate the antioxidant content in the geomembrane.
(8) It is also recommended to evaluate samples at 30 and 60 days to compare with the 90 day response.
(9) The condition of the test should be 20 hr. UV cycle at 75°C followed by 4 hr. condensation at 60°C.
(10) Not recommended : nce the high temperature of the Std-OIT test produces an unrealistic result for some of the antioxidants in the UV exposed samples.
(11) UV resistance is based on percent retained value regardless of the original HP-OIT value.

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Appendix VIb-F.2

Liner System Veneer Stability on Side Slopes

GEOSYNTEC CONSULTANTS

COMPUTATION COVER SHEET

Client: DSWA **Project:** Cherry Island **Project/Proposal #:** ME0250 **Task #:** 2.2

TITLE OF COMPUTATIONS LINER SYSTEM VENEER STABILITY ON SIDE SLOPES

COMPUTATIONS BY:
Signature Douglas T. Mandeville — DATE 3/26/03
Printed Name and Title: Douglas T. Mandeville, Senior Staff Engineer

ASSUMPTIONS AND PROCEDURES CHECKED BY:
(Peer Reviewer)
Signature [signature] — DATE 3/26/03
Printed Name and Title: R. David Espinoza, Senior Engineer

COMPUTATIONS CHECKED BY:
Signature Carrie H. Pendleton — DATE 03/27/03
Printed Name and Title: Carrie H. Pendleton, Staff Engineer

COMPUTATIONS BACKCHECKED BY:
(Originator)
Signature Douglas T. Mandeville — DATE 03/28/03
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APPROVED BY:
(PM or Designate)
Signature [signature] — DATE 3/30/03
Printed Name and Title: R. David Espinoza, Senior Engineer

APPROVAL NOTES:

REVISIONS (Number and initial all revisions)

NO.	SHEET	DATE	BY	CHECKED BY	APPROVAL

Written by: Doug Mandeville Date: 03/26/03 Reviewed by: Carrie Pendleton Date: 03/27/03

Client: DSWA Project: Cherry Island Proj./Proposal No.: ME0250 Task No.: 2.2

LINER SYSTEM VENEER STABILITY ON SIDE SLOPES

PURPOSE:

The purpose of this engineering calculation is to evaluate the veneer slope stability factor of safety failure along the interfaces of the various components of the liner system for the Cherry Island Landfill.

PROCEDURE:

The veneer slope stability factor of safety of the liner system will be evaluated based on a method presented by Giroud, et al. [1995a,b]. The method is based on a limit equilibrium analysis and takes into account soil buttressing effect, geosynthetic tensile forces, and seepage forces within the liner system caused by leachate and is based on the most critical interface that exists within the liner system.

The veneer stability factor of safety will be calculated using the following equation from Giroud et al. [1995a,b]:

$$FS = \lambda \frac{\tan\delta}{\tan\beta} + \frac{a/\sin\beta}{\gamma_t(t-t_w)+\gamma_{sat}t_w} + \frac{\gamma_t(t-t_w^*)+\gamma_b t_w^*}{\gamma_t(t-t_w)+\gamma_{sat}t_w}\frac{t}{h}\frac{\sin\phi}{\sin 2\beta\cos(\beta+\phi)} + \frac{ct/h}{\gamma_t(t-t_w)+\gamma_{sat}t_w}\frac{\cos\phi}{\sin\beta\cos(\beta+\phi)} + \frac{T/h}{\gamma_t(t-t_w)+\gamma_{sat}t_w} \qquad \text{Eq. (1)}$$

where:

$$\lambda = \begin{cases} \dfrac{\gamma_t(t-t_w)+\gamma_b t_w}{\gamma_t(t-t_w)+\gamma_{sat}t_w} & \text{for failure surface above the geomembrane (dimensionless)} \\ 1 & \text{for failure surface below the geomembrane (dimensionless)} \end{cases}$$

FS = Factor of Safety (dimensionless)
γ_t = total unit weight of soil (pcf)
γ_{sat} = saturated unit weight of soil (pcf)
γ_b = buoyant unit weight of soil (pcf)
t = thickness of soil layer (ft)
t_w = thickness of water flow along slope (ft)
t^*_w = thickness of water flow in toe of slope (ft)

β = slope angle (degrees)
δ = interface friction angle along slip surface (degrees)
a = interface adhesion (psf)
ϕ = internal friction angle of soil above critical surface (degrees)
h = height of slope (ft)
T = tension in geosynthetics (lbs/ft)
c = cohesion of soil above critical surface (psf)

According to a technical manual published by the USEPA entitled "Solid Waste Disposal Facility Criteria" [USEPA, 1993], when there is no imminent danger to human life or threat of major environmental impact, the minimum recommended slope stability factor of safety is 1.25. Because a veneer stability failure of the liner system does not pose a threat to human life or the environment and a failure could be easily repaired, the stability of the liner system will be considered acceptable if the factor of safety is greater than or equal to 1.25.

SOIL AND GEOSYNTHETIC PROPERTIES

The maximum slope inclination for the liner system is 2H:1V and the maximum vertical slope height is approximately 40 ft. The liner system on the side slopes consists of the following components, from top to bottom, as shown in Figure 1:

- a 12-in thick protective cover layer;
- a 12-in thick leachate collection zone
- a 60-mil thick high-density polyethylene (HDPE) textured geomembrane;
- a geosynthetic clay liner (GCL); and
- a 24-in thick layer of structural fill.

Alternatively, the 12-in. thick leachate collection zone may be replaced by a 12-in. thick protective cover layer overlying a geomembrane, see Figure 2. Based on the assumed soil friction angle (ϕ) and the interface friction angles (δ) two sliding surfaces are evaluated for each of the liner systems. For each case, the maximum height (h) of soil on the side slope is evaluated by solving Equation 1. Case 1 evaluates the sliding surface between the leachate collection zone or protective soil zone and the geomembrane (i.e., a slip surface above the geomembrane). Case 2 evaluates the sliding surface between the geomembrane and the GCL (i.e., a slip surface below the geomembrane). The data used for the veneer stability analyses is summarized in the table below. Laboratory data collected by GeoSyntec's Soils Geosynthetic Interaction Laboratory indicates that interface friction angle increases with lower confining pressure.

Written by: Doug Mandeville Date: 03/26/03 Reviewed by: Carrie Pendleton Date: 03/27/03

Client: DSWA Project: Cherry Island Proj./Proposal No.: ME0250 Task No.: 2.2

Interface/Material	Selected Properties
Leachate Collection Zone or Protective Cover Zone/Geomembrane	assume γ_t = 120 pcf, and ϕ = 35° tan δ/tan ϕ = 0.7 δ = 26°
60-mil Thick Textured HDPE Geomembrane/GCL Reinforced with nonwoven geotextile	δ = 25°
GCL/Structural Fill	δ = 31°

See table 1 for interface friction angles

For Case 1, the critical interface friction angle for short-term liner stability above the geomembrane liner is δ = 26°. For Case 2, the critical interface friction angle for short term stability below the geomembrane liner is δ = 25°.

The average depth of water within the protective/drainage layer is evaluated using the HELP model [USEPA, 1994]. The HELP model simulation was performed for a period of 5 years, assuming an open cell condition with the leachate collection zone or protective soil zone placed on a 2H:1V slope. The calculated average peak daily hydraulic head on the liner system is 2.077 in. (0.173 ft) for the proposed liner system and is 23.764 in. (1.98 ft) for the alternative liner system. Copies of the HELP analyses are included in Attachment A.

The input parameters for equation 1 are provided below. For this analysis the resisting force due to tension in geosynthetics (T) is neglected (that is, the effect of the anchor trench is conservatively neglected and the protective layer is mainly supported by frictional forces.

FS = 1.25
γ_t = 120 pcf
γ_{sat} = 130 pcf
γ_b = 67.6 pcf
t_w = 0.173 ft for the proposed and 1.98 ft for the alternative (failure surface above geomembrane), 0 ft for failure surface below geomembrane.
t^*_w = 0
β = 26.56°
a = 0
ϕ = 35°
h = unknown, to be calculated
T = 0 (neglect tension contribution)

Written by: Doug Mandeville Date: 03/26/03 Reviewed by: Carrie Pendleton Date: 03/27/03

Client: DSWA Project: Cherry Island Proj./Proposal No.: ME0250 Task No.: 2.2

$c = 0$

Case 1 - Proposed Liner System

This case represents the condition of a failure surface above the geomembrane (i.e., δ = 26), and a uniform thickness of granular protective/drainage layer (i.e., t = 2.0 ft). Calculate the maximum slope height (h) of protective/drainage material layer that may be placed at one time while maintaining a FS of at least 1.25.

$$1.25 = \frac{120(2.0-0.173)+67.6(0.173)}{120(2.0-0.173)+130(0.173)}\frac{\tan 26}{\tan 26.56} + \frac{120(2.0-0)+67.6(0)}{120(2.0-0.173)+130(0.173)}\frac{2.0}{h}\frac{\sin 35}{\sin(2\times 26.56)\cos(35+26.56)}$$

1.25 = (0.955)0.975 + (0.992)(1.51)(2.0)/h; **h= 9.4 ft**

Case 1 - Alternative Liner System

$$1.25 = \frac{120(2.0-1.98)+67.6(1.98)}{120(2.0-1.98)+130(1.98)}\frac{\tan 26}{\tan 26.56} + \frac{120(2.0-0)+67.6(0)}{120(2.0-1.98)+130(1.98)}\frac{2.0}{h}\frac{\sin 35}{\sin(2\times 26.56)\cos(35+26.56)}$$

1.25 = (0.99)1.26 + (0.99)(1.51)(2.0)/h; **h = 3.8 ft**

Case 2 - Proposed Liner System

This case represents the condition of a failure surface between the GCL and the structural fill (i.e. δ= 25°). The maximum slope height (h) of protective/drainage material layer that may be placed at one time while maintaining a FS of at least 1.25.

$$1.25 = \frac{\tan 25}{\tan 26.56} + \frac{120(2.0-0)+67.6(0)}{120(2.0-0)+130(0)}\frac{2.0}{h}\frac{\sin 35}{\sin(2\times 26.56)\cos(35+26.56)}$$

1.25 = 0.93 + 2.0/h; **h = 9.4 ft**

Case 2 - Alternative Liner System

$$1.25 = \frac{\tan 28}{\tan 26.56} + \frac{120(2.0-0)+67.6(0)}{120(2.0-0)+130(0)}\frac{2.0}{h}\frac{\sin 35}{\sin(2\times 26.56)\cos(35+26.56)}$$

1.25 = 0.93 + 2.0/h; **h = 16.2 ft**

Hence, the most critical condition is Case 1 for the alternative liner system (i.e., failure above the geomembrane) when h = 3.8 ft.

RESULTS

The results indicate that the protective/drainage soil must be placed in stages to achieve a minimum factor of safety of 1.25. For the parameters assumed, the critical interface is between the protective/drainage soil and the geotextile component of the geocomposite drainage layer. The maximum height that the protective/drainage soil can be placed on top of the geotextile, and maintain a minimum factor of safety equal to 1.25, is 3.8 feet.

REFERENCES

Giroud, J.P., Williams, N.D., Pelte, T., and Beech, J.F., "Stability of Geosynthetic - Soil Layered Systems on Slopes," Industrial Fabrics Association International, *Geosynthetics International*, Vol. 2, No. 6, St. Paul, MN, pp. 1115-1148, 1995a.

Giroud, J.P., Bachus, R.C., and Bonaparte, R., "Influence of Water Flow on the Stability of Geosynthetic - Soil Layered Systems on Slopes," Industrial Fabrics Association International, *Geosynthetics International,* Vol. 2, No. 6, St. Paul, MN, pp. 1149-1180, 1995b.

USEPA, *"Solid Waste Disposal Facility Criteria"*, Document No. EPA 530-R-93-017, United States Environmental Protection Agency, November 1993.

USEPA, *"The Hydrologic Evaluation of Landfill Performance (HELP) Model, Vol. II, Users Guide for Version 3"*, EPA/530-SW-84-010, US Environmental Protection Agency, Washington, DC, June 1994, 120p.

Written by: Doug Manderville Date: 03/03/19 (YY/MM/DD) Reviewed by: Carrie Pendleton Date: 03/03/27 (YY/MM/DD)

Client: DGWA Project: Cherry Island Project/Proposal No.: ME0250 Task No.: 2.2.7

SUMMARY OF DOCUMENTED INTERFACE FRICTION VALUES

GEOSYNTHETIC/GEOSYNTHETIC	δ (degrees)
HDPE/Nonwoven Geotextile	~~6-12°~~
Rough HDPE/Nonwoven Geotextile	25-35°
HDPE Geonet	8-15°
Rough HDPE/Geonet	8-15°
Rough HDPE/Geocomposite Drainage Layer	17-29°
Geonet/Nonwoven Geotextile	14-22°
HDPE/GCL (hydrated)	5-12°
Rough HDPE/GCL (hydrated)	18-37°
GEOSYNTHETIC/SOIL	**tan δ/tan φ**
HDPE/Clay	0.4-0.7
Rough HDPE/Clay	0.8-0.9
HDPE/Sand	0.5-0.6
Rough HDPE/Sand	0.7-0.8
Needlepunched Geotextile/Sand	0.8-1.0
Needlepunched Geotextile/Angular Gravel	0.7-0.9
Needlepunched Geotextile/Rounded Gravel	0.6-0.8
Geogrid/Soil	~~1.0~~
GCL/Clay	δ = 31-41°
GCL/Sand	δ = 17°-35°

$\delta = \tan^{-1}(x * \tan\phi)$

δ = interface friction angle; φ = soil internal friction angle

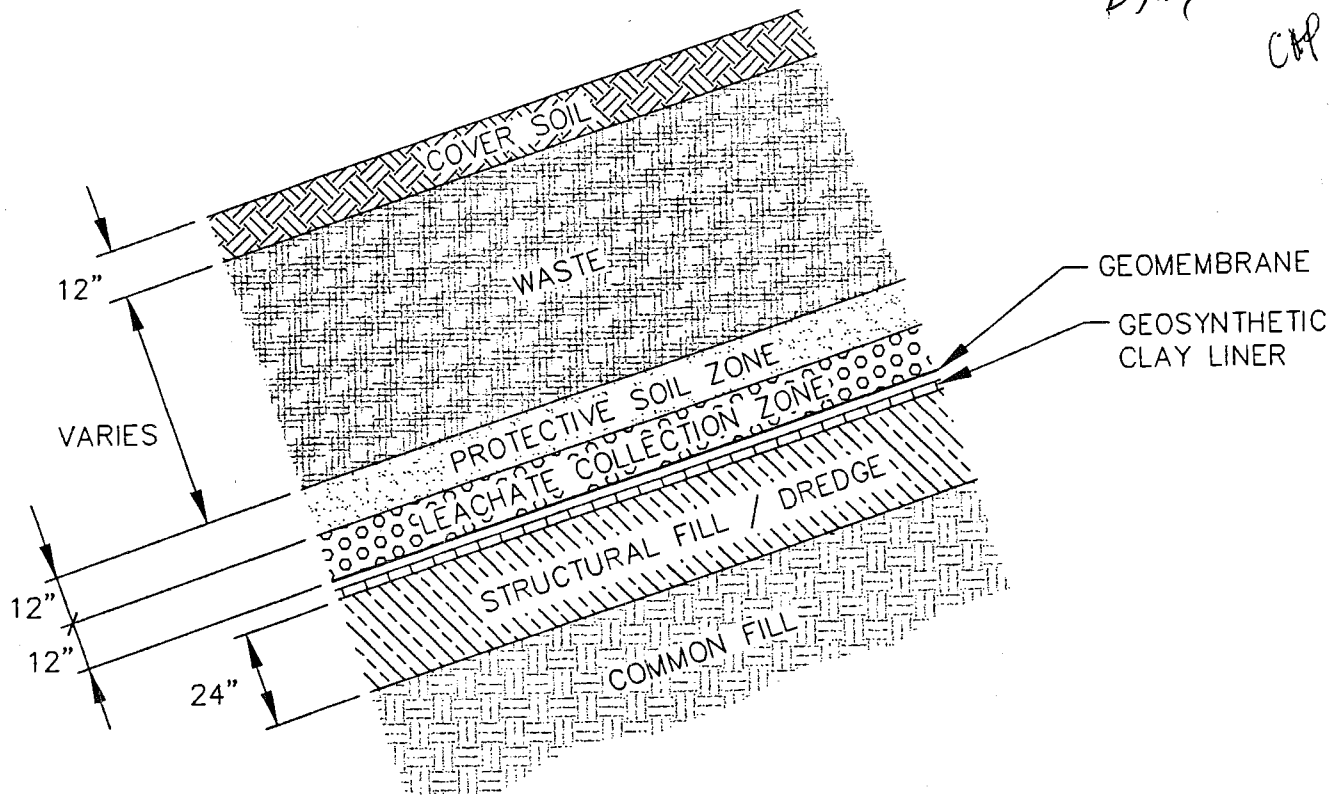
(Adapted from tests by Martin et al. [1984], Williams and Houlihan [1986], Koerner et al. [1986], manufacturers literature, and unpublished results from GeoSyntec Consultants.)

Table 1

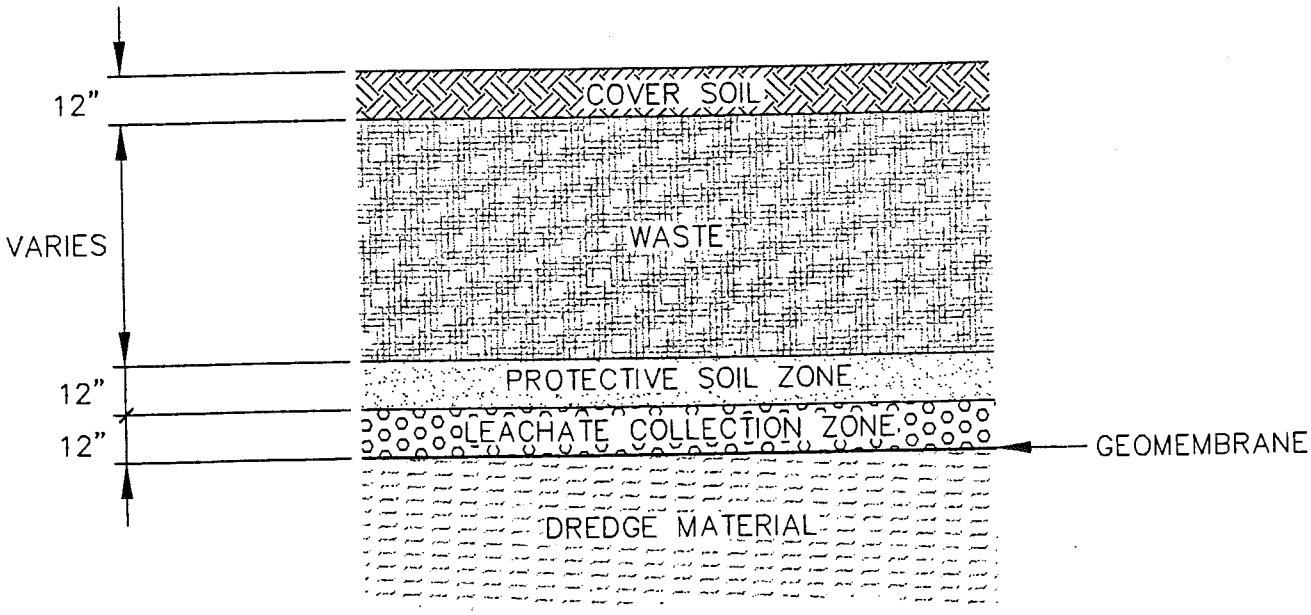
PHASE Va PROPOSED LINER DETAILS

DJM

CMP



SIDESLOPE

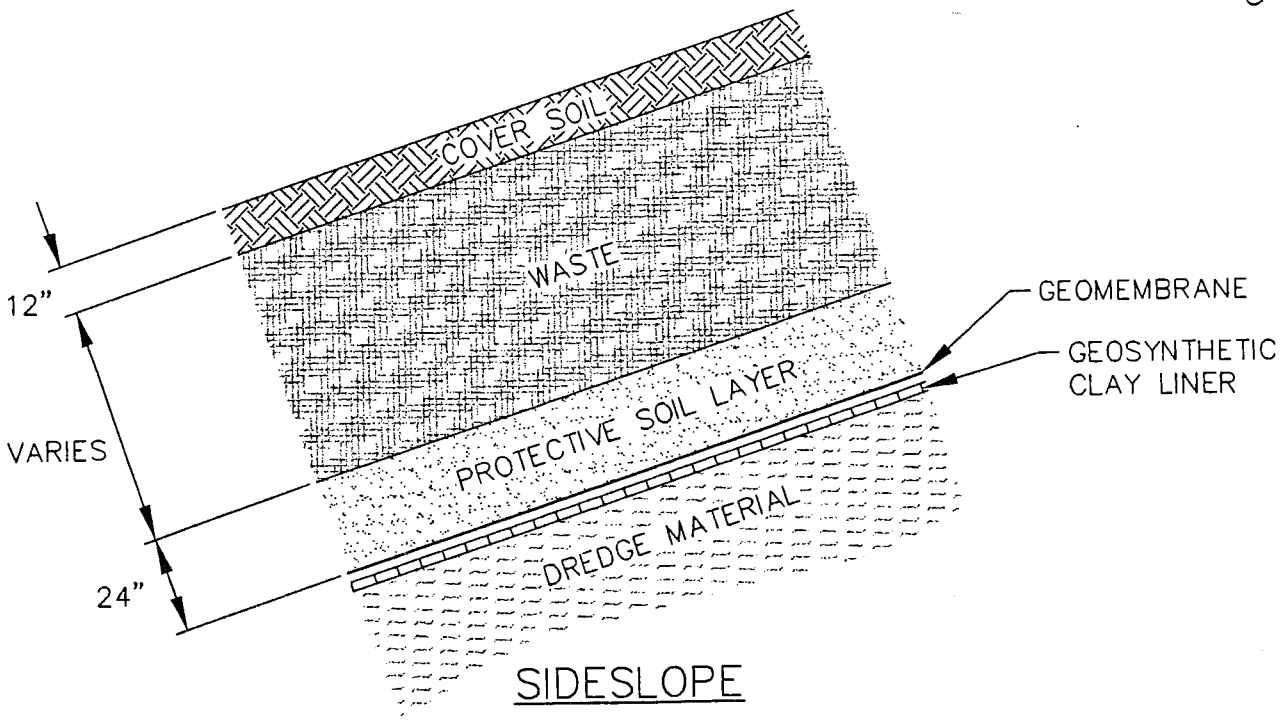


BOTTOM

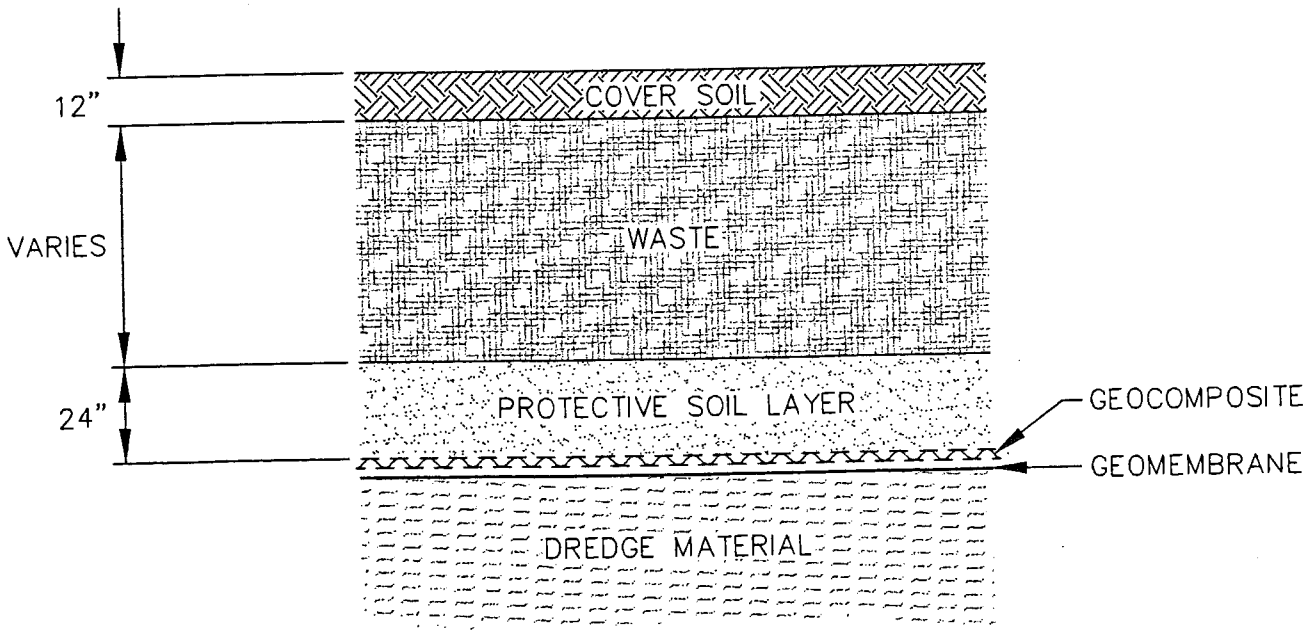
GEOSYNTEC CONSULTANTS
COLUMBIA, MARYLAND

FIGURE NO.	1
PROJECT NO.	ME0250
DOCUMENT NO.	
FILE NO.	0250F701

PHASE Va ALTERNATE LINER DETAILS



SIDESLOPE



BOTTOM

GEOSYNTEC CONSULTANTS
COLUMBIA, MARYLAND

FIGURE NO.	2
PROJECT NO.	ME0250
DOCUMENT NO.	
FILE NO.	0250F701

Written by: Doug Mandeville Date: 03/26/03 Reviewed by: Carrie Pendleton Date: 03/27/03

Client: DSWA Project: Cherry Island Proj./Proposal No.: ME0250 Task No.: 2.2

ATTACHMENT A

```
******************************************************************************
******************************************************************************
**                                                                          **
**                                                                          **
**              HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE               **
**                HELP MODEL VERSION 3.07  (1 NOVEMBER 1997)                **
**                 DEVELOPED BY ENVIRONMENTAL LABORATORY                    **
**                   USAE WATERWAYS EXPERIMENT STATION                      **
**             FOR USEPA RISK REDUCTION ENGINEERING LABORATORY              **
**                                                                          **
**                                                                          **
******************************************************************************
******************************************************************************


PRECIPITATION DATA FILE:      P:\PRJ1\MDENG\HELP3\ME0250\40YEARS.D4
TEMPERATURE DATA FILE:        P:\PRJ1\MDENG\HELP3\ME0250\40YEARS.D7
SOLAR RADIATION DATA FILE:    P:\PRJ1\MDENG\HELP3\ME0250\40YEARS.D13
EVAPOTRANSPIRATION DATA:      P:\PRJ1\MDENG\HELP3\ME0250\40YEARS.D11
SOIL AND DESIGN DATA FILE:    P:\PRJ1\MDENG\HELP3\ME0250\veneer2.D10
OUTPUT DATA FILE:             P:\PRJ1\MDENG\HELP3\ME0250\veneer2.OUT


TIME:  16:58      DATE:   3/13/2003
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Proposed liner system

```
******************************************************************************

     TITLE:  CHERRY ISLAND LANDFILL PHASE V - RUN B3 #2

******************************************************************************


     NOTE:  INITIAL MOISTURE CONTENT OF THE LAYERS AND SNOW WATER
              WERE SPECIFIED BY THE USER.


                                  LAYER  1
                                  --------

                    TYPE 1 - VERTICAL PERCOLATION LAYER
                       MATERIAL TEXTURE NUMBER  22
          THICKNESS                  =      12.00   INCHES
          POROSITY                   =       0.4190 VOL/VOL
          FIELD CAPACITY             =       0.3070 VOL/VOL
          WILTING POINT              =       0.1800 VOL/VOL
          INITIAL SOIL WATER CONTENT =       0.3621 VOL/VOL
          EFFECTIVE SAT. HYD. COND.  =  0.189999992000E-04 CM/SEC
        NOTE:  SATURATED HYDRAULIC CONDUCTIVITY IS MULTIPLIED BY  4.63
                 FOR ROOT CHANNELS IN TOP HALF OF EVAPORATIVE ZONE.


                                  LAYER  2
                                  --------

                    TYPE 2 - LATERAL DRAINAGE LAYER
                       MATERIAL TEXTURE NUMBER   1
          THICKNESS                  =      12.00   INCHES
          POROSITY                   =       0.4170 VOL/VOL
          FIELD CAPACITY             =       0.0450 VOL/VOL
          WILTING POINT              =       0.0180 VOL/VOL
          INITIAL SOIL WATER CONTENT =       0.0180 VOL/VOL
          EFFECTIVE SAT. HYD. COND.  =  0.999999978000E-02 CM/SEC
          SLOPE                      =      50.00   PERCENT
          DRAINAGE LENGTH            =      75.0    FEET


                                  LAYER  3
                                  --------

                    TYPE 4 - FLEXIBLE MEMBRANE LINER
                       MATERIAL TEXTURE NUMBER  35
          THICKNESS                  =       0.06   INCHES
          POROSITY                   =       0.0000 VOL/VOL
          FIELD CAPACITY             =       0.0000 VOL/VOL
          WILTING POINT              =       0.0000 VOL/VOL
          INITIAL SOIL WATER CONTENT =       0.0000 VOL/VOL
          EFFECTIVE SAT. HYD. COND.  =  0.199999996000E-12 CM/SEC
          FML PINHOLE DENSITY        =       1.00   HOLES/ACRE
          FML INSTALLATION DEFECTS   =       1.00   HOLES/ACRE
          FML PLACEMENT QUALITY      =  4 - POOR


                                  LAYER  4
                                  --------

                    TYPE 3 - BARRIER SOIL LINER
                       MATERIAL TEXTURE NUMBER  16
          THICKNESS                  =    1011.60   INCHES
          POROSITY                   =       0.4270 VOL/VOL
          FIELD CAPACITY             =       0.4180 VOL/VOL
          WILTING POINT              =       0.3670 VOL/VOL
          INITIAL SOIL WATER CONTENT =       0.4270 VOL/VOL
          EFFECTIVE SAT. HYD. COND.  =  0.100000001000E-06 CM/SEC


                GENERAL DESIGN AND EVAPORATIVE ZONE DATA
                ----------------------------------------
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DTM CHP

NOTE: SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT SOIL DATA BASE USING SOIL TEXTURE #22 WITH A POOR STAND OF GRASS, A SURFACE SLOPE OF 2.% AND A SLOPE LENGTH OF 1200. FEET.

SCS RUNOFF CURVE NUMBER	=	93.10	
FRACTION OF AREA ALLOWING RUNOFF	=	100.0	PERCENT
AREA PROJECTED ON HORIZONTAL PLANE	=	1.000	ACRES
EVAPORATIVE ZONE DEPTH	=	24.0	INCHES
INITIAL WATER IN EVAPORATIVE ZONE	=	4.561	INCHES
UPPER LIMIT OF EVAPORATIVE STORAGE	=	10.032	INCHES
LOWER LIMIT OF EVAPORATIVE STORAGE	=	2.376	INCHES
INITIAL SNOW WATER	=	0.000	INCHES
INITIAL WATER IN LAYER MATERIALS	=	436.514	INCHES
TOTAL INITIAL WATER	=	436.514	INCHES
TOTAL SUBSURFACE INFLOW	=	0.00	INCHES/YEAR

EVAPOTRANSPIRATION AND WEATHER DATA

NOTE: EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
ALBANY NEW YORK

STATION LATITUDE	=	42.45	DEGREES
MAXIMUM LEAF AREA INDEX	=	3.50	
START OF GROWING SEASON (JULIAN DATE)	=	123	
END OF GROWING SEASON (JULIAN DATE)	=	282	
EVAPORATIVE ZONE DEPTH	=	24.0	INCHES
AVERAGE ANNUAL WIND SPEED	=	8.90	MPH
AVERAGE 1ST QUARTER RELATIVE HUMIDITY	=	68.00	%
AVERAGE 2ND QUARTER RELATIVE HUMIDITY	=	66.00	%
AVERAGE 3RD QUARTER RELATIVE HUMIDITY	=	74.00	%
AVERAGE 4TH QUARTER RELATIVE HUMIDITY	=	74.00	%

NOTE: PRECIPITATION DATA FOR CHERRY ISLAND LF WAS ENTERED BY THE USER.

NOTE: TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING COEFFICIENTS FOR WILMINGTON DELAWARE

NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
31.20	33.20	41.80	52.40	62.20	71.20
76.00	74.80	67.80	56.30	45.60	35.50

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING COEFFICIENTS FOR WILMINGTON DELAWARE AND STATION LATITUDE = 39.80 DEGREES

****

AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1 THROUGH 5

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	3.29	2.79	4.55	3.21	4.19	5.59
	4.23	4.52	4.89	3.51	2.32	2.85
STD. DEVIATIONS	2.46	1.73	2.33	1.18	2.52	1.47
	1.79	2.59	2.17	1.31	0.84	2.65
RUNOFF						
TOTALS	1.208	1.010	1.538	0.113	0.730	0.813
	0.909	0.898	1.549	0.940	0.194	0.431
STD. DEVIATIONS	1.394	1.172	1.594	0.072	0.702	0.379
	1.284	0.667	1.075	0.871	0.171	0.773
EVAPOTRANSPIRATION						
TOTALS	0.718	0.985	2.214	3.458	3.534	4.616
	3.722	3.244	2.014	1.743	1.278	0.769
STD. DEVIATIONS	0.314	0.512	0.280	0.569	1.220	1.647
	1.181	1.644	0.838	0.187	0.119	0.127
LATERAL DRAINAGE COLLECTED FROM LAYER 2						
TOTALS	0.8686	0.7145	1.9419	0.2185	0.3061	0.2049
	0.0322	0.0000	0.1004	0.8093	0.6466	1.3540
STD. DEVIATIONS	0.9278	0.7735	1.6643	0.1128	0.2576	0.3939
	0.0720	0.0000	0.1664	0.7241	0.7582	1.8901
PERCOLATION/LEAKAGE THROUGH LAYER 4						
TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

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DTM CHP

AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)

DAILY AVERAGE HEAD ON TOP OF LAYER 3

AVERAGES	0.0927	0.0829	0.2072	0.0241	0.0327	0.0227
	0.0034	0.0000	0.0111	0.0863	0.0713	0.1445
STD. DEVIATIONS	0.0990	0.0887	0.1776	0.0124	0.0275	0.0434
	0.0077	0.0000	0.0183	0.0773	0.0836	0.2017

AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1 THROUGH 5

	INCHES		CU. FEET	PERCENT
PRECIPITATION	45.95	(7.462)	166798.5	100.00
RUNOFF	10.333	(3.8542)	37507.35	22.487
EVAPOTRANSPIRATION	28.296	(2.0097)	102715.03	61.580
LATERAL DRAINAGE COLLECTED FROM LAYER 2	7.19700	(2.65528)	26125.123	15.66268
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.00014	(0.00005)	0.504	0.00030
AVERAGE HEAD ON TOP OF LAYER 3	0.065	(0.023)		
CHANGE IN WATER STORAGE	0.124	(0.3897)	450.49	0.270

PEAK DAILY VALUES FOR YEARS 1 THROUGH 5

	(INCHES)	(CU. FT.)
PRECIPITATION	4.70	17061.000
RUNOFF	3.070	11144.0332
DRAINAGE COLLECTED FROM LAYER 2	0.62813	2280.11694
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.000010	0.03630
AVERAGE HEAD ON TOP OF LAYER 3	2.077	
MAXIMUM HEAD ON TOP OF LAYER 3	4.019	
LOCATION OF MAXIMUM HEAD IN LAYER 2 (DISTANCE FROM DRAIN)	0.0 FEET	
SNOW WATER	2.75	9974.9512

value used for head on liner system

MAXIMUM VEG. SOIL WATER (VOL/VOL) 0.2545

MINIMUM VEG. SOIL WATER (VOL/VOL) 0.0990

*** Maximum heads are computed using McEnroe's equations. ***

Reference: Maximum Saturated Depth over Landfill Liner
by Bruce M. McEnroe, University of Kansas
ASCE Journal of Environmental Engineering
Vol. 119, No. 2, March 1993, pp. 262-270.

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OTM CHP

****

FINAL WATER STORAGE AT END OF YEAR 5

LAYER	(INCHES)	(VOL/VOL)
1	3.8255	0.3188
2	1.3562	0.1130
3	0.0000	0.0000
4	431.9532	0.4270
SNOW WATER	0.000	

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OTM CHP

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**                                                                          **
**                                                                          **
**              HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE               **
**                HELP MODEL VERSION 3.07  (1 NOVEMBER 1997)                **
**                 DEVELOPED BY ENVIRONMENTAL LABORATORY                    **
**                   USAE WATERWAYS EXPERIMENT STATION                      **
**             FOR USEPA RISK REDUCTION ENGINEERING LABORATORY              **
**                                                                          **
**                                                                          **
******************************************************************************
******************************************************************************


PRECIPITATION DATA FILE:      P:\PRJ1\MDENG\HELP3\ME0250\40YEARS.D4
TEMPERATURE DATA FILE:        P:\PRJ1\MDENG\HELP3\ME0250\40YEARS.D7
SOLAR RADIATION DATA FILE:    P:\PRJ1\MDENG\HELP3\ME0250\40YEARS.D13
EVAPOTRANSPIRATION DATA:      P:\PRJ1\MDENG\HELP3\ME0250\40YEARS.D11
SOIL AND DESIGN DATA FILE:    P:\PRJ1\MDENG\HELP3\ME0250\veneer1.D10
OUTPUT DATA FILE:             P:\PRJ1\MDENG\HELP3\ME0250\veneer1.OUT


TIME:  16:30     DATE:   3/13/2003
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Alternative Liner System

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******************************************************************************

     TITLE:  CHERRY ISLAND LANDFILL PHASE V - RUN B3 SIDE SLOPES

******************************************************************************


     NOTE:  INITIAL MOISTURE CONTENT OF THE LAYERS AND SNOW WATER
              WERE SPECIFIED BY THE USER.


                                  LAYER  1
                                  --------

                     TYPE 2 - LATERAL DRAINAGE LAYER
                       MATERIAL TEXTURE NUMBER  22
          THICKNESS                  =     24.00    INCHES
          POROSITY                   =      0.4190 VOL/VOL
          FIELD CAPACITY             =      0.3070 VOL/VOL
          WILTING POINT              =      0.1800 VOL/VOL
          INITIAL SOIL WATER CONTENT =      0.3621 VOL/VOL
          EFFECTIVE SAT. HYD. COND.  =  0.189999992000E-04 CM/SEC
          SLOPE                      =     50.00    PERCENT
          DRAINAGE LENGTH            =     75.0     FEET


NOTE:  SATURATED HYDRAULIC CONDUCTIVITY IS MULTIPLIED BY  4.63
         FOR ROOT CHANNELS IN TOP HALF OF EVAPORATIVE ZONE.


                                  LAYER  2
                                  --------

                     TYPE 4 - FLEXIBLE MEMBRANE LINER
                       MATERIAL TEXTURE NUMBER  35
          THICKNESS                  =      0.06    INCHES
          POROSITY                   =      0.0000 VOL/VOL
          FIELD CAPACITY             =      0.0000 VOL/VOL
          WILTING POINT              =      0.0000 VOL/VOL
          INITIAL SOIL WATER CONTENT =      0.0000 VOL/VOL
          EFFECTIVE SAT. HYD. COND.  =  0.199999996000E-12 CM/SEC
          FML PINHOLE DENSITY        =      1.00    HOLES/ACRE
          FML INSTALLATION DEFECTS   =      1.00    HOLES/ACRE
          FML PLACEMENT QUALITY      =  4 - POOR


                                  LAYER  3
                                  --------

                     TYPE 3 - BARRIER SOIL LINER
                       MATERIAL TEXTURE NUMBER  16
          THICKNESS                  =   1011.60    INCHES
          POROSITY                   =      0.4270 VOL/VOL
          FIELD CAPACITY             =      0.4180 VOL/VOL
          WILTING POINT              =      0.3670 VOL/VOL
          INITIAL SOIL WATER CONTENT =      0.4270 VOL/VOL
          EFFECTIVE SAT. HYD. COND.  =  0.100000001000E-06 CM/SEC


                  GENERAL DESIGN AND EVAPORATIVE ZONE DATA
                  ----------------------------------------

     NOTE:  SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT
              SOIL DATA BASE USING SOIL TEXTURE #22 WITH A
              POOR STAND OF GRASS, A SURFACE SLOPE OF  2.%
              AND A SLOPE LENGTH OF 1200. FEET.

          SCS RUNOFF CURVE NUMBER                =     93.10
          FRACTION OF AREA ALLOWING RUNOFF       =    100.0     PERCENT
          AREA PROJECTED ON HORIZONTAL PLANE     =      1.000   ACRES
          EVAPORATIVE ZONE DEPTH                 =     24.0     INCHES
          INITIAL WATER IN EVAPORATIVE ZONE      =      8.690   INCHES
          UPPER LIMIT OF EVAPORATIVE STORAGE     =     10.056   INCHES
          LOWER LIMIT OF EVAPORATIVE STORAGE     =      4.320   INCHES
          INITIAL SNOW WATER                     =      0.000   INCHES
          INITIAL WATER IN LAYER MATERIALS       =    440.644   INCHES
```

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DTM CHP

TOTAL INITIAL WATER = 440.644 INCHES
TOTAL SUBSURFACE INFLOW = 0.00 INCHES/YEAR

EVAPOTRANSPIRATION AND WEATHER DATA

NOTE: EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
ALBANY NEW YORK

STATION LATITUDE	=	42.45 DEGREES
MAXIMUM LEAF AREA INDEX	=	3.50
START OF GROWING SEASON (JULIAN DATE)	=	123
END OF GROWING SEASON (JULIAN DATE)	=	282
EVAPORATIVE ZONE DEPTH	=	24.0 INCHES
AVERAGE ANNUAL WIND SPEED	=	8.90 MPH
AVERAGE 1ST QUARTER RELATIVE HUMIDITY	=	68.00 %
AVERAGE 2ND QUARTER RELATIVE HUMIDITY	=	66.00 %
AVERAGE 3RD QUARTER RELATIVE HUMIDITY	=	74.00 %
AVERAGE 4TH QUARTER RELATIVE HUMIDITY	=	74.00 %

NOTE: PRECIPITATION DATA FOR CHERRY ISLAND LF
WAS ENTERED BY THE USER.

NOTE: TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR WILMINGTON DELAWARE

NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
31.20	33.20	41.80	52.40	62.20	71.20
76.00	74.80	67.80	56.30	45.60	35.50

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR WILMINGTON DELAWARE
AND STATION LATITUDE = 39.80 DEGREES

****

AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1 THROUGH 5

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	3.29	2.79	4.55	3.21	4.19	5.59
	4.23	4.52	4.89	3.51	2.32	2.85
STD. DEVIATIONS	2.46	1.73	2.33	1.18	2.52	1.47
	1.79	2.59	2.17	1.31	0.84	2.65
RUNOFF						
TOTALS	1.609	1.264	2.577	0.278	1.039	1.005
	0.929	0.904	1.562	1.016	0.279	1.035
STD. DEVIATIONS	1.663	1.345	2.521	0.186	1.024	0.524
	1.318	0.674	1.087	0.922	0.227	1.626
EVAPOTRANSPIRATION						
TOTALS	0.711	0.954	2.114	3.319	3.599	6.121
	4.545	3.246	1.885	1.488	1.062	0.686
STD. DEVIATIONS	0.290	0.514	0.273	0.523	1.096	0.812
	0.882	1.646	0.799	0.222	0.283	0.186
LATERAL DRAINAGE COLLECTED FROM LAYER 1						
TOTALS	0.3593	0.2722	0.5950	0.3195	0.2065	0.1288
	0.0090	0.0000	0.0000	0.0321	0.1263	0.4364
STD. DEVIATIONS	0.2793	0.2583	0.2353	0.1518	0.0957	0.1084
	0.0125	0.0000	0.0000	0.0466	0.1344	0.4224
PERCOLATION/LEAKAGE THROUGH LAYER 3						
TOTALS	0.0013	0.0011	0.0019	0.0015	0.0013	0.0008
	0.0001	0.0000	0.0000	0.0002	0.0007	0.0014
STD. DEVIATIONS	0.0008	0.0006	0.0004	0.0003	0.0003	0.0004
	0.0001	0.0000	0.0000	0.0003	0.0006	0.0011

AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)

DAILY AVERAGE HEAD ON TOP OF LAYER 2						
AVERAGES	10.1905	9.9182	15.9363	12.6337	9.7626	6.3264
	0.5070	0.0000	0.0000	1.8006	5.3294	11.5829
STD. DEVIATIONS	6.1723	6.1103	3.5862	2.8460	2.9703	3.7466
	0.7024	0.0000	0.0000	2.6190	5.3146	8.8801

****

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PTM CAP

AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1 THROUGH 5

	INCHES		CU. FEET	PERCENT
PRECIPITATION	45.95	(7.462)	166798.5	100.00
RUNOFF	13.495	(5.2286)	48985.93	29.368
EVAPOTRANSPIRATION	29.727	(2.0819)	107910.51	64.695
LATERAL DRAINAGE COLLECTED FROM LAYER 1	2.48494	(0.66055)	9020.328	5.40792
PERCOLATION/LEAKAGE THROUGH LAYER 3	0.01031	(0.00190)	37.432	0.02244
AVERAGE HEAD ON TOP OF LAYER 2	6.999	(1.316)		
CHANGE IN WATER STORAGE	0.233	(1.4187)	844.29	0.506

PEAK DAILY VALUES FOR YEARS 1 THROUGH 5

	(INCHES)	(CU. FT.)
PRECIPITATION	4.70	17061.000
RUNOFF	3.145	11417.7314
DRAINAGE COLLECTED FROM LAYER 1	0.03820	138.65994
PERCOLATION/LEAKAGE THROUGH LAYER 3	0.000091	0.32863
AVERAGE HEAD ON TOP OF LAYER 2	23.764	
MAXIMUM HEAD ON TOP OF LAYER 2	40.223	
LOCATION OF MAXIMUM HEAD IN LAYER 1 (DISTANCE FROM DRAIN)	0.0 FEET	
SNOW WATER	2.75	9974.9512

Value used for head on liner system

MAXIMUM VEG. SOIL WATER (VOL/VOL) 0.4190

MINIMUM VEG. SOIL WATER (VOL/VOL) 0.1800

*** Maximum heads are computed using McEnroe's equations. ***

Reference: Maximum Saturated Depth over Landfill Liner
by Bruce M. McEnroe, University of Kansas
ASCE Journal of Environmental Engineering
Vol. 119, No. 2, March 1993, pp. 262-270.

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DTM
CHP

****

FINAL WATER STORAGE AT END OF YEAR 5

LAYER	(INCHES)	(VOL/VOL)
1	9.8533	0.4106
2	0.0000	0.0000
3	431.9532	0.4270
SNOW WATER	0.000	

****
****

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DTM CHP

Appendix VIb-F.3

Anchor Trench Calculations

GEOSYNTEC CONSULTANTS

COMPUTATION COVER SHEET

Client: DSWA **Project:** Cherry Island **Project/Proposal #:** ME0250 **Task #:** 2.2.7

TITLE OF COMPUTATIONS ANCHOR TRENCH CALCULATIONS

COMPUTATIONS BY:
Signature Douglas T. Mandeville — DATE 3/26/03
Printed Name and Title: Douglas T. Mandeville, Senior Staff Engineer

ASSUMPTIONS AND PROCEDURES CHECKED BY:
(Peer Reviewer)
Signature — DATE 3/26/03
Printed Name and Title: R. David Espinoza, Senior Engineer

COMPUTATIONS CHECKED BY:
Signature Carrie H. Pendleton — DATE 03/27/03
Printed Name and Title: Carrie H. Pendleton, Staff Engineer

COMPUTATIONS BACKCHECKED BY:
(Originator)
Signature Douglas T. Mandeville — DATE 3/27/03
Printed Name and Title: Douglas T. Mandeville, Senior Staff Engineer

APPROVED BY:
(PM or Designate)
Signature — DATE 3/30/03
Printed Name and Title: R. David Espinoza, Senior Engineer

APPROVAL NOTES:

REVISIONS (Number and initial all revisions)

NO.	SHEET	DATE	BY	CHECKED BY	APPROVAL

Written by: Doug Mandeville Date: 03/26/03 Reviewed by: Carrie Pendleton Date: 3/27/03

Client: DSWA Project: Cherry Island Proj./Proposal No.: ME0250 Task No.: 2.2.7

ANCHOR TRENCH CALCULATIONS

PURPOSE

The purpose of this calculation is to evaluate the factor of safety against pull-out of the liner system from the anchor trench for the Cherry Island Landfill (CIL). The factor of safety against pull-out will be evaluated for the construction and waste placement phases (i.e., when equipment driving over the anchor trench and into the landfill will apply the greatest tensile forces to the liner system in the anchor trench). In addition, the tensile strength of the geomembrane component of the liner system will be compared to the tensile forces applied to the liner system and to the frictional resistance available by the proposed anchor trench. It is desirable that the geomembrane does not tear under the applied tensile forces and that the anchor trench fails (i.e., pulls out) before the geomembrane tears. The geosynthetic used in the liner system at CIL will be 60-mil textured HDPE geomembrane.

METHOD OF ANALYSIS

The proposed design of the liner system anchor trench is shown in Figure 1. The factor of safety against pull-out resistance is evaluated based on a force equilibrium analysis as the ratio of the sum of the resisting forces, $F_{resisting}$, to the sum of the driving forces, $F_{driving}$, as follows:

$$FS_{pull-out} = \frac{\Sigma F_{resisting}}{\Sigma F_{driving}} \quad (1)$$

In this analysis, the resisting forces include frictional forces within the anchor trench (Figure 1). The driving force consists of the sum of tensile forces applied to the liner system by: (i) construction equipment (T), and (ii) drainage/protective cover soil on the sideslope (T_s). Thus,

$$F_{driving} = T + T_s \quad (2)$$

Slippage in the liner system is assumed to occur at the weakest interface.

Driving Force

1. The tensile force applied to the liner system by construction equipment is estimated as follows:

$$T = \frac{S + F_b - F_r}{B} \tag{3}$$

where

T = tensile force per foot of liner material (lb/ft);
S = force of the equipment acting downslope (lb);
F_b = force on liner system due to equipment braking acting downslope (lb);
F_r = frictional resisting force on liner system acting up slope (lb); and
B = width of equipment (ft).

The force of the equipment acting downslope, S, is estimated as the force along the slope applied by equipment (i.e., bulldozer) that will be used during placement of the leachate collection drainage/protective cover material and waste as follows:

$$S = W\sin\beta \tag{4}$$

where

W = weight of bulldozer (lb); and
β = side slope angle (degrees), see Figure 1.

The braking force, F_b, is estimated as the change in momentum of the bulldozer going from the maximum speed to a speed of 0 mph over one second, as follows:

$$F_b = \frac{\Delta M}{\Delta t} = \frac{m(v_1 - v_2)}{\Delta t} \tag{5}$$

where

ΔM = change in momentum (lb-ft/s);
m = mass of bulldozer (lb);
v = velocity (ft/s) ($v_1 = v_{max}$ and $v_2 = 0$); and
Δt = time interval = 1 sec.

The frictional force on the liner system caused by the equipment, F_r, is evaluated as follows:

$$F_r = N\tan\delta \tag{6}$$

where

N = normal force due to weight of equipment (lb/ft);
δ = interface friction strength (degrees);

2. The tensile force, T_s, applied to the liner system by the soil is calculated as:

$$T_s = W_s \sin\beta - N(\tan\delta_{lower}) \geq 0 \tag{7}$$

where

W_s = weight of the overlying soil (lb/ft);
β = slope angle
N = normal force of the soil on the sideslope (lb/ft);
δ_{lower} = interface friction angle of the geocomposite/textured HDPE geomembrane interface.

Resisting Forces

The pull-out resistance of the liner system is evaluated as the sum of frictional forces within the anchor trench. A free body diagram illustrating these forces is presented in Figure 2. As shown in this figure, forces F_1, F_2, F_3 F_4, and F_5 act along flat planes of contact between the liner system and soil. These frictional forces are developed in the liner system due to shear resistance between the geomembrane layer and the adjacent geotextile, geocomposite, or soil layer. It is assumed that frictional resistance can be developed on both sides of the geosynthetics within the anchor trench. However, along the roll-out length, L_{ro}, it is assumed that resistance is only generated between the geosynthetic clay liner (GCL) and the textured geomembrane.

The frictional forces that act along flat planes of contact are evaluated as the product of the normal force, N, and the tangent of the interface friction angle, δ, between the liner system and the adjacent material (similar to Equation 5). For forces F_1, F_2, and F_5, the normal force is taken as the weight of the overlying soil. For forces F_3 and F_4, the normal force is estimated as the at-rest lateral earth pressure at mid-depth within the anchor trench.

The frictional forces F_1 through F_5 are calculated according to the following equations and act in the direction shown in Figure 2.

$$F_1 + F_2 = (\gamma_{sc} d_{sc} + \gamma_{at} d_{at}) L(\tan(\delta_{lower}) + \tan(\delta_{upper})) \quad (8)$$

$$F_3 + F_4 = (\tan(\delta_{upper}) + \tan(\delta_{lower}))(\gamma_{sc} d_{sc} + 0.5\gamma_{at} d_{at}) \cdot (d_{at}) \cdot K_o \quad (9)$$

$$F_5 = \gamma_{sc} d_{sc} L_{ro} \tan\delta_{lower} \quad (10)$$

where:

γ_{sc}	=	unit weight of leachate collection drainage/protective cover layer (pcf);
γ_{at}	=	unit weight of anchor trench backfill (pcf);
d_{sc}	=	depth of leachate collection drainage/protective layer (ft);
d_{at}	=	depth of anchor trench (ft);
L	=	width of anchor trench (ft);
L_{ro}	=	roll out length of liner between top of slope and front edge of anchor trench (ft);
δ_{lower}	=	interface friction angle between geomembrane and underlying geocomposite layer (degrees);
δ_{upper}	=	interface friction angle between the geomembrane and overlying geotextile material (degrees);
K_o	=	coefficient of at-rest, lateral earth pressure; and
β	=	angle between tension forces at corners in anchor trench.

INPUT PARAMETERS

The proposed anchor trench geometry is as follows:

Length of roll out (L_{ro})	=	1 ft
Width of anchor trench (W_{at})	=	2 ft
Depth of anchor trench (d_{at})	=	2 ft

The sideslopes of the CIL liner system are inclined at a 2H:1V slope (i.e., $\beta = 26.5°$).

A Caterpillar D6H bulldozer is assumed to be typical of equipment that will be used for placing leachate collection drainage/protection layer and waste. The Caterpillar D6H has the following properties [Caterpillar, 1992]:

Weight (W)	=	40,104 lbs
Maximum Speed (v_{max})	=	2 miles/hour

Width (B) = 8' - 8" (8.67 ft)

Assume that the unit weight of the leachate collection drainage/protective cover material and the anchor trench backfill is 120 pcf and that the shear strength of these materials is $\phi = 35°$. Based on Jaky's equation [Jaky, 1948]: $K_o = 1 - \sin\phi = 1 - \sin(35) = 0.426$. The following interface friction angles (δ) and soil properties are taken from the calculation package entitled "Liner System Veneer Stability on Sideslopes"; presented as Appendix VIb-F.2; a copy of this information is presented in Table 1.

Geotextile component of GCL/textured HDPE geomembrane interface = 25 - 35 degrees (Assume $\delta_{upper} = 25°$)
GCL/subbase = 31 - 41 degrees (Assume $\delta_{lower} = 31°$)
Tensile yield strength of 60-mil textured HDPE geomembrane = 1,512 lb/ft [GRI GM13, 1999, see Table 2]
Yield strain of 60-mil textured HDPE geomembrane = 12% [GRI GM13, 1999]

CALCULATIONS

Driving Force

$$S = 40{,}104 \text{ lb} \sin(26.6) = 17{,}957 \text{ lb}$$

$$F_b = \frac{(40{,}104 \text{ lb} \div 32.2 \text{ ft/s}^2)(2 \text{ mph} \times 5{,}280 \text{ ft/mi} \div 3{,}600 \text{ s})}{1 \text{ s}} = 3{,}654 \text{ lb}$$

$$F_r = N\tan\delta = W\cos\beta\tan\delta = 40{,}104\, lb \cos(26.6)\tan(23) = 15{,}221 \text{ lb}$$

$$T = \frac{17{,}935 \text{ lb} + 3{,}654 \text{ lb} - 15{,}226 \text{ lb}}{8.67 \text{ ft}} = 734 \text{ lb/ft}$$

$$T_s = (95\text{ft})(120\text{pcf}(2\text{ft})\sin(26.6) - ((95\text{ft})(120\text{pcf})(2\text{ft})\cos(26.6)\tan(26)) = 266 \text{ lb/ft}$$

$$\Sigma F_d = 734 \text{ lb/ft} + 266 \text{lb/ft} = 1{,}000 \text{ lb/ft}$$

Check that tensile force applied to liner system is less than tensile strength of geomembrane:

1,000 lb/ft < 1,512 lb/ft O.K.

Resisting Force

$$F_1 + F_2 = (120 \times 2 + 120 \times 2.0)2.0(\tan(25) + \tan(31)) = 1{,}024 lb/ft$$

$$F_3 + F_4 = (\tan(25) + \tan(31))(120 \times 2.0 + 0.5 \times 120 \times 2.0) \cdot (2.0) \cdot 0.426 = 327 \ lb/ft$$

$$F_5 = 120 \times 2.0 \times 1.0 \times \tan 25 = 112 \text{ lb/ft}$$

$$\sum_{i=1}^{5} F_i = 1{,}024 + 327 + 112 = 1{,}463 \text{ lb/ft}$$

Check that resisting force applied to liner system is less than tensile strength of geomembrane:

1,463 lb/ft < 1,512 lb/ft O.K.

$$FS_{pull-out} = \frac{\Sigma F_{resisting}}{\Sigma F_{driving}} = \frac{1{,}463}{1{,}000} = 1.463$$

RESULTS

The factor of safety against pull-out is estimated to be 1.463, which is adequate for the construction and waste placement phases. The tensile strength of the geomembrane is greater than both the applied tensile forces and the frictional resistance provided by the anchor trench. This indicates that the geomembrane will not tear under the loading conditions considered and that the anchor trench is likely to pull-out before the geomembrane tears.

REFERENCES

Caterpillar, *"Caterpillar Performance Handbook,"* Caterpillar Inc. Peoria, IL, 1992.

Geosynthetics Research Institute, GRI GM13, revision 2, April 1999.

Written by: Doug Mandeville Date: 03/03/19 (YY MM DD) Reviewed by: Carrie Pendleton Date: 03/03/27 (YY MM DD)

Client: DSWA Project: Cherry Island Project/Proposal No.: ME0250 Task No.: 2.2.7

SUMMARY OF DOCUMENTED INTERFACE FRICTION VALUES

GEOSYNTHETIC/GEOSYNTHETIC	δ (degrees)
HDPE/Nonwoven Geotextile	6-12°
Rough HDPE/Nonwoven Geotextile	25-35°
HDPE Geonet	8-15°
Rough HDPE/Geonet	8-15°
Rough HDPE/Geocomposite Drainage Layer	17-29°
Geonet/Nonwoven Geotextile	14-22°
HDPE/GCL (hydrated)	5-12°
Rough HDPE/GCL (hydrated)	18-37°
GEOSYNTHETIC/SOIL	**tan δ/tan φ**
HDPE/Clay	0.4-0.7
Rough HDPE/Clay	0.8-0.9
HDPE/Sand	0.5-0.6
Rough HDPE/Sand	0.7-0.8
Needlepunched Geotextile/Sand	0.8-1.0
Needlepunched Geotextile/Angular Gravel	0.7-0.9
Needlepunched Geotextile/Rounded Gravel	0.6-0.8
Geogrid/Soil	1.0
GCL/Clay	δ = 31-41°
GCL/Sand	δ = 17°-35°

$\delta = \tan^{-1}(x * \tan\phi)$

δ = interface friction angle; φ = soil internal friction angle

(Adapted from tests by Martin et al. [1984], Williams and Houlihan [1986], Koerner et al. [1986], manufacturers literature, and unpublished results from GeoSyntec Consultants.)

ENGLISH UNITS

Table 2(a) - High Density Polyethylene (HDPE) Geomembrane - Textured

Property	Test Method	Test Value							Testing Frequency (minimum)
		30 mils	40 mils	50 mils	60 mils	80 mils	100 mils	120 mils	
hickness (min. ave.) · lowest individual for 8 out of 10 values · lowest individual for any of the 10 values	D 5994	nom. (-5%) -10% -15%	nom. (-5%) -10% -15%	nom. (-5%) -10% -15%	nom. (-5%) -10% -15%	nom. (-5%) -10% -15%	nom. (-5%) -10% -15%	nom. (-5%) -10% -15%	per roll
sperity Height (min. ave.) *(1)*	GM 12	10 mil	10 mil	10 mil	10 mil	10 mil	10 mil	10 mil	every 2nd roll *(2)*
ensity (min. ave.)	D 1505/D792	0.940 g/cc	0.940 g/cc	0.940 g/cc	0.940 g/cc	0.940 g/cc	0.940 g/cc	0.940 g/cc	200,000 lb
ensile Properties (min. ave.) *(3)* · yield stress · break stress · yield elongation · break elongation	D 638 Type IV	63 lb/in. 45 lb/in. 12% 100%	84 lb/in. 60 lb/in. 12% 100%	105 lb/in. 75 lb/in. 12% 100%	126 lb/in. 90 lb/in. 12% 100%	168 lb/in. 120 lb/in. 12% 100%	210 lb/in. 150 lb/in. 12% 100%	252 lb/in. 180 lb/in. 12% 100%	20,000 lb
ear Resistance (min. ave.)	D 1004	21 lb	28 lb	35 lb	42 lb	56 lb	70 lb	84 lb	45,000 lb
uncture Resistance (min. ave.)	D 4833	45 lb	60 lb	75 lb	90 lb	120 lb	150 lb	180 lb	45,000 lb
tress Crack Resistance *(4)*	D 5397 (App.)	200 hr.	200 hr.	200 hr.	200 hr.	200 hr.	200 hr.	200 hr.	per GRI-GM 10
arbon Black Content (range)	D 1603 *(5)*	2.0 - 3.0%	2.0 - 3.0%	2.0 - 3.0%	2.0 - 3.0%	2.0 - 3.0%	2.0 - 3.0%	2.0 - 3.0%	20,000 lb
arbon Black Dispersion	D 5596	note *(6)*	note *(6)*	note *(6)*	note *(6)*	note *(6)*	note *(6)*	note *(6)*	45,000 lb
xidative Induction Time (OIT) (min. ave.) *(7)* a) Standard OIT — or — b) High Pressure OIT	D 3895 D 5885	100 min. 400 min.	100 min. 400 min.	100 min. 400 min.	100 min. 400 min.	100 min. 400 min.	100 min. 400 min.	100 min. 400 min.	200,000 lb
Oven Aging at 85°C *(7), (8)* a) Standard OIT (min. ave.) - % retained after 90 days — or — b) High Pressure OIT (min. ave.) - % retained after 90 days	D 5721 D 3895 D 5885	55% 80%	55% 80%	55% 80%	55% 80%	55% 80%	55% 80%	55% 80%	per each formulation
UV Resistance *(9)* a) Standard OIT — or — b) High Pressure OIT (min. ave.) - % retained after 1600 hrs *(11)*	GM11 D 3895 D 5885	N.R. *(10)* 50%	N.R. *(10)* 50%	N.R. *(10)* 50%	N.R. *(10)* 50%	N.R. *(10)* 50%	N.R. *(10)* 50%	N.R. *(10)* 50%	per each formulation

(1) Of 10 readings; 8 out of 10 must be ≥ 7 mil, and lowest individual reading must be ≥ 5 mil
(2) Alternate the measurement side for double sided textured sheet
(3) Machine direction (MD) and cross machine direction (XMD) average values should be on the basis of 5 test specimens each direction
Yield elongation is calculated using a gage length of 1.3 inches
Break elongation is calculated using a gage length of 2.0 inches
(4) The SP-NCTL test is not appropriate for testing geomembranes with textured or irregular rough surfaces. Test should be conducted on smooth edges of textured rolls or on smooth sheets made from the same formulation as being used for the textured sheet materials.
The yield stress used to calculate the applied load for the SP-NCTL test should be the manufacturer's mean value via MQC testing.
(5) Other methods such as D 4218 (muffle furnace) or microwave methods are acceptable if an appropriate correlation to D1603 (tube furnace) can be established.
(6) Carbon black dispersion for 10 different views:
· all 10 in Categories 1 or 2
(7) The manufacturer has the option to select either one of the OIT methods listed to evaluate the antioxidant content in the geomembrane.
(8) It is also recommended to evaluate samples at 30 and 60 days to compare with the 90 day response.
(9) The condition of the test should be 20 hr. UV cycle at 75°C followed by 4 hr. condensation at 60°C.
(10) Not recommended since the high temperature of the Std-OIT test produces an unrealistic result for some of the antioxidants in the UV exposed samples.
(11) UV resistance is based on percent retained value regardless of the original HP-OIT value.

Table 2

rev. 2 - 4/29/9

9 of 16

Written by: Doug Mandeville Date: 03/02/26 (YY/MM/DD) Reviewed by: Carrie Pendleton Date: 03/03/27 (YY/MM/DD)

Client: DSWA Project: Cherry Island Project/Proposal No.: ME0250 Task No.: 2-2-7

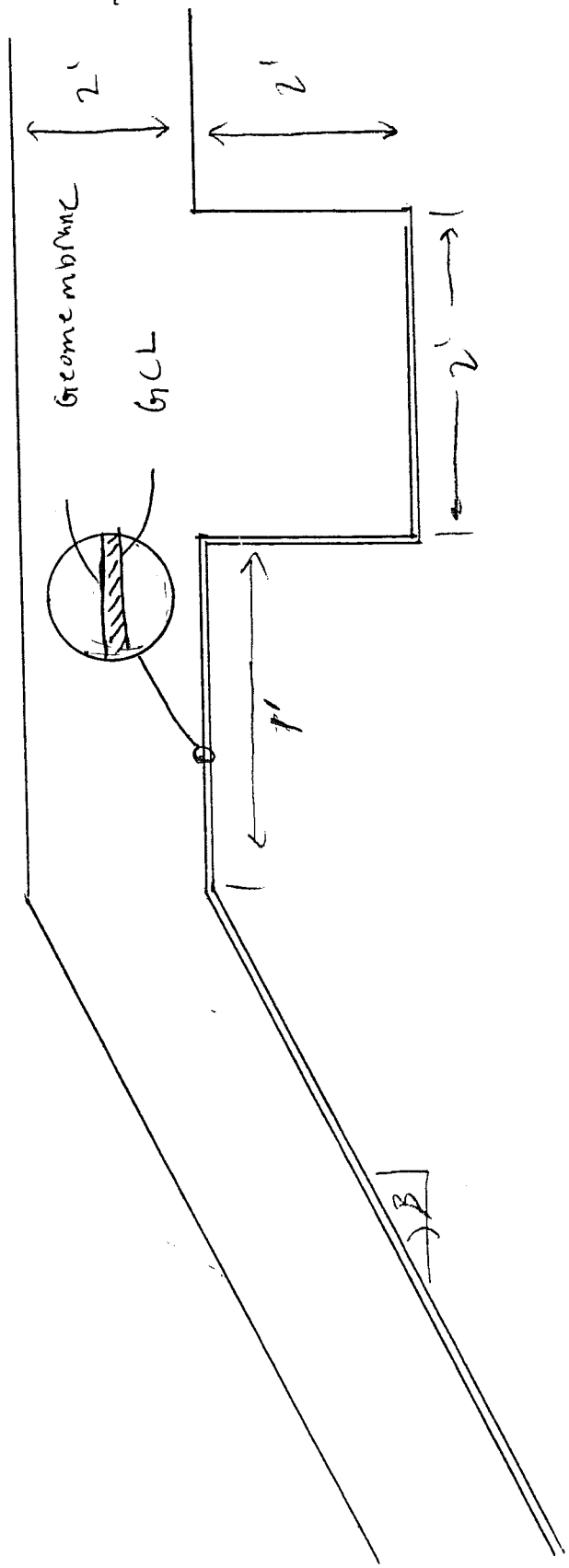


Figure 1

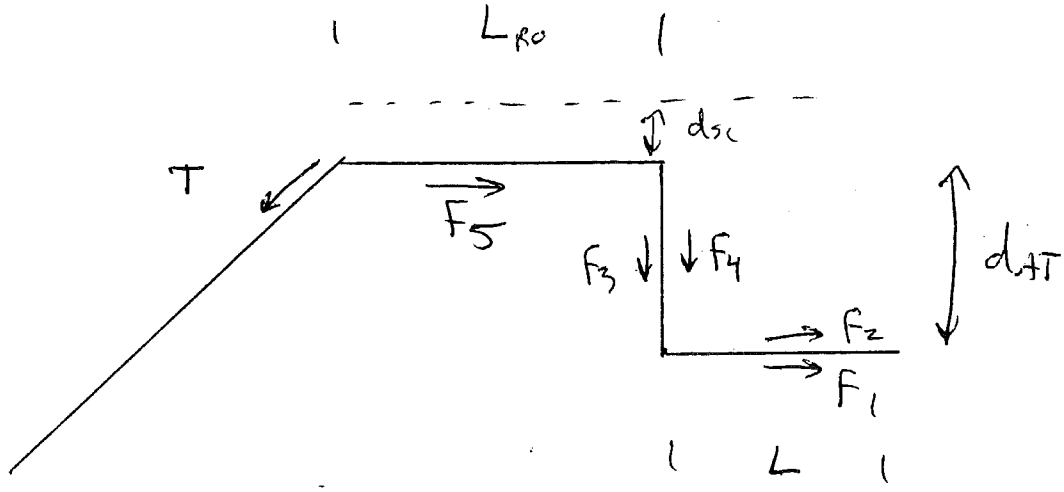
Not to scale

Written by: Doug Mandeville Date: 03/02/26 (YY MM DD) Reviewed by: Carrie Pendleton Date: 03/03/27 (YY MM DD)

Client: DSWA Project: Cherry Island Project/Proposal No.: ME0250 Task No.: 2.2.7

Figure 2

Free Body Diagram of Liner System Anchor Trench



APPENDIX VIb-G

LEACHATE COLLECTION, REMOVAL, AND TRANSMISSION SYSTEM CALCULATIONS

Appendix VIb-G.1

Leachate Generation Analysis

GEOSYNTEC CONSULTANTS

COMPUTATION COVER SHEET

Client: DSWA **Project:** Cherry Island Landfill **Project/Proposal #:** ME0250 **Task #:** 2.3.4

TITLE OF COMPUTATIONS LEACHATE GENERATION ANALYSIS

COMPUTATIONS BY:
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Signature — 3/27/03 DATE
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COMPUTATIONS CHECKED BY:
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COMPUTATIONS BACKCHECKED BY:
(Originator)
Signature Carrie H. Pendleton — 03/28/03 DATE
Printed Name and Title: Carrie H. Pendleton, Staff Engineer

APPROVED BY:
(PM or Designate)
Signature — 3/30/03 DATE
Printed Name and Title: R. David Espinoza, Senior Engineer

APPROVAL NOTES: The calculations presented herein are suitable for a landfill elevation of 195 ft-msl. As shown in this calculation package, the design was performed for a more conservative grading configuration than that shown in Drawing 78 entitled "Landfill Final Development and Grading Plan" (Appendix VIb-A). RDE 6/10/04

REVISIONS (Number and initial all revisions)

NO.	SHEET	DATE	BY	CHECKED BY	APPROVAL

LEACHATE GENERATION ANALYSIS

1.0 OBJECTIVE

The objective of this calculation package is to evaluate the future leachate generation rates at Cherry Island Landfill (CIL) using site-specific information and actual leachate generation rates at the site. In addition, the expected head on the liner is evaluated for future conditions. The HELP, Version 3 [USEPA, 1994a and 1994b] computer program is used to aid the analysis.

2.0 METHOD

Analysis of historical leachate generation at CIL is done by considering each phase separately, and analyzing leachate generation from the time the cell began receiving waste. Because historical leachate generation records for the landfill are only accurate from 1992 (prior to this date, problems with the leachate flow meter resulted in inaccurate readings), results from the HELP runs were used starting in that year (e.g., beginning with Year 8 for Phase I). The HELP model is used to calculate a per acre rate of leachate collected from the leachate collection system (LCS). Because the amount of leachate collected in the LCS is directly proportional to area, the per acre value calculated by the HELP model for each phase is multiplied by the phase area to estimate leachate generation for the entire site.

3.0 INPUT DATA

3.1 Introduction

The input data in the HELP model is classified into site/design specific data such as the layering configuration and material properties, and location specific data such as climatic data. For both types of input data properties, HELP offers the option of using default values or user defined values. For this analysis, both default values and user defined values are used. Where applicable, user defined input values are denoted as such. In what follows, each set of input data is described.

3.2 Weather Data

The HELP model requires the following weather-related input data: (i) evapotranspiration, (ii) precipitation, (iii) temperature, and (iv) solar radiation data. Actual precipitation data collected at the CIL site was used in the model. The HELP model provides default values and synthetically generated weather data for specific cities in the United States. Wilmington, Delaware was selected for temperature, solar radiation, and evapotranspiration data. The monthly precipitation data recorded at the CIL site was used in the analysis (Figure 1).

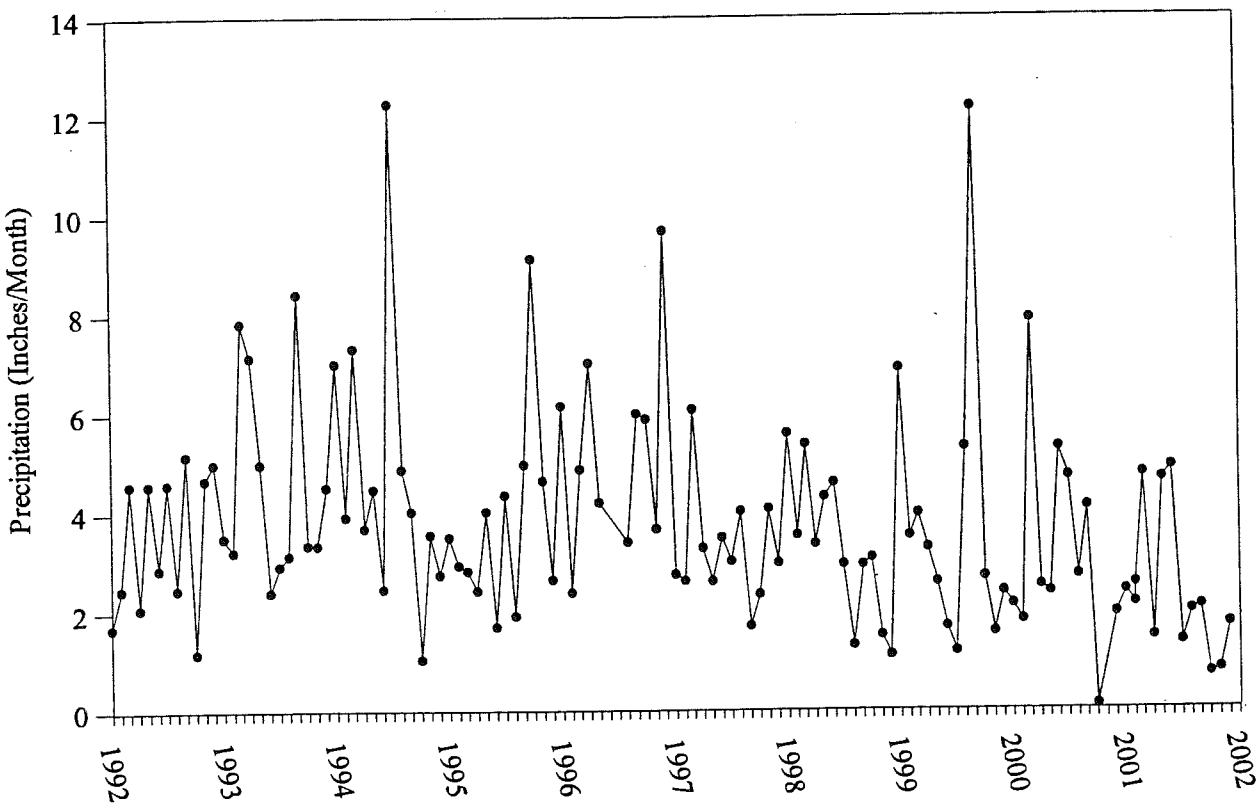


Figure 1 – Historical Precipitation Recorded at CIL

The HELP default values for evaporative zone depth are used. The site conditions are modeled as supporting a poor stand of grass, leading to a default value of 9 inches. The maximum leaf area index (LAI) is also based on default values, resulting in an LAI of 1.0.

3.3 Soil Data

A typical configuration of the soil layers for Phases I-V used in the analysis is shown in Figure 2. As shown in this figure, the system consists of four layers, namely: (1) Dredge Material, (2) Leachate Collection System, (3) Waste, and (4) Intermediate Cover. A description of each of these layers is presented below.

Layer 1 - Intermediate Soil Cover

The intermediate soil cover layer represents the soils that are placed over the waste between periods of waste placement. At any point in time, the majority of the site is overlain by intermediate cover. This layer is assumed to be approximately 12 inches in thickness in all phases. Because the permeability of the uppermost layer is the main factor controlling the amount of infiltration into waste, this parameter was varied by changing the soil type (in HELP, there are up to 26 soil types with default values of hydraulic properties such as porosity, field capacity, wilting point, and saturated hydraulic conductivity).

Layer 2 - Waste

Soil texture number 18 (Municipal Waste) was chosen for the waste layer; however, certain parameters were adjusted to reflect the actual waste conditions at the site. The thickness of the waste layer was chosen based on the 2001 settlement plate data (Attachment A).

For each phase, the information from all the settlement plates in that phase was used to obtain an average waste thickness. Values for site-specific porosity of the waste were obtained from lab testing of waste samples obtained at the site. The lab testing results are shown in Appendix O-6 of the Waste Characterization Report [GeoSyntec, 2003]. The data required to calculate the porosity of the sample are the waste sample volume, total unit weight of the sample, and the initial moisture content of the sample. This data is summarized in the table below. The waste samples were collected from Phase 2 and are assumed to be representative of the entire site.

Sample ID	Total Unit Weight (pcf)	Initial Moisture Content (%)	Initial Saturation (%)
1A	76.8	100%	100%
1B	75.0	100%	100%
2A	80.4	100%	100%
2B	74.7	100%	100%
3B	70.8	100%	100%

From this data, the porosity can be calculated using the following formulas. A sample calculation for Sample 1A is shown as Attachment B.

$$\text{Total Weight of Sample} = \frac{\text{Sample Volume (in}^3)}{1728\,\text{in}^3/\text{ft}^3} \times \text{Total Unit Weight (pcf)}$$

$$\text{Initial Weight of Solids} = \frac{\text{Total Weight of Sample}}{1 + \text{Initial Moisture Content}}$$

Initial Weight of Water (lb) = Total Weight of Sample – Initial Weight of Solids

$$\text{Initial Volume of Water (in}^3) = \frac{\text{Initial Weight of Water}}{62.4\,\text{pcf}} \times 1728\,\text{in}^3/\text{ft}^3$$

Initial Volume of Solids = Sample Volume – Initial Volume of Water

Because the sample is 100% saturated, $e = \frac{\text{Initial Volume of Water}}{\text{Initial Volume of Solids}}$.

$$n = \frac{e}{1+e}$$

The void ratio and porosity values for the five waste samples are shown below.

Sample ID	Void Ratio	Porosity
1A	1.60	0.62
1B	1.51	0.60
2A	1.81	0.64
2B	1.49	0.60
3B	1.31	0.57

An average porosity of 0.61 was used for HELP calculations.

The default values for field capacity and wilting point were used in the analysis and the initial soil water content was chosen as the same value as the wilting point as the waste is likely to have a low water content when disposed of in the landfill.

Layer 3 - Leachate Collection System

As shown in the design drawings, the leachate collection system at CIL varies by phase. Although there is no leachate collection layer in Phase I, there is a leachate collection piping system that collects leachate from Phase I. As a result, for modeling purposes, the bottom 1 ft of waste was considered the drainage layer for Phase I. Phase II has a leachate collection layer that consists of 12" of Backfill Type F (with a likely permeability of 10^{-4} cm/s or lower); due to the somewhat low permeability of the leachate collection layer, lateral drainage will more likely take place along the bottom of the waste. Therefore, as in Phase I, the bottom 1 ft of waste was modeled as a drainage layer. Phase III has a leachate collection layer that consists of 12" of sand. The LCS in Phases IV and V consists of 12" of rice gravel. However, borings done in waste as part of the waste characterization field work yielded samples of the leachate collection layer with the voids in the gravel essentially filled with sand. Therefore, the hydraulic conductivity of sand (Soil Type 1) was used in the HELP simulations for Phases III, IV, and V.

The slope used for each phase was measured from the design drawings. Similarly, the drainage length was measured from the design drawings and corresponds to the longest distance a drop of water must travel within the cell before reaching a leachate collection pipe. The slope values and drainage lengths for each phase are shown in the table below and on Figure 3.

The amount of subsurface inflow into the LCS from consolidation of dredge material was calculated using the most recent data available from the settlement plates in each phase. The settlement plate data is summarized in Attachment A. For each phase, the data from all settlement plates in that phase were used to get an average settlement rate in feet per year. Using a void ratio of 2.3 for the dredge (GeoSyntec, 2002), and assuming that all voids were initially filled with water, we can calculate the average amount of consolidation water entering the LCS each year. A sample calculation is shown as Attachment C. All input information for the LCS is summarized in the table below.

Phase	Slope (%)	Drainage Length (ft)	k (cm/s)	Subsurface Inflow (in/yr)
I	1.0	250	$1x10^{-3}$	8.91
II	0.3	230	$1x10^{-3}$	9.38
III	1.5	230	$1x10^{-2}$	4.77
IV	2.0	60	$1x10^{-2}$	6.23
V	2.0	75	$1x10^{-2}$	8.04

Layer 4 - Dredge Material

For the dredge spoils, material texture number 16 was chosen. Default values were used for all parameters with the exception of porosity. From known locations of the top and bottom of dredge, the average thickness of the dredge layer was calculated. The elevation of the top of the dredge is taken from the settlement plate data in each phase, summarized in Attachment A. The bottom of the dredge was assumed to be at an elevation of -20 ft MSL in Phases I and II, -35 ft MSL in Phases III and IV, and an elevation of -40 ft MSL in Phase V. These elevations were estimated from the cross sections developed of the site for the Geotechnical and Hydrogeological Report [GeoSyntec, 2003].

Summary

A summary of soil layer thicknesses (in inches) for each of the five phases is shown in the table below.

Soil Layer No.	Soil Layer Type	Phase I	Phase II	Phase III	Phase IV	Phase V
1	Cover	12.0	12.0	12.0	12.0	12.0
2	Waste	622.5	681.2	321.1	302.3	342.2
3	LCS	12.0	12.0	12.0	12.0	12.0
4	Dredge	337.5	554.8	904.9	947.8	1011.6

3.4 Surface Data

HELP models the surface runoff using the Soil Conservation Service (SCS) curve number method. HELP uses the surface slopes, lengths, soil type, and vegetative cover to determine a runoff curve number, which is used for runoff calculations. The amount of infiltration into the waste was controlled by changing the soil type for the Intermediate Soil Cover. This soil type was varied until a given soil type resulted in leachate generation that matched the historical cumulative leachate generated at the site. The soil type that gave the closest match was material texture number 22, which allowed approximately 50% of precipitation to infiltrate into the waste. The calculated amount of infiltration is in agreement with site conditions (i.e. large area and shallow slopes over a large majority of the site). A significant portion of the precipitation falling on the site will infiltrate since these conditions are not conducive to runoff.

4.0 CALIBRATION

The amount of infiltration into the waste was controlled by changing the soil type for the Intermediate Soil Cover. This soil type was varied until a given soil type resulted in leachate generation that matched the historical cumulative leachate generated at the site. The soil type that gave the closest match was material texture number 22, which allowed approximately 50% of precipitation to infiltrate into the waste.

The HELP outputs for the five runs (one for each phase) that matched the historical leachate generation data are included as Attachment D. The results are shown in tabular form in Attachment E. The simulation results are plotted below.

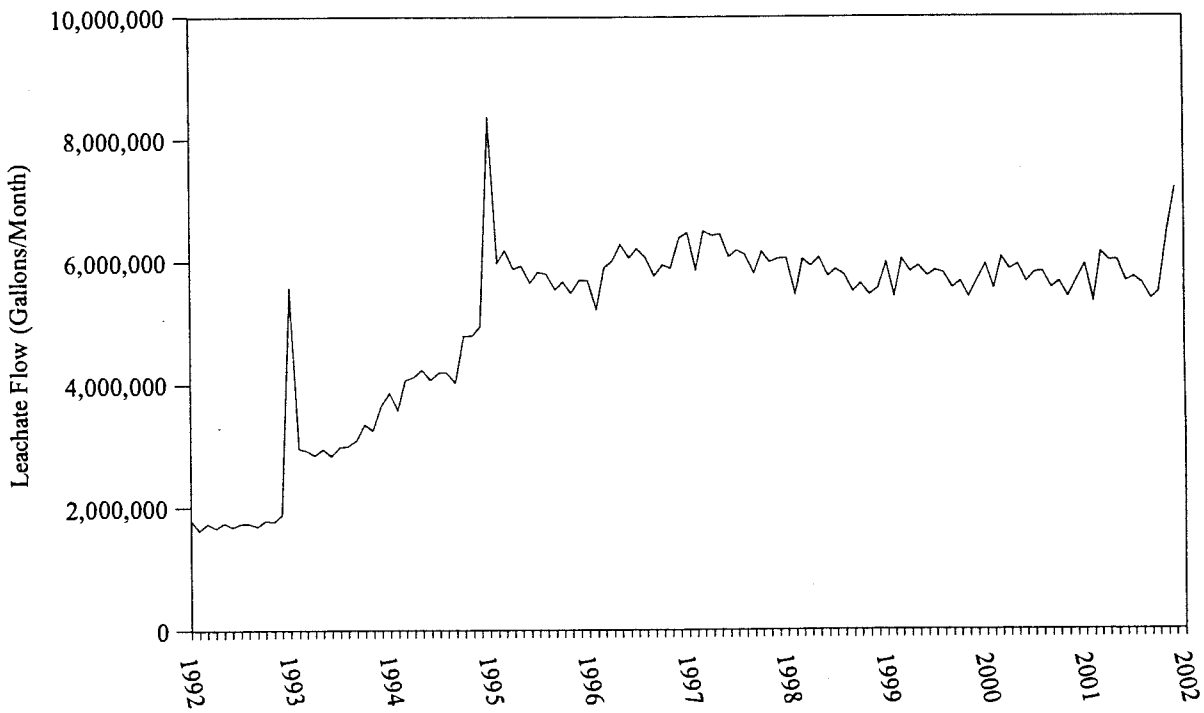


Figure 4 – Leachate Flow from HELP Simulation

A direct comparison (e.g., of monthly leachate rates between historical leachate production data and leachate estimations from HELP) cannot be performed because the results from HELP are obtained for average conditions and historical data from any particular month may not be reliable due to the following factors:

- unknowns related to when the leachate was pumped out of the system;

- whether or not all the leachate was pumped out at any given time; and
- leachate being pumped out on the 1st of the month that was actually generated in the previous month.

Analyzing the historical data cumulatively reduces the effect these uncertainties have on the data and makes comparison with HELP average results much easier. The cumulative data from the HELP simulation and the actual leachate data from CIL are plotted below to try to see a correlation between the actual data and modeled data.

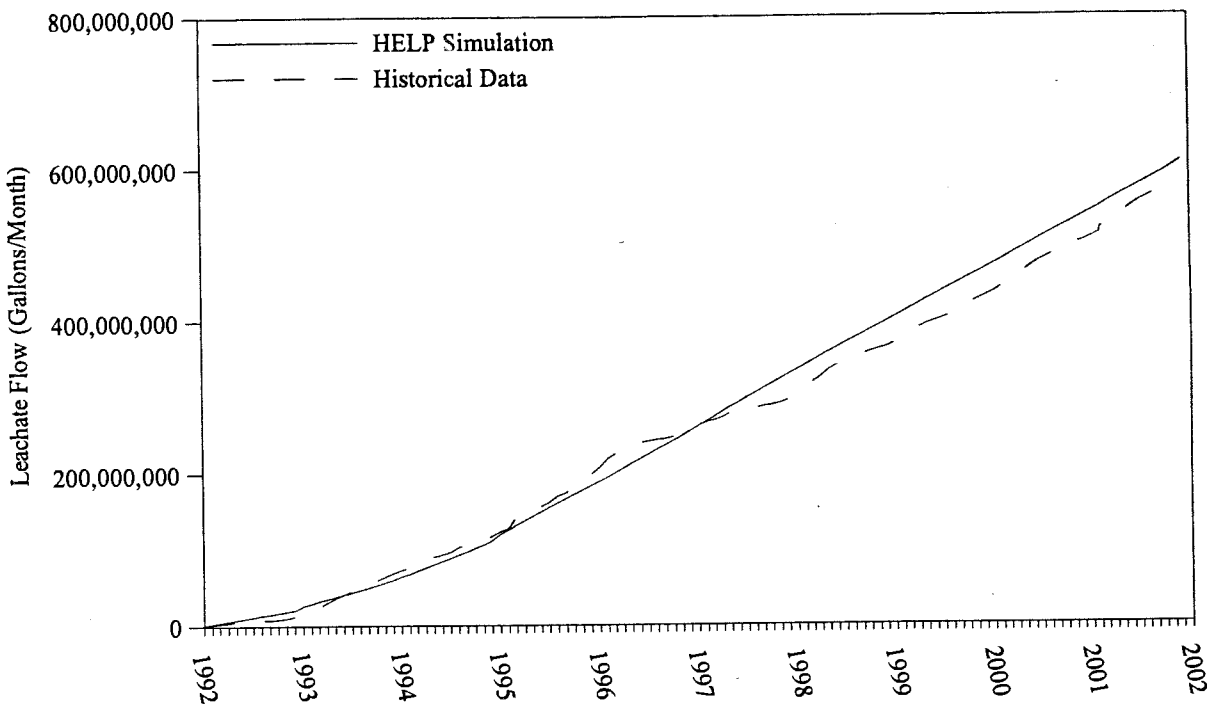


Figure 5 – Cumulative Leachate Flow from HELP Simulation

The parameters used in this analysis will be used in the next section to estimate the amount of leachate head on the liner, and to confirm that this head remains below the required level.

5.0 LEACHATE HEAD ON EXISTING LINER

The objective of this analysis is to estimate the expected leachate head on the liner at Cherry Island Landfill (CIL) using site-specific information, and to confirm that the head on the liner will remain below the required regulatory limit of 12 inches. Only Phases III, IV,

and V are considered in this analysis as these are the phases proposed for expansion. The HELP, Version 3 [USEPA, 1994a and 1994b] computer program is used to aid the analysis.

Analysis of leachate head at CIL is done using the same methods and parameters as the previous calculations above. The resulting average head on the liner from these calculations is within the required limit for all phases. These HELP simulations are included as Attachment A. In addition, HELP analyses were performed for the final conditions at the site for each of Phases III, IV, and V. The average head on the liner remains below the required limit. The results of these analyses are shown as Attachment F and are summarized below.

Phase	Expected Head (in)	
	Average Peak Daily	Annual Average
III	11.976	5.876
IV	11.726	1.639
V	11.816	2.704

Based on the analysis done here, leachate generation at CIL will not increase with additional waste placement. Therefore, leachate generation rates can be expected to remain close to the historical 10-year average of 780 gpad.

6.0 LEACHATE HEAD ON PROPOSED LINER (PHASE Va)

The leachate head on the proposed Phase Va was also analyzed using the same method discussed above. The cell was analyzed for both the proposed liner system and the alternative liner system. The proposed liner system is shown as Figure 6 and the alternate liner system is shown as Figure 7. The analysis for the proposed liner system was performed for the bottom areas which have a 2% slope. It is assumed that if the head on the liner is within allowable limits for the bottom areas, it will also be within allowable limits for the side slopes which are a 2:1 (50%) slope. The proposed liner analysis is denoted as Case 1 below.

The analysis for the alternate liner system was performed in two parts – one analysis for the side slopes and one for the bottom areas. It is proposed that the bottom areas have a geocomposite over the liner as well as 24" inches of protective material between the geocomposite and the waste. The side slopes will have no geocomposite but will have 24" of protective material that will serve as the drainage layer. In addition to

calculating the expected head on the liner, the permeability of the protective soil layer that is necessary to keep the head within the required limit was also calculated. The alternate liner side slope analysis is denoted as Case 2 below, while the alternate liner bottom area analysis is denoted as Case 3. The results of these analyses are shown as Attachment G and are summarized below.

Case	Expected Head (in)		k (cm/s)
	Average Peak Daily	Annual Average	
1	0.547	0.002	N/A
2	10.504	0.157	1.9×10^{-5}
3	0.006	0.000	1.9×10^{-5}

7.0 REFERENCES

GeoSyntec Consultants (2003). "Construction Drawings for Landfill Expansion Contract S01445NC Cherry Island Landfill New Castle County, Delaware 95% Draft – 22 January 2003".

DSWA (2001). Historical leachate production data.

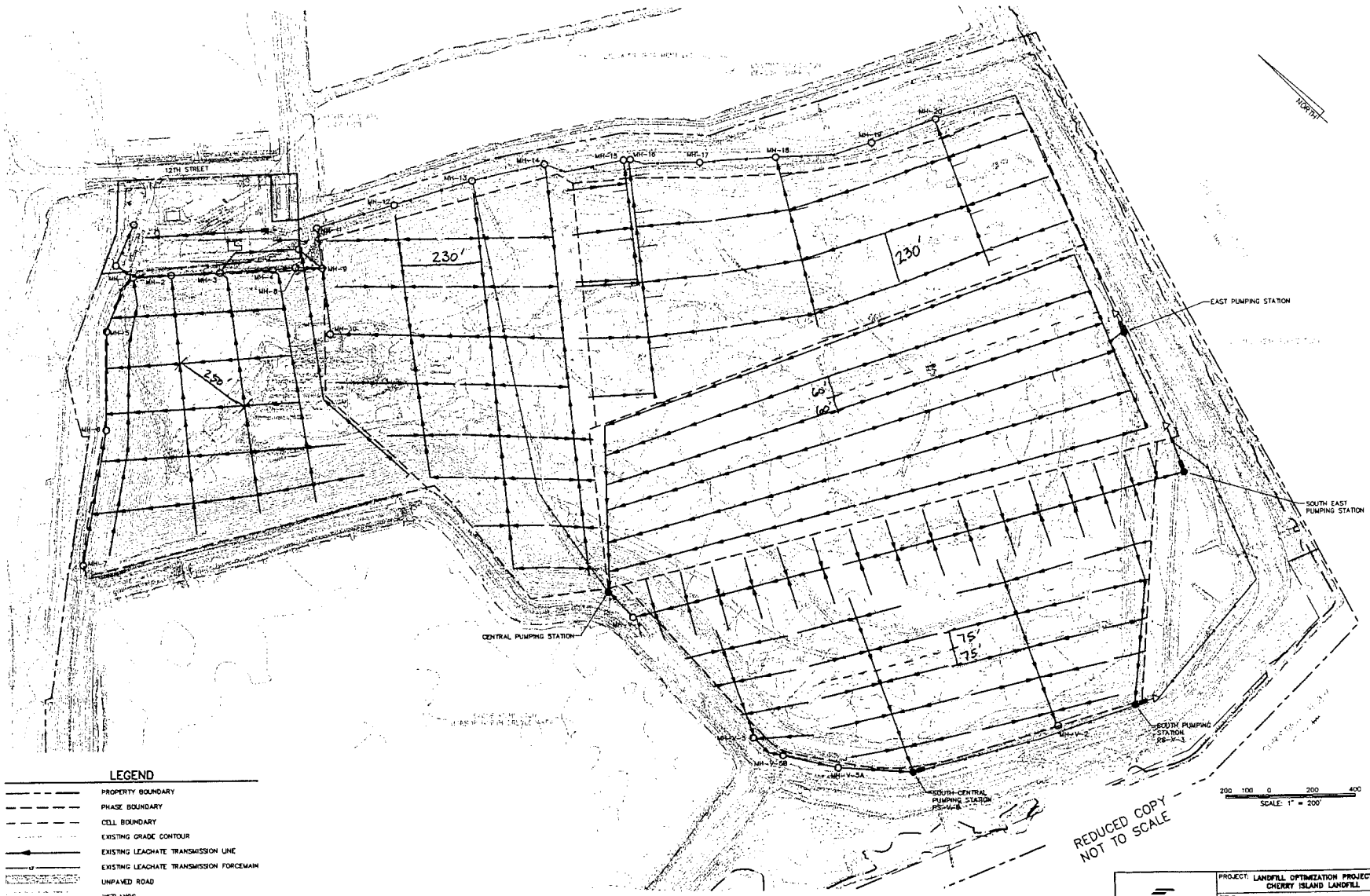
GeoSyntec Consultants (2003). "Geotechnical Characterization Report", Volume I.

Holtz, R. D. and Kovacs, W.D. (1981) "An Introduction to Geotechnical Engineering." Prentice Hall, Inc., Englewood Cliffs, NJ.

USEPA, "*The Hydrologic Evaluation of Landfill Performance (HELP) Model, Vol. I, Users Guide for Version 3*", EPA/530-SW-84-009, US Environmental Protection Agency, Washington, DC, June 1994a, 120p.

USEPA, "*The Hydrologic Evaluation of Landfill Performance (HELP) Model, Vol. II, Users Guide for Version 3*", EPA/530-SW-84-010, US Environmental Protection Agency, Washington, DC, June 1994b, 120p.

FIGURES



LEGEND

- PROPERTY BOUNDARY
- PHASE BOUNDARY
- CELL BOUNDARY
- EXISTING GRADE CONTOUR
- EXISTING LEACHATE TRANSMISSION LINE
- EXISTING LEACHATE TRANSMISSION FORCEMAIN
- UNPAVED ROAD
- WETLANDS
- EXISTING PUMPING STATION
- EXISTING MANHOLE
- EXISTING AIR RELEASE VALVE MANHOLE
- EXISTING PUMP STATION VALVE VAULT

GEOSYNTEC CONSULTANTS
COLUMBIA, MARYLAND

PROJECT:	LANDFILL OPTIMIZATION PROJECT CHERRY ISLAND LANDFILL
TITLE:	EXISTING LCS PLAN
SCALE:	NTS
PROJ. NO.:	ME0250
DATE:	FEB 2003
FILE NO.:	0250F607
SHEET NO:	3

P:\cadd\0250\0250-600-100percent\FIGURES\0250F607.DWG Mon Feb 03 10:41:17 2003 CHP

ATTACHMENT A

ATTACHMENT A

SUMMARY OF SETTLEMENT PLATE DATA

Phase	Settlement Plate	Reading Date	Thickness of Waste (ft)	Top of Dredge Elevation (ft)	Dredge Settlement (ft/year)
I	P1_SP_1AA	17 Mar 1986	-	16.5	0.79
		1 Oct 2001	55.5	4.2	
	P1_SP_1BA	26 Feb 1986	-	19.5	1.51
		1 Oct 2001	75.5	-4.0	
	P1_SP_3	15 Dec 1992	-	15.6	0.18
		1 Oct 2001	12.9	14.0	
	P1_SP_4	15 Dec 1992	-	17.3	0.14
		1 Oct 2001	6.4	16.1	
	P1_SP_5	15 Dec 1992	-	21.3	0.70
		1 Oct 2001	43.0	15.1	
	P1_SP_6	15 Dec 1992	-	25.6	2.07
		1 Oct 2001	83.6	7.4	
	P1_SP_7	15 Dec 1992	-	24.8	2.07
		1 Oct 2001	83.7	6.6	
II	P2_SP_1	14 Apr 1994	-	34.5	0.66
		1 Oct 2001	45.3	29.6	
	P2_SP_2	14 Apr 1994	-	35.4	0.55
		1 Oct 2001	45.8	31.3	
	P2_SP_4	14 Apr 1994	-	33.7	1.46
		1 Oct 2001	56.0	22.8	
	P2_SP_5	14 Apr 1994	-	33.2	1.59
		1 Oct 2001	71.1	21.3	
	P2_SP_7	14 Apr 1994	-	33.6	2.54
		1 Oct 2001	73.6	14.6	
	P2_SP_8	14 Apr 1994	-	33.0	1.12
		1 Oct 2001	68.9	24.6	
	P2_SP_10	14 Apr 1994	-	35.2	0.70
		1 Oct 2001	50.8	30.0	
	P2_SP_13	14 Apr 1994	-	36.2	1.00
		1 Oct 2001	55.5	28.7	
	P2_SP_14	14 Apr 1994	-	36.7	0.47
		1 Oct 2001	43.9	33.2	
III	P3_SP_1	1 Feb 1994	-	44.9	0.63
		1 Oct 2001	38.7	40.1	
	P3_SP_2	1 Feb 1994	-	46.4	0.69
		1 Oct 2001	35.7	41.1	
	P3_SP_4	1 Feb 1994	-	45.5	0.57
		24 Apr 2001	28.8	41.4	
	P3_SP_5	1 Feb 1994	-	45.4	0.65
		1 Oct 2001	37.7	40.4	

ATTACHMENT A

SUMMARY OF SETTLEMENT PLATE DATA

	P3_SP_8	1 Feb 1994	-	43.6	0.52
		8 Aug 2001	25.6	39.7	
	P3_SP_11	1 Feb 1994	-	45.0	0.69
		1 Oct 2001	16.9	39.7	
	P3_SP_12	1 Feb 1994	-	44.7	0.53
		1 Oct 2001	20.5	40.6	
	P3_SP_13	1 Feb 1994	-	43.6	0.53
		1 Oct 2001	18.3	39.5	
	P3_SP_14	1 Feb 1994	-	43.6	0.31
		1 Oct 2001	18.6	41.2	
IV	P4_SP_1	4 Apr 1997	-	46.65	1.02
		1 Oct 2001	36.75	42.05	
	P4_SP_2	4 Apr 1997	-	47.9	0.64
		8 Aug 2001	30.0	45.1	
	P4_SP_5	4 Apr 1997	-	45.9	0.53
		1 Oct 2001	18.0	43.5	
	P4_SP_6	4 Apr 1997	-	48.9	0.58
		1 Oct 2001	30.3	46.3	
	P4_SP_7	4 Apr 1997	-	47.15	0.73
		1 Oct 2001	16.35	43.85	
	P4_SP_8	4 Apr 1997	-	47.4	0.96
		1 Oct 2001	19.7	43.1	
V	P5_SP_1	31 Jul 1997	-	48.13	1.46
		1 Oct 2001	37.57	42.03	
	P5_SP_2	4 Apr 1997	-	48.12	1.02
		1 Oct 2001	29.28	43.52	
	P5_SP_3	31 Jul 1997	-	48.88	0.72
		1 Oct 2001	21.92	45.88	
	P5_SP_4	4 Apr 1997	-	49.09	0.53
		1 Oct 2001	25.51	46.69	
	P5_SP_5	31 Jul 1997	-	48.28	1.63
		1 Oct 2001	29.42	41.48	
	P5_SP_6	17 Oct 1997	-	48.28	0.68
		1 Oct 2001	30.32	45.58	
	P5_SP_7	17 Oct 1997	-	48.07	0.91
		1 Oct 2001	25.43	44.47	
	P5_SP_8	31 Jul 1997	-	47.84	0.70
		1 Oct 2001	28.46	44.94	
	P5_SP_9	31 Jul 1997	-	48.21	1.15
		1 Oct 2001	28.09	43.41	
	P5_SP_10	17 Oct 1997	-	48.22	0.81
		1 Oct 2001	29.18	45.02	

ATTACHMENT B

Written by: C. Pendleton Date: 02/10/14 (YY MM DD) Reviewed by: D. Mandeville Date: / / (YY MM DD)

Client: DSWA Project: Cherry Island Project/Proposal No.: ME0250 Task No.: 2.3.4

Sample 1A

Sample Volume = 720 in^3
Total Unit Weight = 76.8 pcf
Initial Moisture Content = 100%

$$\text{Total Weight of Sample} = \frac{\text{Sample Volume}}{1728\ in^3/ft^3} \times \text{Total Unit Weight}$$

$$= \frac{720\ in^3}{1728\ in^3/ft^3} \times 76.8\ lb/ft^3 = 32.0\ lb$$

$$\text{Initial Weight of Solids} = \frac{\text{Total Weight of Sample}}{1 + \text{Initial Moisture Content}}$$

$$= \frac{32.0\ lb}{1 + 1.0} = 16.0\ lb$$

$$\text{Initial Weight of Water} = \text{Total Weight of Sample} - \text{Initial Weight of Solids}$$

$$= 32.0\ lb - 16.0\ lb = 16.0\ lb$$

$$\text{Initial Volume of Water} = \frac{\text{Initial Weight of Water}}{62.4\ pcf} \times 1728\ in^3/ft^3$$

$$= \frac{16.0\ lb}{62.4\ pcf} \times 1728\ in^3/ft^3 = 443\ in^3$$

$$\text{Initial Volume of Solids} = \text{Sample Volume} - \text{Initial Volume of Water}$$

$$= 720\ in^3 - 443\ in^3 = 277\ in^3$$

$$\text{Void Ratio } (e) = \frac{\text{Initial Volume of Water}}{\text{Initial Volume of Solids}}$$ (because the sample is 100% saturated)

$$= \frac{443\ in^3}{277\ in^3} = 1.6$$

$$\text{Porosity } (n) = \frac{e}{1+e}$$

$$= \frac{1.6}{1+1.6} = 0.62$$

ATTACHMENT C

Written by: C. Pendleton Date: 02/11/27 (YY/MM/DD) Reviewed by: D. Mandeville Date: __/__/__ (YY/MM/DD)

Client: DSWA Project: Cherry Island LF Project/Proposal No.: ME0250 Task No.: 2.3.4

Phase I

From settlement plate data shown in Attachment A, the average dredge settlement rate for Phase I is 1.07 ft/year or 12.78 in/yr.

The void ratio, e, of the dredge is 2.3 (GeoSyntec, 2002).

$$n = \frac{e}{1+e} = \frac{2.3}{1+2.3} = 0.697$$

$$n = \frac{V_v}{V}$$

Assuming that all voids were initially filled with water, V_v represents the amount of consolidation water entering the leachate collection system.

Using a unit area,

$$V_v = n \times V = 0.697 \times 12.78 \text{ in/yr} = \underline{\underline{8.91 \text{ in/yr}}}$$

ATTACHMENT D

```
******************************************************************************
******************************************************************************
**                                                                          **
**                                                                          **
**              HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE               **
**                HELP MODEL VERSION 3.07  (1 NOVEMBER 1997)                **
**                  DEVELOPED BY ENVIRONMENTAL LABORATORY                   **
**                    USAE WATERWAYS EXPERIMENT STATION                     **
**              FOR USEPA RISK REDUCTION ENGINEERING LABORATORY             **
**                                                                          **
**                                                                          **
******************************************************************************
******************************************************************************


PRECIPITATION DATA FILE:      P:\PRJ1\MDENG\HELP3\ME0250\PHASE1.D4
TEMPERATURE DATA FILE:        P:\PRJ1\MDENG\HELP3\ME0250\PHASE1.D7
SOLAR RADIATION DATA FILE:    P:\PRJ1\MDENG\HELP3\ME0250\PHASE1.D13
EVAPOTRANSPIRATION DATA:      P:\PRJ1\MDENG\HELP3\ME0250\PHASE1.D11
SOIL AND DESIGN DATA FILE:    P:\PRJ1\MDENG\HELP3\ME0250\CIL1B-3.D10
OUTPUT DATA FILE:             P:\PRJ1\MDENG\HELP3\ME0250\CIL1B-3.OUT


TIME:  15:16      DATE:  12/20/2002


******************************************************************************

     TITLE:  CHERRY ISLAND LANDFILL PHASE I - RUN B

******************************************************************************


     NOTE:  INITIAL MOISTURE CONTENT OF THE LAYERS AND SNOW WATER
            WERE SPECIFIED BY THE USER.


                                   LAYER  1
                                   --------

                  TYPE 1 - VERTICAL PERCOLATION LAYER
                      MATERIAL TEXTURE NUMBER  22
       THICKNESS                  =      12.00   INCHES
       POROSITY                   =       0.4190 VOL/VOL
       FIELD CAPACITY             =       0.3070 VOL/VOL
       WILTING POINT              =       0.1800 VOL/VOL
       INITIAL SOIL WATER CONTENT =       0.3621 VOL/VOL
       EFFECTIVE SAT. HYD. COND.  =  0.189999992000E-04 CM/SEC
     NOTE:  SATURATED HYDRAULIC CONDUCTIVITY IS MULTIPLIED BY  1.80
            FOR ROOT CHANNELS IN TOP HALF OF EVAPORATIVE ZONE.


                                   LAYER  2
                                   --------

                  TYPE 1 - VERTICAL PERCOLATION LAYER
                      MATERIAL TEXTURE NUMBER   0
       THICKNESS                  =     618.20   INCHES
       POROSITY                   =       0.6100 VOL/VOL
       FIELD CAPACITY             =       0.2920 VOL/VOL
       WILTING POINT              =       0.0770 VOL/VOL
       INITIAL SOIL WATER CONTENT =       0.0770 VOL/VOL
       EFFECTIVE SAT. HYD. COND.  =  0.100000005000E-02 CM/SEC


                                   LAYER  3
                                   --------

                  TYPE 2 - LATERAL DRAINAGE LAYER
                      MATERIAL TEXTURE NUMBER   0
       THICKNESS                  =      12.00   INCHES
       POROSITY                   =       0.6100 VOL/VOL
       FIELD CAPACITY             =       0.2920 VOL/VOL
       WILTING POINT              =       0.0770 VOL/VOL
       INITIAL SOIL WATER CONTENT =       0.0770 VOL/VOL
       EFFECTIVE SAT. HYD. COND.  =  0.100000005000E-02 CM/SEC
       SLOPE                      =       1.00   PERCENT
       DRAINAGE LENGTH            =     250.0    FEET
       SUBSURFACE INFLOW          =       8.91   INCHES/YR


                                   LAYER  4
                                   --------

                  TYPE 3 - BARRIER SOIL LINER
                      MATERIAL TEXTURE NUMBER   0
       THICKNESS                  =     337.50   INCHES
       POROSITY                   =       0.6970 VOL/VOL
       FIELD CAPACITY             =       0.4180 VOL/VOL
       WILTING POINT              =       0.3670 VOL/VOL
       INITIAL SOIL WATER CONTENT =       0.6970 VOL/VOL
       EFFECTIVE SAT. HYD. COND.  =  0.100000001000E-06 CM/SEC


                  GENERAL DESIGN AND EVAPORATIVE ZONE DATA
                  ----------------------------------------

     NOTE:  SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT


            SOIL DATA BASE USING SOIL TEXTURE #22 WITH A
            POOR STAND OF GRASS, A SURFACE SLOPE OF  2.%
            AND A SLOPE LENGTH OF  600. FEET.

     SCS RUNOFF CURVE NUMBER            =     93.30
     FRACTION OF AREA ALLOWING RUNOFF   =    100.0    PERCENT
     AREA PROJECTED ON HORIZONTAL PLANE =      1.000  ACRES
     EVAPORATIVE ZONE DEPTH             =      9.0    INCHES
     INITIAL WATER IN EVAPORATIVE ZONE  =      3.259  INCHES
     UPPER LIMIT OF EVAPORATIVE STORAGE =      3.771  INCHES
     LOWER LIMIT OF EVAPORATIVE STORAGE =      1.620  INCHES
     INITIAL SNOW WATER                 =      0.000  INCHES
     INITIAL WATER IN LAYER MATERIALS   =    288.108  INCHES
     TOTAL INITIAL WATER                =    288.108  INCHES
     TOTAL SUBSURFACE INFLOW            =      8.91   INCHES/YEAR


                  EVAPOTRANSPIRATION AND WEATHER DATA
                  -----------------------------------

     NOTE:  EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
            WILMINGTON              DELAWARE

         STATION LATITUDE                      =  39.80 DEGREES
         MAXIMUM LEAF AREA INDEX               =   1.00
         START OF GROWING SEASON (JULIAN DATE) =    107
         END OF GROWING SEASON (JULIAN DATE)   =    298
         EVAPORATIVE ZONE DEPTH                =   9.0  INCHES
         AVERAGE ANNUAL WIND SPEED             =   9.20 MPH
         AVERAGE 1ST QUARTER RELATIVE HUMIDITY =  67.00 %
         AVERAGE 2ND QUARTER RELATIVE HUMIDITY =  67.00 %
         AVERAGE 3RD QUARTER RELATIVE HUMIDITY =  72.00 %
         AVERAGE 4TH QUARTER RELATIVE HUMIDITY =  71.00 %


     NOTE:  PRECIPITATION DATA FOR     CHERRY ISLAND LF
            WAS ENTERED BY THE USER.


     NOTE:  TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING
            COEFFICIENTS FOR    WILMINGTON          DELAWARE

          NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

     JAN/JUL    FEB/AUG    MAR/SEP    APR/OCT    MAY/NOV    JUN/DEC
     -------    -------    -------    -------    -------    -------
      31.20      33.20      41.80      52.40      62.20      71.20
      76.00      74.80      67.80      56.30      45.60      35.50


     NOTE:  SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
            COEFFICIENTS FOR    WILMINGTON          DELAWARE

                  AND STATION LATITUDE  =  39.80 DEGREES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                  MONTHLY TOTALS (IN INCHES) FOR YEAR    1
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                              JAN/JUL  FEB/AUG  MAR/SEP  APR/OCT  MAY/NOV  JUN/DEC
                              -------  -------  -------  -------  -------  -------
PRECIPITATION                  1.87     1.39     4.15     2.02     1.86     5.95
                               2.42     5.10     3.84     3.78     1.81     7.26

RUNOFF                         0.133    0.004    0.589    0.052    0.045    0.698
                               0.108    0.915    1.787    0.638    0.107    2.036

EVAPOTRANSPIRATION             1.423    1.731    2.413    2.172    1.347    5.170
                               2.818    3.274    1.420    2.408    1.857    1.097

SUBSURFACE INFLOW INTO         0.7567   0.6835   0.7567   0.7323   0.7567   0.7323
  LAYER  3                     0.7567   0.7567   0.7323   0.7567   0.7323   0.7567

LATERAL DRAINAGE COLLECTED     0.0000   0.0006   0.0214   0.0500   0.0829   0.0874
  FROM LAYER  3                0.0936   0.1268   0.1643   0.2134   0.2172   0.2245

PERCOLATION/LEAKAGE THROUGH    0.0000   0.0204   0.1064   0.1042   0.1089   0.1057
  LAYER  4                     0.1093   0.1104   0.1080   0.1127   0.1093   0.1129

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                  MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)
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AVERAGE DAILY HEAD ON          0.000    0.093    3.048    7.287   11.154   12.000
  TOP OF LAYER  4             12.354   15.721   19.603   23.149   24.000   24.000

STD. DEVIATION OF DAILY        0.000    0.215    1.278    1.209    0.899    0.000
  HEAD ON TOP OF LAYER  4      0.534    1.177    1.101    0.856    0.000    0.000

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                        ANNUAL TOTALS FOR YEAR    1
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                                      INCHES        CU. FEET      PERCENT
                                     --------     -----------     -------
  PRECIPITATION                        41.45      150463.469     100.00
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RUNOFF	7.114	25822.018	17.16
EVAPOTRANSPIRATION	27.130	98482.297	65.45
SUBSURFACE INFLOW INTO LAYER 3	8.910000	32343.301	21.50
DRAINAGE COLLECTED FROM LAYER 3	1.2821	4654.143	3.09
PERC./LEAKAGE THROUGH LAYER 4	1.108254	4022.964	2.67
AVG. HEAD ON TOP OF LAYER 4	12.7008		
CHANGE IN WATER STORAGE	22.636	82168.633	54.61
SOIL WATER AT START OF YEAR	288.108	1045832.190	
SOIL WATER AT END OF YEAR	310.744	1128000.750	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	-8.9100	-32343.279	-21.50

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MONTHLY TOTALS (IN INCHES) FOR YEAR 2

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	2.12 2.92	4.54 0.75	4.19 7.04	4.19 2.82	7.87 1.75	5.80 0.61
RUNOFF	0.408 0.494	1.298 0.006	4.497 3.032	0.221 0.752	1.981 0.022	0.985 0.000
EVAPOTRANSPIRATION	0.833 2.398	0.542 0.309	1.825 1.578	3.591 1.721	3.985 1.634	5.045 0.795
SUBSURFACE INFLOW INTO LAYER 3	0.7567 0.7567	0.6835 0.7567	0.7567 0.7323	0.7323 0.7567	0.7567 0.7323	0.7323 0.7567
LATERAL DRAINAGE COLLECTED FROM LAYER 3	0.2245 0.2245	0.2027 0.2245	0.2245 0.2172	0.2172 0.2245	0.2245 0.2172	0.2172 0.2245
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.1129 0.1129	0.1020 0.1129	0.1129 0.1093	0.1093 0.1129	0.1129 0.1093	0.1093 0.1129

MONTHLY TOTALS (IN INCHES) FOR YEAR 3

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	7.06 6.60	1.11 4.24	2.48 3.95	2.14 1.63	2.69 1.57	7.65 1.38
RUNOFF	3.393 3.441	0.003 1.382	0.011 1.011	0.064 0.042	0.490 0.129	1.582 0.070
EVAPOTRANSPIRATION	0.758 3.169	1.702 3.013	2.458 1.876	1.997 2.424	2.467 1.067	4.584 0.872
SUBSURFACE INFLOW INTO LAYER 3	0.7567 0.7567	0.6835 0.7567	0.7567 0.7323	0.7323 0.7567	0.7567 0.7323	0.7323 0.7567
LATERAL DRAINAGE COLLECTED FROM LAYER 3	0.2245 0.2245	0.2027 0.2245	0.2245 0.2172	0.2172 0.2245	0.2245 0.2172	0.2172 0.2245
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.1129 0.1129	0.1020 0.1129	0.1129 0.1093	0.1093 0.1129	0.1129 0.1093	0.1093 0.1129

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 4	24.000 24.000	24.000 24.000	24.000 24.000	24.000 24.000	24.000 24.000	24.000 24.000
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 4	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000

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ANNUAL TOTALS FOR YEAR 3

	INCHES	CU. FEET	PERCENT
PRECIPITATION	42.50	154274.984	100.00
RUNOFF	11.617	42169.238	27.33
EVAPOTRANSPIRATION	26.387	95785.453	62.09
SUBSURFACE INFLOW INTO LAYER 3	8.910000	32343.301	20.96
DRAINAGE COLLECTED FROM LAYER 3	2.6428	9593.442	6.22
PERC./LEAKAGE THROUGH LAYER 4	1.329840	4827.318	3.13

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 4	24.000 24.000	24.000 24.000	24.000 24.000	24.000 24.000	24.000 24.000	24.000 24.000
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 4	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000

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ANNUAL TOTALS FOR YEAR 2

	INCHES	CU. FEET	PERCENT
PRECIPITATION	44.60	161897.969	100.00
RUNOFF	13.696	49716.031	30.71
EVAPOTRANSPIRATION	24.256	88048.219	54.39
SUBSURFACE INFLOW INTO LAYER 3	8.910000	32343.301	19.98
DRAINAGE COLLECTED FROM LAYER 3	2.6428	9593.442	5.93
PERC./LEAKAGE THROUGH LAYER 4	1.329840	4827.318	2.98
AVG. HEAD ON TOP OF LAYER 4	24.0000		
CHANGE IN WATER STORAGE	20.496	74399.602	45.95
SOIL WATER AT START OF YEAR	310.744	1128000.750	
SOIL WATER AT END OF YEAR	331.240	1202400.370	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	-8.9100	-32343.342	-19.98

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AVG. HEAD ON TOP OF LAYER 4	24.0000		
CHANGE IN WATER STORAGE	18.343	66586.133	43.16
SOIL WATER AT START OF YEAR	331.240	1202400.370	
SOIL WATER AT END OF YEAR	349.580	1268973.870	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.003	12.606	0.01
ANNUAL WATER BUDGET BALANCE	-8.9100	-32343.289	-20.96

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MONTHLY TOTALS (IN INCHES) FOR YEAR 4

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	4.44 3.62	2.19 4.51	3.41 2.34	4.62 4.37	2.81 3.12	4.90 1.74
RUNOFF	3.165 0.142	1.295 1.027	0.841 0.189	0.224 1.113	0.328 0.385	0.613 0.039
EVAPOTRANSPIRATION	0.321 3.582	0.839 3.691	2.236 1.689	3.931 2.132	2.799 1.611	3.907 1.072
SUBSURFACE INFLOW INTO LAYER 3	0.7567 0.7567	0.7079 0.7567	0.7567 0.7323	0.7323 0.7567	0.7567 0.7323	0.7323 0.7567
LATERAL DRAINAGE COLLECTED FROM LAYER 3	0.2245 0.2245	0.2100 0.2245	0.2245 0.2172	0.2172 0.2245	0.2245 0.2172	0.2172 0.2245
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.1129 0.1129	0.1057 0.1129	0.1129 0.1093	0.1093 0.1129	0.1129 0.1093	0.1093 0.1129

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 4	24.000 24.000	24.000 24.000	24.000 24.000	24.000 24.000	24.000 24.000	24.000 24.000

STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 4	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000

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ANNUAL TOTALS FOR YEAR 4

	INCHES	CU. FEET	PERCENT
PRECIPITATION	42.07	152714.141	100.00
RUNOFF	9.362	33982.668	22.25
EVAPOTRANSPIRATION	27.811	100955.547	66.11
SUBSURFACE INFLOW INTO LAYER 3	8.934411	32431.912	21.24
DRAINAGE COLLECTED FROM LAYER 3	2.6501	9619.726	6.30
PERC./LEAKAGE THROUGH LAYER 4	1.333483	4840.543	3.17
AVG. HEAD ON TOP OF LAYER 4	24.0000		
CHANGE IN WATER STORAGE	18.782	68179.500	44.65
SOIL WATER AT START OF YEAR	349.580	1268973.870	
SOIL WATER AT END OF YEAR	368.365	1337166.000	
SNOW WATER AT START OF YEAR	0.003	12.606	0.01
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	-8.9344	-32431.934	-21.24

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MONTHLY TOTALS (IN INCHES) FOR YEAR 5

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	0.98 5.57	4.73 8.02	8.53 7.27	3.09 4.94	5.72 3.35	3.65 3.28
RUNOFF	0.121 1.041	3.340 2.140	2.585 2.771	0.203 2.367	1.604 0.369	0.910 0.214
EVAPOTRANSPIRATION	0.765 4.796	0.640 4.573	2.680 4.019	3.433 1.960	3.730 1.806	1.467 1.128
SUBSURFACE INFLOW INTO LAYER 3	0.7567 0.7567	0.6835 0.7567	0.7567 0.7323	0.7323 0.7567	0.7567 0.7323	0.7323 0.7567
LATERAL DRAINAGE COLLECTED FROM LAYER 3	0.2245 0.2245	0.2027 0.2245	0.2245 0.2172	0.2172 0.2245	0.2245 0.2172	0.2172 0.2245
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.1129 0.1129	0.1020 0.1129	0.1129 0.1093	0.1093 0.1129	0.1129 0.1093	0.1093 0.1129

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 4	24.000 24.000	24.000 24.000	24.000 24.000	24.000 24.000	24.000 24.000	24.000 24.000
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 4	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000

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ANNUAL TOTALS FOR YEAR 5

	INCHES	CU. FEET	PERCENT
PRECIPITATION	59.13	214641.937	100.00
RUNOFF	17.664	64121.414	29.87
EVAPOTRANSPIRATION	30.997	112518.531	52.42
SUBSURFACE INFLOW INTO LAYER 3	8.910000	32343.301	15.07
DRAINAGE COLLECTED FROM LAYER 3	2.6428	9593.442	4.47
PERC./LEAKAGE THROUGH LAYER 4	1.329840	4827.318	2.25
AVG. HEAD ON TOP OF LAYER 4	24.0000		
CHANGE IN WATER STORAGE	24.316	88267.891	41.12
SOIL WATER AT START OF YEAR	368.365	1337166.000	
SOIL WATER AT END OF YEAR	392.682	1425433.870	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	-8.9100	-32343.365	-15.07

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MONTHLY TOTALS (IN INCHES) FOR YEAR 6

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	3.86 5.26	2.45 7.83	4.12 3.95	3.55 2.25	4.92 4.13	5.49 1.23
RUNOFF	0.409 1.352	2.541 2.729	0.886 1.090	0.318 0.291	1.080 1.167	1.075 0.091
EVAPOTRANSPIRATION	0.755 4.030	1.058 4.603	2.610 3.003	3.402 0.508	2.709 1.717	4.276 1.104
SUBSURFACE INFLOW INTO LAYER 3	0.7567 0.7567	0.6835 0.7567	0.7567 0.7323	0.7323 0.7567	0.7567 0.7323	0.7323 0.7567
LATERAL DRAINAGE COLLECTED FROM LAYER 3	0.2245 0.2245	0.2027 0.2245	0.2245 0.2172	0.2172 0.2245	0.2245 0.2172	0.2172 0.2245
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.1129 0.1129	0.1020 0.1129	0.1129 0.1093	0.1093 0.1129	0.1129 0.1093	0.1093 0.1129

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 4	24.000 24.000	24.000 24.000	24.000 24.000	24.000 24.000	24.000 24.000	24.000 24.000
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 4	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000

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ANNUAL TOTALS FOR YEAR 6

	INCHES	CU. FEET	PERCENT
PRECIPITATION	49.04	178015.187	100.00
RUNOFF	13.030	47298.367	26.57
EVAPOTRANSPIRATION	29.774	108080.016	60.71
SUBSURFACE INFLOW INTO LAYER 3	8.910000	32343.301	18.17
DRAINAGE COLLECTED FROM LAYER 3	2.6428	9593.442	5.39
PERC./LEAKAGE THROUGH LAYER 4	1.329840	4827.318	2.71
AVG. HEAD ON TOP OF LAYER 4	24.0000		
CHANGE IN WATER STORAGE	20.083	72902.648	40.95
SOIL WATER AT START OF YEAR	392.682	1425433.870	
SOIL WATER AT END OF YEAR	412.765	1498336.500	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	-8.9100	-32343.299	-18.17

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MONTHLY TOTALS (IN INCHES) FOR YEAR 7

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	4.59 1.55	1.40 5.61	5.75 5.53	4.02 1.83	1.74 7.03	2.86 4.38
RUNOFF	2.193 0.031	1.002 1.444	1.447 1.898	0.251 0.500	0.040 2.396	0.704 1.536
EVAPOTRANSPIRATION	0.948 1.565	0.327 4.149	1.823 2.275	4.042 1.776	1.911 1.219	2.180 1.064
SUBSURFACE INFLOW INTO LAYER 3	0.7567 0.7567	0.6835 0.7567	0.7567 0.7323	0.7323 0.7567	0.7567 0.7323	0.7323 0.7567

LATERAL DRAINAGE COLLECTED FROM LAYER 3	0.2245	0.2027	0.2245	0.2172	0.2245	0.2172
	0.2245	0.2245	0.2172	0.2245	0.2393	0.3985
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.1129	0.1020	0.1129	0.1093	0.1129	0.1093
	0.1129	0.1129	0.1093	0.1129	0.1098	0.1164

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 4	24.000	24.000	24.000	24.000	24.000	24.000
	24.000	24.000	24.000	24.000	25.606	35.163
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 4	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	2.156	2.960

ANNUAL TOTALS FOR YEAR 7

	INCHES	CU. FEET	PERCENT
PRECIPITATION	46.29	168032.703	100.00
RUNOFF	13.443	48797.879	29.04
EVAPOTRANSPIRATION	23.277	84496.562	50.29
SUBSURFACE INFLOW INTO LAYER 3	8.910000	32343.301	19.25
DRAINAGE COLLECTED FROM LAYER 3	2.8389	10305.389	6.13
PERC./LEAKAGE THROUGH LAYER 4	1.333813	4841.742	2.88
AVG. HEAD ON TOP OF LAYER 4	25.0640		
CHANGE IN WATER STORAGE	23.217	84277.641	50.16
SOIL WATER AT START OF YEAR	412.765	1498336.500	
SOIL WATER AT END OF YEAR	435.982	1582614.250	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	-8.9100	-32343.205	-19.25

MONTHLY TOTALS (IN INCHES) FOR YEAR 8

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	5.72	2.50	3.55	6.62	2.47	3.30
	1.89	4.41	1.64	3.14	2.70	3.30
RUNOFF	2.027	0.673	0.444	2.010	0.062	0.475
	0.189	0.895	0.154	0.809	0.644	0.581
EVAPOTRANSPIRATION	1.421	1.837	2.819	4.447	2.024	3.143
	1.692	3.719	1.486	1.524	1.500	0.690
SUBSURFACE INFLOW INTO LAYER 3	0.7567	0.7079	0.7567	0.7323	0.7567	0.7323
	0.7567	0.7567	0.7323	0.7567	0.7323	0.7567
LATERAL DRAINAGE COLLECTED FROM LAYER 3	0.6108	0.7008	0.8150	0.8530	0.9736	0.9747
	1.0386	1.0683	1.0601	1.1527	1.1669	1.2836
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.1198	0.1140	0.1226	0.1194	0.1245	0.1209
	0.1253	0.1256	0.1218	0.1265	0.1230	0.1279

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 4	46.074	52.375	54.947	57.543	61.061	62.298
	63.435	64.492	65.452	67.421	69.225	71.769
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 4	4.163	0.824	0.538	1.474	0.385	0.343
	0.323	0.302	0.262	1.279	0.167	1.438

ANNUAL TOTALS FOR YEAR 8

	INCHES	CU. FEET	PERCENT
PRECIPITATION	41.24	149701.187	100.00
RUNOFF	8.965	32541.770	21.74
EVAPOTRANSPIRATION	26.303	95479.227	63.78
SUBSURFACE INFLOW INTO LAYER 3	8.934411	32431.912	21.66
DRAINAGE COLLECTED FROM LAYER 3	11.6982	42464.426	28.37
PERC./LEAKAGE THROUGH LAYER 4	1.471317	5340.879	3.57
AVG. HEAD ON TOP OF LAYER 4	61.3410		
CHANGE IN WATER STORAGE	10.672	38738.684	25.88
SOIL WATER AT START OF YEAR	435.982	1582614.250	
SOIL WATER AT END OF YEAR	446.654	1621352.870	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	-8.9344	-32431.885	-21.66

MONTHLY TOTALS (IN INCHES) FOR YEAR 9

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	4.63	2.81	2.61	4.64	3.92	5.10
	5.22	6.98	10.80	0.60	4.39	3.09
RUNOFF	3.440	2.478	0.722	0.645	0.163	1.147
	1.841	2.580	4.762	0.011	0.444	0.798
EVAPOTRANSPIRATION	0.387	0.205	1.768	3.969	3.555	2.993
	2.618	3.862	4.202	0.667	1.103	0.792
SUBSURFACE INFLOW INTO LAYER 3	0.7567	0.6835	0.7567	0.7323	0.7567	0.7323
	0.7567	0.7567	0.7323	0.7567	0.7323	0.7567
LATERAL DRAINAGE COLLECTED FROM LAYER 3	1.3731	1.2614	1.4168	1.4878	1.5667	1.5024
	1.6155	1.6279	1.7441	1.8904	1.7770	1.9901
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.1288	0.1165	0.1292	0.1261	0.1306	0.1263
	0.1310	0.1312	0.1282	0.1334	0.1287	0.1342

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 4	74.626	75.365	75.987	79.625	80.498	80.082
	81.918	82.278	86.628	89.557	88.100	91.990
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 4	0.972	0.000	0.906	1.337	0.165	0.116
	0.884	0.240	7.629	0.469	0.374	3.840

ANNUAL TOTALS FOR YEAR 9

	INCHES	CU. FEET	PERCENT
PRECIPITATION	54.79	198887.719	100.00
RUNOFF	19.030	69080.523	34.73
EVAPOTRANSPIRATION	26.121	94818.070	47.67
SUBSURFACE INFLOW INTO LAYER 3	8.910000	32343.301	16.26
DRAINAGE COLLECTED FROM LAYER 3	19.2533	69889.391	35.14
PERC./LEAKAGE THROUGH LAYER 4	1.544172	5605.345	2.82
AVG. HEAD ON TOP OF LAYER 4	82.2212		
CHANGE IN WATER STORAGE	6.661	24180.975	12.16
SOIL WATER AT START OF YEAR	446.654	1621352.870	
SOIL WATER AT END OF YEAR	453.062	1644615.250	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.253	918.644	0.46
ANNUAL WATER BUDGET BALANCE	-8.9100	-32343.279	-16.26

MONTHLY TOTALS (IN INCHES) FOR YEAR, 10

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	3.98 6.20	2.12 5.67	4.68 11.97	3.52 7.03	3.38 2.02	4.46 2.41
RUNOFF	3.014 3.167	1.598 1.679	1.603 6.800	0.588 2.187	0.170 0.042	0.683 0.187
EVAPOTRANSPIRATION	0.530 2.021	0.433 3.655	2.889 3.142	2.334 2.415	2.878 1.545	4.616 0.776
SUBSURFACE INFLOW INTO LAYER 3	0.7567 0.7567	0.6835 0.7567	0.7567 0.7323	0.7323 0.7567	0.7567 0.7323	0.7323 0.7567
LATERAL DRAINAGE COLLECTED FROM LAYER 3	2.0486 1.8877	1.7843 1.8530	2.0125 1.7398	1.9978 2.1276	2.0045 2.1344	1.8737 2.1755
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.1347 0.1334	0.1212 0.1331	0.1344 0.1283	0.1305 0.1350	0.1344 0.1316	0.1295 0.1357

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 4	93.704 89.487	91.809 88.554	92.586 86.883	94.111 94.521	92.566 97.664	90.775 96.916
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 4	0.620 0.192	0.499 0.366	3.275 2.903	0.309 11.382	0.577 0.580	0.482 0.703

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ANNUAL TOTALS FOR YEAR 10

	INCHES	CU. FEET	PERCENT
PRECIPITATION	57.44	208507.234	100.00
RUNOFF	21.718	78834.695	37.81
EVAPOTRANSPIRATION	27.234	98859.789	47.41
SUBSURFACE INFLOW INTO LAYER 3	8.910000	32343.301	15.51
DRAINAGE COLLECTED FROM LAYER 3	23.6395	85811.273	41.16
PERC./LEAKAGE THROUGH LAYER 4	1.581727	5741.668	2.75
AVG. HEAD ON TOP OF LAYER 4	92.4647		

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ANNUAL TOTALS FOR YEAR 11

	INCHES	CU. FEET	PERCENT
PRECIPITATION	45.18	164003.359	100.00
RUNOFF	14.144	51341.617	31.31
EVAPOTRANSPIRATION	27.922	101357.047	61.80
SUBSURFACE INFLOW INTO LAYER 3	8.910000	32343.301	19.72
DRAINAGE COLLECTED FROM LAYER 3	23.2475	84388.516	51.46
PERC./LEAKAGE THROUGH LAYER 4	1.578982	5731.706	3.49
AVG. HEAD ON TOP OF LAYER 4	91.7515		
CHANGE IN WATER STORAGE	-3.892	-14128.951	-8.62
SOIL WATER AT START OF YEAR	454.402	1649480.250	
SOIL WATER AT END OF YEAR	450.510	1635351.370	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	-8.9100	-32343.271	-19.72

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MONTHLY TOTALS (IN INCHES) FOR YEAR 12

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	8.05 5.35	2.10 3.72	8.59 2.36	9.03 6.26	4.39 5.12	8.03 5.83
RUNOFF	0.417 1.961	3.606 0.690	8.888 0.501	3.215 2.507	0.623 1.868	3.113 1.695

CHANGE IN WATER STORAGE	1.087	3946.429	1.89
SOIL WATER AT START OF YEAR	453.062	1644615.250	
SOIL WATER AT END OF YEAR	454.402	1649480.250	
SNOW WATER AT START OF YEAR	0.253	918.644	0.44
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	-8.9100	-32343.316	-15.51

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MONTHLY TOTALS (IN INCHES) FOR YEAR 11

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	3.93 10.86	3.22 3.62	3.86 1.46	2.79 1.67	1.90 2.93	6.67 2.27
RUNOFF	3.408 4.750	1.781 0.742	0.465 0.230	0.303 0.193	0.154 0.598	1.191 0.329
EVAPOTRANSPIRATION	0.156 5.525	0.856 2.919	3.180 0.654	3.383 1.976	1.627 1.645	4.965 1.037
SUBSURFACE INFLOW INTO LAYER 3	0.7567 0.7567	0.6835 0.7567	0.7567 0.7323	0.7323 0.7567	0.7567 0.7323	0.7323 0.7567
LATERAL DRAINAGE COLLECTED FROM LAYER 3	2.1588 1.9374	1.9464 1.9132	2.1476 1.8028	2.0342 1.8213	2.0238 1.7537	1.8957 1.8126
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.1356 0.1338	0.1224 0.1336	0.1355 0.1289	0.1308 0.1328	0.1345 0.1285	0.1297 0.1328

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 4	96.498 90.807	96.404 90.167	96.221 88.820	95.070 87.693	93.066 87.444	91.374 87.455
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 4	0.721 0.288	0.526 0.415	0.415 0.430	0.519 0.235	0.591 0.329	0.328 0.419

EVAPOTRANSPIRATION	0.734 3.385	0.479 2.974	2.254 0.944	4.088 2.026	4.134 1.820	4.413 1.192
SUBSURFACE INFLOW INTO LAYER 3	0.7567 0.7567	0.7079 0.7567	0.7567 0.7323	0.7323 0.7567	0.7567 0.7323	0.7323 0.7567
LATERAL DRAINAGE COLLECTED FROM LAYER 3	1.8032 2.0193	1.6455 1.9479	1.8010 1.8304	1.9137 1.8971	2.0277 1.9156	1.9682 2.1159
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.1327 0.1345	0.1238 0.1339	0.1327 0.1291	0.1297 0.1335	0.1346 0.1298	0.1303 0.1352

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 4	87.198 92.949	85.981 91.084	87.131 89.584	91.473 89.736	93.166 91.722	93.321 95.223
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 4	0.390 0.593	0.328 0.481	1.430 0.435	4.876 0.666	0.305 3.386	0.951 3.675

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ANNUAL TOTALS FOR YEAR 12

	INCHES	CU. FEET	PERCENT
PRECIPITATION	68.83	249852.844	100.00
RUNOFF	29.084	105574.477	42.25
EVAPOTRANSPIRATION	28.444	103251.406	41.32
SUBSURFACE INFLOW INTO LAYER 3	8.934411	32431.912	12.98
DRAINAGE COLLECTED FROM LAYER 3	22.8855	83074.500	33.25
PERC./LEAKAGE THROUGH LAYER 4	1.579641	5734.099	2.29
AVG. HEAD ON TOP OF LAYER 4	90.7142		
CHANGE IN WATER STORAGE	4.706	17082.316	6.84
SOIL WATER AT START OF YEAR	450.510	1635351.370	
SOIL WATER AT END OF YEAR	453.187	1645068.120	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	2.029	7365.574	2.95

ANNUAL WATER BUDGET BALANCE	-8.9344	-32432.033	-12.98

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MONTHLY TOTALS (IN INCHES) FOR YEAR 13

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	2.02 3.99	1.24 0.38	5.86 6.34	2.65 6.41	2.08 1.89	1.82 4.28
RUNOFF	0.718 1.688	0.725 0.000	1.989 1.944	0.228 3.239	0.039 0.073	0.204 0.924
EVAPOTRANSPIRATION	0.613 1.697	0.252 0.375	2.575 2.385	2.645 2.647	1.932 1.612	2.097 1.018
SUBSURFACE INFLOW INTO LAYER 3	0.7567 0.7567	0.6835 0.7567	0.7567 0.7323	0.7323 0.7567	0.7567 0.7323	0.7323 0.7567
LATERAL DRAINAGE COLLECTED FROM LAYER 3	2.2249 2.0712	2.0330 2.0297	2.2639 1.8987	2.2518 2.0345	2.2235 1.9844	2.0565 1.9752
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.1360 0.1349	0.1231 0.1346	0.1364 0.1297	0.1325 0.1346	0.1361 0.1304	0.1310 0.1341

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 4	97.922 94.283	98.780 93.217	99.087 91.456	100.629 93.336	98.108 93.754	95.650 91.801
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 4	4.031 0.422	0.729 0.600	1.886 0.383	0.586 1.228	0.781 0.595	0.666 0.547

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ANNUAL TOTALS FOR YEAR 13

	INCHES	CU. FEET	PERCENT
PRECIPITATION	38.96	141424.828	100.00
RUNOFF	11.771	42729.309	30.21
EVAPOTRANSPIRATION	19.848	72047.156	50.94
SUBSURFACE INFLOW INTO LAYER 3	8.910000	32343.301	22.87
DRAINAGE COLLECTED FROM LAYER 3	25.0472	90921.383	64.29
PERC./LEAKAGE THROUGH LAYER 4	1.593407	5784.067	4.09
AVG. HEAD ON TOP OF LAYER 4	95.6686		
CHANGE IN WATER STORAGE	-1.479	-5370.477	-3.80
SOIL WATER AT START OF YEAR	453.187	1645068.120	
SOIL WATER AT END OF YEAR	453.062	1644614.500	
SNOW WATER AT START OF YEAR	2.029	7365.574	5.21
SNOW WATER AT END OF YEAR	0.675	2448.736	1.73
ANNUAL WATER BUDGET BALANCE	-8.9100	-32343.312	-22.87

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MONTHLY TOTALS (IN INCHES) FOR YEAR 14

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	1.68 2.56	0.64 1.74	4.01 2.98	4.21 2.88	3.90 1.21	3.86 8.76
RUNOFF	0.060 0.403	0.796 0.246	0.472 0.285	0.427 0.176	0.228 0.053	0.458 3.853
EVAPOTRANSPIRATION	0.738 2.514	0.340 1.552	2.981 2.442	4.102 1.953	2.708 1.444	3.598 1.007
SUBSURFACE INFLOW INTO LAYER 3	0.7567 0.7567	0.6835 0.7567	0.7567 0.7323	0.7323 0.7567	0.7567 0.7323	0.7323 0.7567
LATERAL DRAINAGE COLLECTED FROM LAYER 3	2.0575 1.9079	1.8302 1.8507	2.0410 1.7424	1.9949 1.7653	2.0302 1.7004	1.8943 1.6923
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.1347 0.1336	0.1215 0.1331	0.1347 0.1284	0.1305 0.1324	0.1346 0.1280	0.1297 0.1316

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 4	93.557 90.026	93.130 88.491	93.508 87.124	94.034 86.155	93.230 85.929	91.335 83.655
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 4	6.595 0.441	0.539 0.434	0.436 0.361	0.541 0.291	0.601 0.251	0.515 5.876

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ANNUAL TOTALS FOR YEAR 14

	INCHES	CU. FEET	PERCENT
PRECIPITATION	38.43	139500.906	100.00
RUNOFF	7.458	27071.635	19.41
EVAPOTRANSPIRATION	25.379	92125.094	66.04
SUBSURFACE INFLOW INTO LAYER 3	8.910000	32343.301	23.19
DRAINAGE COLLECTED FROM LAYER 3	22.5070	81700.227	58.57
PERC./LEAKAGE THROUGH LAYER 4	1.572612	5708.581	4.09
AVG. HEAD ON TOP OF LAYER 4	90.0145		
CHANGE IN WATER STORAGE	-0.666	-2418.128	-1.73
SOIL WATER AT START OF YEAR	453.062	1644614.500	
SOIL WATER AT END OF YEAR	451.589	1639267.870	
SNOW WATER AT START OF YEAR	0.675	2448.736	1.76
SNOW WATER AT END OF YEAR	1.481	5377.126	3.85
ANNUAL WATER BUDGET BALANCE	-8.9100	-32343.213	-23.18

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MONTHLY TOTALS (IN INCHES) FOR YEAR 15

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	0.95 2.68	4.60 12.91	4.04 4.59	0.69 3.00	3.91 3.10	2.40 4.24
RUNOFF	0.921 0.293	3.919 7.215	1.247 1.394	0.000 0.366	1.695 0.578	0.513 0.212
EVAPOTRANSPIRATION	0.682 2.808	0.536 5.312	2.630 2.620	0.609 2.293	1.567 1.515	1.563 1.006
SUBSURFACE INFLOW INTO LAYER 3	0.7567 0.7567	0.6835 0.7567	0.7567 0.7323	0.7323 0.7567	0.7567 0.7323	0.7323 0.7567
LATERAL DRAINAGE COLLECTED FROM LAYER 3	1.8889 1.8531	1.6663 1.8313	1.9287 1.7481	1.8862 1.7614	1.8952 1.6671	1.8468 1.7559
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.1334 0.1331	0.1202 0.1329	0.1337 0.1284	0.1296 0.1323	0.1335 0.1277	0.1293 0.1323

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 4	89.520 88.557	88.333 87.966	90.566 87.286	91.116 86.049	89.685 84.970	90.037 85.896
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 4	0.262 0.400	0.387 0.146	1.624 0.377	0.511 0.344	0.498 0.287	0.456 0.226

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ANNUAL TOTALS FOR YEAR 15

	INCHES	CU. FEET	PERCENT
PRECIPITATION	47.11	171009.375	100.00
RUNOFF	18.353	66621.664	38.96
EVAPOTRANSPIRATION	23.142	84004.641	49.12
SUBSURFACE INFLOW INTO LAYER 3	8.910000	32343.301	18.91

DRAINAGE COLLECTED FROM LAYER 3	21.7292	78876.937	46.12
PERC./LEAKAGE THROUGH LAYER 4	1.566498	5686.389	3.33
AVG. HEAD ON TOP OF LAYER 4	88.3318		
CHANGE IN WATER STORAGE	0.139	506.319	0.30
SOIL WATER AT START OF YEAR	451.589	1639267.870	
SOIL WATER AT END OF YEAR	451.068	1637378.370	
SNOW WATER AT START OF YEAR	1.481	5377.126	3.14
SNOW WATER AT END OF YEAR	2.141	7773.000	4.55
ANNUAL WATER BUDGET BALANCE	-8.9100	-32343.271	-18.91

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MONTHLY TOTALS (IN INCHES) FOR YEAR 16

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	3.42 5.56	2.71 3.22	4.10 3.06	3.22 0.90	1.44 2.77	4.36 3.04
RUNOFF	1.543 1.241	1.929 0.486	1.167 0.337	0.313 0.125	0.039 0.236	0.887 0.284
EVAPOTRANSPIRATION	0.794 3.052	0.356 3.372	2.483 1.527	3.628 1.961	1.526 1.305	3.295 1.011
SUBSURFACE INFLOW INTO LAYER 3	0.7567 0.7567	0.7079 0.7567	0.7567 0.7323	0.7323 0.7567	0.7567 0.7323	0.7323 0.7567
LATERAL DRAINAGE COLLECTED FROM LAYER 3	1.9753 1.9067	1.9678 1.9145	2.0876 1.8007	2.0055 1.8093	1.9969 1.7078	1.8705 1.7879
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.1340 0.1336	0.1264 0.1336	0.1350 0.1289	0.1306 0.1327	0.1343 0.1281	0.1295 0.1326

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 4	91.388 89.992	95.107 90.200	94.702 88.762	94.315 87.365	92.366 86.140	90.686 86.772
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 4	5.669 0.436	0.627 0.362	0.638 0.428	0.514 0.386	0.571 0.337	0.371 1.153

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ANNUAL TOTALS FOR YEAR 16

	INCHES	CU. FEET	PERCENT
PRECIPITATION	37.80	137213.984	100.00
RUNOFF	8.585	31164.277	22.71
EVAPOTRANSPIRATION	24.310	88245.469	64.31
SUBSURFACE INFLOW INTO LAYER 3	8.934411	32431.912	23.64
DRAINAGE COLLECTED FROM LAYER 3	22.8304	82874.305	60.40
PERC./LEAKAGE THROUGH LAYER 4	1.579278	5732.780	4.18
AVG. HEAD ON TOP OF LAYER 4	90.6496		
CHANGE IN WATER STORAGE	-1.636	-5939.167	-4.33
SOIL WATER AT START OF YEAR	451.068	1637378.370	
SOIL WATER AT END OF YEAR	451.574	1639212.250	
SNOW WATER AT START OF YEAR	2.141	7773.000	5.66
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	-8.9344	-32431.770	-23.64

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MONTHLY TOTALS (IN INCHES) FOR YEAR 17

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	0.66 2.67	1.49 1.56	3.09 3.30	2.64 2.64	1.65 5.00	2.73 1.38
RUNOFF	0.000 0.272	0.535 0.005	0.601 0.251	0.046 0.428	0.025 1.194	0.373 0.011
EVAPOTRANSPIRATION	1.036 2.701	0.339 1.275	2.577 3.410	1.725 1.266	1.879 1.379	2.557 1.077
SUBSURFACE INFLOW INTO LAYER 3	0.7567 0.7567	0.6835 0.7567	0.7567 0.7323	0.7323 0.7567	0.7567 0.7323	0.7323 0.7567
LATERAL DRAINAGE COLLECTED FROM LAYER 3	1.8931 1.7305	1.6638 1.6946	1.8502 1.6087	1.8079 1.6337	1.8157 1.6554	1.7127 1.8136
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.1335 0.1321	0.1201 0.1317	0.1331 0.1272	0.1289 0.1312	0.1328 0.1276	0.1281 0.1328

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 4	89.630 85.190	88.258 84.180	88.472 83.265	88.962 82.445	87.539 84.453	86.281 87.482
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 4	0.362 0.298	0.388 0.291	1.073 0.252	0.436 0.235	0.402 3.332	0.336 0.331

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ANNUAL TOTALS FOR YEAR 17

	INCHES	CU. FEET	PERCENT
PRECIPITATION	28.81	104580.328	100.00
RUNOFF	3.740	13576.884	12.98
EVAPOTRANSPIRATION	21.221	77031.391	73.66
SUBSURFACE INFLOW INTO LAYER 3	8.910000	32343.301	30.93
DRAINAGE COLLECTED FROM LAYER 3	20.8799	75794.102	72.47
PERC./LEAKAGE THROUGH LAYER 4	1.559162	5659.759	5.41
AVG. HEAD ON TOP OF LAYER 4	86.3465		
CHANGE IN WATER STORAGE	-0.770	-2795.171	-2.67
SOIL WATER AT START OF YEAR	451.574	1639212.250	
SOIL WATER AT END OF YEAR	450.804	1636417.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	-8.9100	-32343.334	-30.93

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AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1 THROUGH 17

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	3.53 4.41	2.43 4.72	4.53 4.85	3.74 3.30	3.33 3.17	4.65 3.44
STD. DEVIATIONS	2.14 2.31	1.25 3.09	1.76 3.02	1.89 1.92	1.72 1.54	1.80 2.21
RUNOFF						
TOTALS	1.492 1.318	1.619 1.422	1.674 1.673	0.536 0.926	0.516 0.606	0.918 0.757
STD. DEVIATIONS	1.356 1.370	1.206 1.717	2.138 1.830	0.829 1.006	0.656 0.682	0.663 1.020
EVAPOTRANSPIRATION						
TOTALS	0.758 2.963	0.734 3.096	2.482 2.275	3.147 1.862	2.516 1.516	3.522 0.985
STD. DEVIATIONS	0.333 1.075	0.539 1.439	0.403 1.024	1.057 0.593	0.902 0.239	1.231 0.145
SUBSURFACE INFLOW INTO LAYER 3						
TOTALS	0.7567 0.7567	0.6835 0.7567	0.7567 0.7323	0.7323 0.7567	0.7567 0.7323	0.7323 0.7567
LATERAL DRAINAGE COLLECTED FROM LAYER 3						
TOTALS	1.1401 1.1417	1.0426 1.1297	1.1607 1.0849	1.1521 1.1443	1.1757 1.1180	1.1168 1.1852

STD. DEVIATIONS	0.8948	0.8075	0.8933	0.8786	0.8796	0.8266
	0.8378	0.8192	0.7754	0.8190	0.7976	0.8299

PERCOLATION/LEAKAGE THROUGH LAYER 4

TOTALS	0.1177	0.1086	0.1242	0.1205	0.1245	0.1203
	0.1242	0.1242	0.1202	0.1244	0.1205	0.1249
STD. DEVIATIONS	0.0320	0.0245	0.0110	0.0107	0.0108	0.0102
	0.0104	0.0102	0.0097	0.0101	0.0098	0.0100

AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)

DAILY AVERAGE HEAD ON TOP OF LAYER 4

AVERAGES	59.0658	59.3903	60.0151	61.0686	60.9670	60.4611
	60.1764	60.0206	59.9331	60.6721	61.1180	62.2425
STD. DEVIATIONS	35.5981	35.4437	35.3644	35.4471	34.5189	33.8323
	33.4183	32.7287	32.0286	32.2339	32.3138	32.1520

AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1 THROUGH 17

	INCHES		CU. FEET	PERCENT
PRECIPITATION	46.10	(9.538)	167336.6	100.00
RUNOFF	13.457	(6.2422)	48849.68	29.192
EVAPOTRANSPIRATION	25.856	(2.9307)	93858.00	56.089
SUBSURFACE INFLOW INTO LAYER 3	8.91000		32343.299	19.32829
LATERAL DRAINAGE COLLECTED FROM LAYER 3	13.59177	(9.99370)	49338.125	29.48436
PERCOLATION/LEAKAGE THROUGH LAYER 4	1.45422	(0.14561)	5278.812	3.15461
AVERAGE HEAD ON TOP OF LAYER 4	60.428	(33.583)		
CHANGE IN WATER STORAGE	9.570	(10.6095)	34740.28	20.761

PEAK DAILY VALUES FOR YEARS 1 THROUGH 17

	(INCHES)	(CU. FT.)
PRECIPITATION	5.15	18694.500
RUNOFF	4.082	14817.1279
DRAINAGE COLLECTED FROM LAYER 3	0.07671	278.45050
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.004428	16.07400
AVERAGE HEAD ON TOP OF LAYER 4	101.858	
MAXIMUM HEAD ON TOP OF LAYER 4	122.136	
LOCATION OF MAXIMUM HEAD IN LAYER 3 (DISTANCE FROM DRAIN)	204.9 FEET	
SNOW WATER	8.02	29119.9824

MAXIMUM VEG. SOIL WATER (VOL/VOL) 0.4065

MINIMUM VEG. SOIL WATER (VOL/VOL) 0.1800

*** Maximum heads are computed using McEnroe's equations. ***

Reference: Maximum Saturated Depth over Landfill Liner
by Bruce M. McEnroe, University of Kansas
ASCE Journal of Environmental Engineering
Vol. 119, No. 2, March 1993, pp. 262-270.

FINAL WATER STORAGE AT END OF YEAR 17

LAYER	(INCHES)	(VOL/VOL)
1	3.8940	0.3245
2	204.3521	0.3306
3	7.3200	0.6100
4	235.2375	0.6970
SNOW WATER	0.000	

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**                                                                          **
**                                                                          **
**              HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE               **
**                HELP MODEL VERSION 3.07  (1 NOVEMBER 1997)                **
**                 DEVELOPED BY ENVIRONMENTAL LABORATORY                    **
**                   USAE WATERWAYS EXPERIMENT STATION                      **
**             FOR USEPA RISK REDUCTION ENGINEERING LABORATORY              **
**                                                                          **
**                                                                          **
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PRECIPITATION DATA FILE:      P:\PRJ1\MDENG\HELP3\ME0250\PHASE2.D4
TEMPERATURE DATA FILE:        P:\PRJ1\MDENG\HELP3\ME0250\PHASE2.D7
SOLAR RADIATION DATA FILE:    P:\PRJ1\MDENG\HELP3\ME0250\PHASE2.D13
EVAPOTRANSPIRATION DATA:      P:\PRJ1\MDENG\HELP3\ME0250\PHASE2.D11
SOIL AND DESIGN DATA FILE:    P:\PRJ1\MDENG\HELP3\ME0250\CIL2B-3.D10
OUTPUT DATA FILE:             P:\PRJ1\MDENG\HELP3\ME0250\CIL2B-3.OUT


TIME:  12: 1      DATE:  12/18/2002


******************************************************************************

     TITLE:  CHERRY ISLAND LANDFILL PHASE II - RUN B

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     NOTE:  INITIAL MOISTURE CONTENT OF THE LAYERS AND SNOW WATER
              WERE SPECIFIED BY THE USER.


                                  LAYER  1
                                  --------

                  TYPE 1 - VERTICAL PERCOLATION LAYER
                      MATERIAL TEXTURE NUMBER  22
     THICKNESS                    =     12.00   INCHES
     POROSITY                     =      0.4190 VOL/VOL
     FIELD CAPACITY               =      0.3070 VOL/VOL
     WILTING POINT                =      0.1800 VOL/VOL
     INITIAL SOIL WATER CONTENT   =      0.3621 VOL/VOL
     EFFECTIVE SAT. HYD. COND.    =  0.189999992000E-04 CM/SEC
    NOTE:  SATURATED HYDRAULIC CONDUCTIVITY IS MULTIPLIED BY  1.80
             FOR ROOT CHANNELS IN TOP HALF OF EVAPORATIVE ZONE.


                                  LAYER  2
                                  --------

                  TYPE 1 - VERTICAL PERCOLATION LAYER
                      MATERIAL TEXTURE NUMBER   0
     THICKNESS                    =    681.20   INCHES
     POROSITY                     =      0.6100 VOL/VOL
     FIELD CAPACITY               =      0.2920 VOL/VOL
     WILTING POINT                =      0.0770 VOL/VOL
     INITIAL SOIL WATER CONTENT   =      0.0770 VOL/VOL
     EFFECTIVE SAT. HYD. COND.    =  0.100000005000E-02 CM/SEC


                                  LAYER  3
                                  --------

                  TYPE 2 - LATERAL DRAINAGE LAYER
                      MATERIAL TEXTURE NUMBER   0
     THICKNESS                    =     12.00   INCHES
     POROSITY                     =      0.6100 VOL/VOL
     FIELD CAPACITY               =      0.2920 VOL/VOL
     WILTING POINT                =      0.0770 VOL/VOL
     INITIAL SOIL WATER CONTENT   =      0.0770 VOL/VOL
     EFFECTIVE SAT. HYD. COND.    =  0.100000005000E-02 CM/SEC
     SLOPE                        =      0.30   PERCENT
     DRAINAGE LENGTH              =    230.0    FEET
     SUBSURFACE INFLOW            =      9.38   INCHES/YR


                                  LAYER  4
                                  --------

                  TYPE 3 - BARRIER SOIL LINER
                      MATERIAL TEXTURE NUMBER   0
     THICKNESS                    =    554.80   INCHES
     POROSITY                     =      0.6970 VOL/VOL
     FIELD CAPACITY               =      0.4180 VOL/VOL
     WILTING POINT                =      0.3670 VOL/VOL
     INITIAL SOIL WATER CONTENT   =      0.6970 VOL/VOL
     EFFECTIVE SAT. HYD. COND.    =  0.100000001000E-06 CM/SEC


                  GENERAL DESIGN AND EVAPORATIVE ZONE DATA
                  ----------------------------------------

     NOTE:  SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT


          SOIL DATA BASE USING SOIL TEXTURE #22 WITH A
          POOR STAND OF GRASS, A SURFACE SLOPE OF  3.%
          AND A SLOPE LENGTH OF  850. FEET.

     SCS RUNOFF CURVE NUMBER                =     93.30
     FRACTION OF AREA ALLOWING RUNOFF       =    100.0    PERCENT
     AREA PROJECTED ON HORIZONTAL PLANE     =      1.000  ACRES
     EVAPORATIVE ZONE DEPTH                 =      9.0    INCHES
     INITIAL WATER IN EVAPORATIVE ZONE      =      3.259  INCHES
     UPPER LIMIT OF EVAPORATIVE STORAGE     =      3.771  INCHES
     LOWER LIMIT OF EVAPORATIVE STORAGE     =      1.620  INCHES
     INITIAL SNOW WATER                     =      0.000  INCHES
     INITIAL WATER IN LAYER MATERIALS       =    444.417  INCHES
     TOTAL INITIAL WATER                    =    444.417  INCHES
     TOTAL SUBSURFACE INFLOW                =      9.38   INCHES/YEAR


                  EVAPOTRANSPIRATION AND WEATHER DATA
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     NOTE:  EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
              WILMINGTON              DELAWARE

          STATION LATITUDE                      =  39.80 DEGREES
          MAXIMUM LEAF AREA INDEX               =   1.00
          START OF GROWING SEASON (JULIAN DATE) =   107
          END OF GROWING SEASON (JULIAN DATE)   =   298
          EVAPORATIVE ZONE DEPTH                =   9.0  INCHES
          AVERAGE ANNUAL WIND SPEED             =   9.20 MPH
          AVERAGE 1ST QUARTER RELATIVE HUMIDITY =  67.00 %
          AVERAGE 2ND QUARTER RELATIVE HUMIDITY =  67.00 %
          AVERAGE 3RD QUARTER RELATIVE HUMIDITY =  72.00 %
          AVERAGE 4TH QUARTER RELATIVE HUMIDITY =  71.00 %


     NOTE:  PRECIPITATION DATA FOR     CHERRY ISLAND LF
              WAS ENTERED BY THE USER.


     NOTE:  TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING
              COEFFICIENTS FOR     WILMINGTON          DELAWARE

          NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

     JAN/JUL   FEB/AUG   MAR/SEP   APR/OCT   MAY/NOV   JUN/DEC
     -------   -------   -------   -------   -------   -------
      31.20     33.20     41.80     52.40     62.20     71.20
      76.00     74.80     67.80     56.30     45.60     35.50


     NOTE:  SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
              COEFFICIENTS FOR     WILMINGTON          DELAWARE


          AND STATION LATITUDE =  39.80 DEGREES


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                  MONTHLY TOTALS (IN INCHES) FOR YEAR    1
------------------------------------------------------------------------------

                          JAN/JUL  FEB/AUG  MAR/SEP  APR/OCT  MAY/NOV  JUN/DEC
                          -------  -------  -------  -------  -------  -------
PRECIPITATION              7.06     1.11     2.48     2.14     2.69     7.65
                           6.60     4.24     3.95     1.63     1.57     1.38

RUNOFF                     2.698    0.004    0.008    0.066    0.549    1.580
                           3.532    1.359    1.015    0.048    0.132    0.013

EVAPOTRANSPIRATION         1.003    1.633    2.542    1.985    2.223    4.761
                           2.839    2.722    1.912    2.391    1.032    1.131

SUBSURFACE INFLOW INTO     0.7967   0.7196   0.7967   0.7710   0.7967   0.7710
  LAYER  3                 0.7967   0.7967   0.7710   0.7967   0.7710   0.7967

LATERAL DRAINAGE COLLECTED 0.0000   0.0004   0.0095   0.0270   0.0480   0.0482
  FROM LAYER  3            0.0625   0.0995   0.1380   0.1615   0.1563   0.1615

PERCOLATION/LEAKAGE THROUGH 0.0000  0.0298   0.1061   0.1036   0.1077   0.1043
  LAYER  4                 0.1081   0.1089   0.1062   0.1100   0.1065   0.1100

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                  MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)
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AVERAGE DAILY HEAD ON      0.000    0.203    3.636    8.181   11.716   12.000
  TOP OF LAYER  4         13.744   18.130   22.331   24.000   24.000   24.000

STD. DEVIATION OF DAILY    0.000    0.375    1.363    1.303    0.480    0.000
  HEAD ON TOP OF LAYER  4  1.265    1.278    1.170    0.000    0.000    0.000

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                  ANNUAL TOTALS FOR YEAR    1
------------------------------------------------------------------------------
                                  INCHES        CU. FEET       PERCENT
                                  --------    ----------       -------
PRECIPITATION                      42.50      154274.984       100.00
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RUNOFF	11.004	39944.469	25.89
EVAPOTRANSPIRATION	26.174	95011.664	61.59
SUBSURFACE INFLOW INTO LAYER 3	9.380000	34049.398	22.07
DRAINAGE COLLECTED FROM LAYER 3	0.9125	3312.328	2.15
PERC./LEAKAGE THROUGH LAYER 4	1.100996	3996.615	2.59
AVG. HEAD ON TOP OF LAYER 4	13.4951		
CHANGE IN WATER STORAGE	22.069	80108.695	51.93
SOIL WATER AT START OF YEAR	444.417	1613234.250	
SOIL WATER AT END OF YEAR	466.486	1693342.870	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	-9.3800	-34049.395	-22.07

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MONTHLY TOTALS (IN INCHES) FOR YEAR 2

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	4.44	2.19	3.41	4.62	2.81	4.90
	3.62	4.51	2.28	4.43	3.12	1.74
RUNOFF	0.000	3.270	3.138	0.199	0.308	0.609
	0.144	1.026	0.191	1.087	0.394	0.241
EVAPOTRANSPIRATION	0.873	0.668	1.821	4.277	2.679	3.680
	3.461	3.940	1.657	2.413	1.667	0.911
SUBSURFACE INFLOW INTO LAYER 3	0.7967	0.7196	0.7967	0.7710	0.7967	0.7710
	0.7967	0.7967	0.7710	0.7967	0.7710	0.7967
LATERAL DRAINAGE COLLECTED FROM LAYER 3	0.1615	0.1459	0.1615	0.1563	0.1615	0.1563
	0.1615	0.1615	0.1563	0.1615	0.1563	0.1615
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.1100	0.0994	0.1100	0.1065	0.1100	0.1065
	0.1100	0.1100	0.1065	0.1100	0.1065	0.1100

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 4	24.000	24.000	24.000	24.000	24.000	24.000
	24.000	24.000	24.000	24.000	24.000	24.000
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 4	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000

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ANNUAL TOTALS FOR YEAR 2

	INCHES	CU. FEET	PERCENT
PRECIPITATION	42.07	152714.141	100.00
RUNOFF	10.608	38506.402	25.21
EVAPOTRANSPIRATION	28.045	101804.164	66.66
SUBSURFACE INFLOW INTO LAYER 3	9.380000	34049.398	22.30
DRAINAGE COLLECTED FROM LAYER 3	1.9016	6902.739	4.52
PERC./LEAKAGE THROUGH LAYER 4	1.295261	4701.796	3.08
AVG. HEAD ON TOP OF LAYER 4	24.0000		
CHANGE IN WATER STORAGE	18.980	68897.773	45.12
SOIL WATER AT START OF YEAR	466.486	1693342.870	
SOIL WATER AT END OF YEAR	485.466	1762240.750	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	-9.3800	-34049.328	-22.30

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MONTHLY TOTALS (IN INCHES) FOR YEAR 3

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	0.98	4.73	8.53	3.09	5.72	3.65
	5.57	8.02	7.27	4.94	3.35	3.28
RUNOFF	0.246	1.292	2.324	0.220	1.668	0.906
	1.156	2.150	2.728	1.451	0.318	0.599
EVAPOTRANSPIRATION	0.842	1.590	2.031	3.681	3.414	1.393
	4.571	4.550	3.911	1.863	1.553	0.730
SUBSURFACE INFLOW INTO LAYER 3	0.7967	0.7196	0.7967	0.7710	0.7967	0.7710
	0.7967	0.7967	0.7710	0.7967	0.7710	0.7967
LATERAL DRAINAGE COLLECTED FROM LAYER 3	0.1615	0.1459	0.1615	0.1563	0.1615	0.1563
	0.1615	0.1615	0.1563	0.1615	0.1563	0.1615
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.1100	0.0994	0.1100	0.1065	0.1100	0.1065
	0.1100	0.1100	0.1065	0.1100	0.1065	0.1100

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 4	24.000	24.000	24.000	24.000	24.000	24.000
	24.000	24.000	24.000	24.000	24.000	24.000
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 4	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000

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ANNUAL TOTALS FOR YEAR 3

	INCHES	CU. FEET	PERCENT
PRECIPITATION	59.13	214641.937	100.00
RUNOFF	15.059	54662.910	25.47
EVAPOTRANSPIRATION	30.129	109367.008	50.95
SUBSURFACE INFLOW INTO LAYER 3	9.380000	34049.398	15.86
DRAINAGE COLLECTED FROM LAYER 3	1.9016	6902.739	3.22
PERC./LEAKAGE THROUGH LAYER 4	1.295261	4701.796	2.19
AVG. HEAD ON TOP OF LAYER 4	24.0000		
CHANGE IN WATER STORAGE	29.506	107106.211	49.90
SOIL WATER AT START OF YEAR	485.466	1762240.750	
SOIL WATER AT END OF YEAR	514.845	1868887.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.127	459.893	0.21
ANNUAL WATER BUDGET BALANCE	-9.3800	-34049.332	-15.86

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MONTHLY TOTALS (IN INCHES) FOR YEAR 4

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	3.86	2.74	3.83	3.55	5.78	4.63
	5.26	7.89	3.89	2.25	4.13	1.23
RUNOFF	2.984	0.494	0.856	0.342	1.181	1.004
	1.356	2.714	1.086	0.289	1.157	0.089
EVAPOTRANSPIRATION	0.445	0.901	2.483	3.576	2.655	4.248
	3.825	4.543	3.009	0.581	1.652	1.036
SUBSURFACE INFLOW INTO LAYER 3	0.7967	0.7453	0.7967	0.7710	0.7967	0.7710
	0.7967	0.7967	0.7710	0.7967	0.7710	0.7967
LATERAL DRAINAGE COLLECTED FROM LAYER 3	0.1615	0.1511	0.1615	0.1563	0.1615	0.1563
	0.1615	0.1615	0.1563	0.1615	0.1563	0.1615
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.1100	0.1029	0.1100	0.1065	0.1100	0.1065
	0.1100	0.1100	0.1065	0.1100	0.1065	0.1100

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 4	24.000	24.000	24.000	24.000	24.000	24.000
	24.000	24.000	24.000	24.000	24.000	24.000

STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 4	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000

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ANNUAL TOTALS FOR YEAR 4

	INCHES	CU. FEET	PERCENT
PRECIPITATION	49.04	178015.187	100.00
RUNOFF	13.553	49198.250	27.64
EVAPOTRANSPIRATION	28.955	105106.602	59.04
SUBSURFACE INFLOW INTO LAYER 3	9.405699	34142.687	19.18
DRAINAGE COLLECTED FROM LAYER 3	1.9068	6921.651	3.89
PERC./LEAKAGE THROUGH LAYER 4	1.298809	4714.678	2.65
AVG. HEAD ON TOP OF LAYER 4	24.0000		
CHANGE IN WATER STORAGE	22.138	80359.453	45.14
SOIL WATER AT START OF YEAR	514.845	1868887.000	
SOIL WATER AT END OF YEAR	537.109	1949706.370	
SNOW WATER AT START OF YEAR	0.127	459.893	0.26
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	-9.4057	-34142.754	-19.18

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MONTHLY TOTALS (IN INCHES) FOR YEAR 5

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	4.59 1.55	1.40 5.61	5.75 5.53	4.02 1.83	1.74 7.03	2.86 4.38
RUNOFF	1.742 0.034	0.495 1.458	2.177 1.880	0.227 0.499	0.036 2.343	0.755 0.634
EVAPOTRANSPIRATION	0.581 1.106	0.642 4.572	2.795 2.358	3.759 1.944	1.910 1.422	2.045 1.157
SUBSURFACE INFLOW INTO LAYER 3	0.7967 0.7967	0.7196 0.7967	0.7967 0.7710	0.7710 0.7967	0.7967 0.7710	0.7710 0.7967
LATERAL DRAINAGE COLLECTED FROM LAYER 3	0.1615 0.1615	0.1459 0.1615	0.1615 0.1563	0.1563 0.1615	0.1615 0.1563	0.1563 0.1615
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.1100 0.1100	0.0994 0.1100	0.1100 0.1065	0.1065 0.1100	0.1100 0.1065	0.1065 0.1100

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 4	24.000 24.000	24.000 24.000	24.000 24.000	24.000 24.000	24.000 24.000	24.000 24.000
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 4	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000

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ANNUAL TOTALS FOR YEAR 5

	INCHES	CU. FEET	PERCENT
PRECIPITATION	46.29	168032.703	100.00
RUNOFF	12.281	44580.484	26.53
EVAPOTRANSPIRATION	24.291	88177.328	52.48
SUBSURFACE INFLOW INTO LAYER 3	9.380000	34049.398	20.26
DRAINAGE COLLECTED FROM LAYER 3	1.9016	6902.739	4.11
PERC./LEAKAGE THROUGH LAYER 4	1.295261	4701.796	2.80
AVG. HEAD ON TOP OF LAYER 4	24.0000		
CHANGE IN WATER STORAGE	25.281	91768.945	54.61
SOIL WATER AT START OF YEAR	537.109	1949706.370	
SOIL WATER AT END OF YEAR	562.390	2041475.250	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	-9.3799	-34049.187	-20.26

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MONTHLY TOTALS (IN INCHES) FOR YEAR 6

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	5.72 1.71	2.50 4.59	3.55 1.64	6.62 3.14	2.37 2.70	3.40 3.09
RUNOFF	1.298 0.189	2.576 0.892	0.435 0.151	1.935 0.810	0.065 0.650	0.471 0.237
EVAPOTRANSPIRATION	0.749 1.537	1.088 3.870	2.856 1.527	4.464 1.231	2.398 1.684	3.035 1.067
SUBSURFACE INFLOW INTO LAYER 3	0.7967 0.7967	0.7196 0.7967	0.7967 0.7710	0.7710 0.7967	0.7967 0.7710	0.7710 0.7967
LATERAL DRAINAGE COLLECTED FROM LAYER 3	0.1615 0.1615	0.1459 0.1615	0.1615 0.1563	0.1563 0.1615	0.1615 0.1563	0.1563 0.1615
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.1100 0.1100	0.0994 0.1100	0.1100 0.1065	0.1065 0.1100	0.1100 0.1065	0.1065 0.1100

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 4	24.000 24.000	24.000 24.000	24.000 24.000	24.000 24.000	24.000 24.000	24.000 24.000
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 4	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000

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ANNUAL TOTALS FOR YEAR 6

	INCHES	CU. FEET	PERCENT
PRECIPITATION	41.03	148938.891	100.00
RUNOFF	9.710	35246.945	23.67
EVAPOTRANSPIRATION	25.505	92583.711	62.16
SUBSURFACE INFLOW INTO LAYER 3	9.380000	34049.398	22.86
DRAINAGE COLLECTED FROM LAYER 3	1.9016	6902.739	4.63
PERC./LEAKAGE THROUGH LAYER 4	1.295261	4701.796	3.16
AVG. HEAD ON TOP OF LAYER 4	24.0000		
CHANGE IN WATER STORAGE	21.378	77602.547	52.10
SOIL WATER AT START OF YEAR	562.390	2041475.250	
SOIL WATER AT END OF YEAR	583.768	2119077.750	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	-9.3800	-34049.449	-22.86

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MONTHLY TOTALS (IN INCHES) FOR YEAR 7

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	4.63 5.22	2.81 6.98	2.61 10.80	4.64 0.60	3.92 4.39	5.10 3.09
RUNOFF	1.266 1.915	3.187 2.564	0.262 4.800	0.690 0.011	0.149 0.736	1.139 0.617
EVAPOTRANSPIRATION	0.761 2.564	0.432 3.533	2.359 3.929	3.702 0.670	3.556 1.132	3.080 1.090
SUBSURFACE INFLOW INTO LAYER 3	0.7967 0.7967	0.7196 0.7967	0.7967 0.7710	0.7710 0.7967	0.7967 0.7710	0.7710 0.7967

LATERAL DRAINAGE COLLECTED	0.1615	0.1459	0.1615	0.1563	0.1615	0.1563
FROM LAYER 3	0.1615	0.1615	0.2148	0.3131	0.3629	0.5608
PERCOLATION/LEAKAGE THROUGH	0.1100	0.0994	0.1100	0.1065	0.1100	0.1065
LAYER 4	0.1100	0.1100	0.1073	0.1120	0.1091	0.1144

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON	24.000	24.000	24.000	24.000	24.000	24.000
TOP OF LAYER 4	24.000	24.000	28.520	34.662	38.233	47.226
STD. DEVIATION OF DAILY	0.000	0.000	0.000	0.000	0.000	0.000
HEAD ON TOP OF LAYER 4	0.000	0.000	3.336	1.078	1.082	3.185

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ANNUAL TOTALS FOR YEAR 7

	INCHES	CU. FEET	PERCENT
PRECIPITATION	54.79	198887.719	100.00
RUNOFF	17.337	62932.840	31.64
EVAPOTRANSPIRATION	26.808	97314.437	48.93
SUBSURFACE INFLOW INTO LAYER 3	9.380000	34049.398	17.12
DRAINAGE COLLECTED FROM LAYER 3	2.7176	9864.799	4.96
PERC./LEAKAGE THROUGH LAYER 4	1.305154	4737.709	2.38
AVG. HEAD ON TOP OF LAYER 4	28.3867		
CHANGE IN WATER STORAGE	25.382	92136.727	46.33
SOIL WATER AT START OF YEAR	583.768	2119077.750	
SOIL WATER AT END OF YEAR	609.150	2211214.500	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	-9.3800	-34049.398	-17.12

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SUBSURFACE INFLOW INTO LAYER 3	9.405699	34142.687	16.37
DRAINAGE COLLECTED FROM LAYER 3	15.4621	56127.449	26.92
PERC./LEAKAGE THROUGH LAYER 4	1.409198	5115.388	2.45
AVG. HEAD ON TOP OF LAYER 4	73.1572		
CHANGE IN WATER STORAGE	12.592	45710.660	21.92
SOIL WATER AT START OF YEAR	609.150	2211214.500	
SOIL WATER AT END OF YEAR	621.742	2256925.250	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	-9.4057	-34142.633	-16.37

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MONTHLY TOTALS (IN INCHES) FOR YEAR 9

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	3.93	3.22	3.86	2.79	1.90	6.67
	10.86	3.62	1.46	1.67	2.93	2.27
RUNOFF	2.405	2.543	2.262	0.277	0.152	1.210
	4.724	0.733	0.230	0.215	0.614	0.373
EVAPOTRANSPIRATION	0.479	0.382	1.880	3.409	1.655	4.808
	5.495	2.960	0.641	1.897	1.468	0.744
SUBSURFACE INFLOW INTO	0.7967	0.7196	0.7967	0.7710	0.7967	0.7710
LAYER 3	0.7967	0.7967	0.7710	0.7967	0.7710	0.7967
LATERAL DRAINAGE COLLECTED	1.9140	1.7031	1.8758	1.8684	1.8795	1.7857
FROM LAYER 3	1.8568	1.8513	1.7585	1.7926	1.7479	1.8257
PERCOLATION/LEAKAGE THROUGH	0.1226	0.1106	0.1224	0.1187	0.1224	0.1183
LAYER 4	0.1223	0.1223	0.1182	0.1220	0.1181	0.1222

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

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MONTHLY TOTALS (IN INCHES) FOR YEAR 8

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	3.98	2.12	4.69	3.51	3.50	4.34
	7.37	4.61	13.90	4.99	2.02	2.41
RUNOFF	0.908	0.032	1.093	0.557	0.174	0.671
	3.617	1.210	8.075	1.099	0.040	0.340
EVAPOTRANSPIRATION	1.433	1.674	2.658	2.345	2.890	4.596
	2.194	3.702	2.870	2.314	1.610	0.685
SUBSURFACE INFLOW INTO	0.7967	0.7453	0.7967	0.7710	0.7967	0.7710
LAYER 3	0.7967	0.7967	0.7710	0.7967	0.7710	0.7967
LATERAL DRAINAGE COLLECTED	0.7433	0.8311	1.0160	1.1421	1.2238	1.2118
FROM LAYER 3	1.2872	1.3216	1.2961	1.7349	1.7840	1.8702
PERCOLATION/LEAKAGE THROUGH	0.1159	0.1094	0.1178	0.1149	0.1190	0.1153
LAYER 4	0.1194	0.1196	0.1158	0.1215	0.1183	0.1224

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON	54.933	60.368	64.749	70.064	71.411	72.271
TOP OF LAYER 4	73.317	74.334	74.710	84.358	88.358	89.015
STD. DEVIATION OF DAILY	1.776	1.283	2.294	1.049	0.234	0.254
HEAD ON TOP OF LAYER 4	0.525	0.174	1.926	9.614	0.277	0.912

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ANNUAL TOTALS FOR YEAR 8

	INCHES	CU. FEET	PERCENT
PRECIPITATION	57.44	208507.234	100.00
RUNOFF	17.817	64674.488	31.02
EVAPOTRANSPIRATION	28.971	105164.562	50.44

AVERAGE DAILY HEAD ON	90.092	89.395	89.151	90.496	89.246	88.403
TOP OF LAYER 4	88.688	88.553	87.702	87.088	87.427	87.915
STD. DEVIATION OF DAILY	0.442	0.348	1.036	0.308	0.374	0.265
HEAD ON TOP OF LAYER 4	0.350	0.261	0.310	0.136	0.556	0.584

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ANNUAL TOTALS FOR YEAR 9

	INCHES	CU. FEET	PERCENT
PRECIPITATION	45.18	164003.359	100.00
RUNOFF	15.737	57123.539	34.83
EVAPOTRANSPIRATION	25.816	93712.547	57.14
SUBSURFACE INFLOW INTO LAYER 3	9.380000	34049.398	20.76
DRAINAGE COLLECTED FROM LAYER 3	21.8594	79349.539	48.38
PERC./LEAKAGE THROUGH LAYER 4	1.439998	5227.191	3.19
AVG. HEAD ON TOP OF LAYER 4	88.6797		
CHANGE IN WATER STORAGE	-0.912	-3310.514	-2.02
SOIL WATER AT START OF YEAR	621.742	2256925.250	
SOIL WATER AT END OF YEAR	620.831	2253614.750	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	-9.3800	-34049.539	-20.76

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MONTHLY TOTALS (IN INCHES) FOR YEAR 10

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	8.05	2.10	8.59	7.13	6.01	8.31
	5.35	3.72	2.36	6.26	5.12	5.36
RUNOFF	6.731	0.290	2.972	2.498	1.404	3.090
	1.960	0.715	0.507	2.496	1.886	2.046
EVAPOTRANSPIRATION	0.404	0.994	2.981	4.016	4.408	4.544
	3.366	3.002	0.843	2.326	1.557	0.802
SUBSURFACE INFLOW INTO LAYER 3	0.7967	0.7196	0.7967	0.7710	0.7967	0.7710
	0.7967	0.7967	0.7710	0.7967	0.7710	0.7967
LATERAL DRAINAGE COLLECTED FROM LAYER 3	1.8342	1.6949	2.0728	2.1855	2.2923	2.1887
	2.2254	2.1285	1.9838	2.0323	2.0429	2.3174
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.1222	0.1105	0.1232	0.1200	0.1242	0.1201
	0.1240	0.1235	0.1192	0.1231	0.1194	0.1243

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 4	88.128	89.165	93.660	97.656	98.887	98.201
	97.386	95.175	93.344	92.929	94.547	99.433
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 4	0.334	1.287	3.857	5.178	0.552	0.781
	0.697	0.595	0.506	0.400	3.547	1.625

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ANNUAL TOTALS FOR YEAR 10

	INCHES	CU. FEET	PERCENT
PRECIPITATION	68.36	248146.750	100.00
RUNOFF	26.594	96536.633	38.90
EVAPOTRANSPIRATION	29.243	106152.211	42.78
SUBSURFACE INFLOW INTO LAYER 3	9.380000	34049.398	13.72
DRAINAGE COLLECTED FROM LAYER 3	24.9988	90745.477	36.57
PERC./LEAKAGE THROUGH LAYER 4	1.453951	5277.843	2.13
AVG. HEAD ON TOP OF LAYER 4	94.8759		
CHANGE IN WATER STORAGE	4.830	17533.324	7.07
SOIL WATER AT START OF YEAR	620.831	2253614.750	
SOIL WATER AT END OF YEAR	625.113	2269161.250	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.547	1986.848	0.80
ANNUAL WATER BUDGET BALANCE	-9.3800	-34049.348	-13.72

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MONTHLY TOTALS (IN INCHES) FOR YEAR 11

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	2.02	1.24	5.86	2.65	2.08	1.82
	3.99	0.38	6.34	6.41	1.89	4.28
RUNOFF	1.947	0.069	0.953	0.262	0.038	0.204
	1.688	0.000	1.963	3.251	0.071	0.332
EVAPOTRANSPIRATION	0.316	1.000	3.167	2.576	2.070	1.961
	1.699	0.327	2.182	2.650	1.775	0.998
SUBSURFACE INFLOW INTO LAYER 3	0.7967	0.7196	0.7967	0.7710	0.7967	0.7710
	0.7967	0.7967	0.7710	0.7967	0.7710	0.7967
LATERAL DRAINAGE COLLECTED FROM LAYER 3	2.3067	2.0626	2.2944	2.3179	2.2868	2.1114
	2.1270	2.0855	1.9527	2.1371	2.0829	2.0674
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.1243	0.1122	0.1242	0.1207	0.1242	0.1198
	0.1235	0.1233	0.1191	0.1236	0.1197	0.1233

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 4	99.206	98.694	98.693	101.150	98.762	96.398
	95.141	94.176	92.586	95.366	95.724	93.754
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 4	0.773	0.533	3.767	0.515	0.755	0.637
	0.445	0.567	0.364	1.387	0.611	0.541

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ANNUAL TOTALS FOR YEAR 11

	INCHES	CU. FEET	PERCENT
PRECIPITATION	38.96	141424.828	100.00
RUNOFF	10.778	39123.992	27.66
EVAPOTRANSPIRATION	20.721	75217.672	53.19
SUBSURFACE INFLOW INTO LAYER 3	9.380000	34049.398	24.08
DRAINAGE COLLECTED FROM LAYER 3	25.8325	93771.844	66.31
PERC./LEAKAGE THROUGH LAYER 4	1.457781	5291.744	3.74
AVG. HEAD ON TOP OF LAYER 4	96.6374		
CHANGE IN WATER STORAGE	-1.069	-3881.556	-2.74
SOIL WATER AT START OF YEAR	625.113	2269161.250	
SOIL WATER AT END OF YEAR	622.395	2259294.250	
SNOW WATER AT START OF YEAR	0.547	1986.848	1.40
SNOW WATER AT END OF YEAR	2.196	7972.360	5.64
ANNUAL WATER BUDGET BALANCE	-9.3800	-34049.465	-24.08

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WARNING: TEMPERATURE FOR YEAR 12 USED WITH PRECIPITATION FOR YEAR 13

WARNING: SOLAR RADIATION FOR YEAR 12 USED WITH PRECIPITATION FOR YEAR 13

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MONTHLY TOTALS (IN INCHES) FOR YEAR 13

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	1.68	0.64	4.01	4.21	3.90	3.86
	2.56	1.74	2.98	2.88	1.21	8.76
RUNOFF	0.617	2.018	0.693	0.442	0.233	0.440
	0.406	0.246	0.287	0.184	0.049	2.771
EVAPOTRANSPIRATION	0.709	0.551	2.409	4.096	2.786	3.432
	2.475	1.648	2.272	1.884	1.815	0.931
SUBSURFACE INFLOW INTO LAYER 3	0.7967	0.7196	0.7967	0.7710	0.7967	0.7710
	0.7967	0.7967	0.7710	0.7967	0.7710	0.7967
LATERAL DRAINAGE COLLECTED FROM LAYER 3	1.9962	1.7474	1.9868	2.0049	2.0404	1.9083
	1.9400	1.8841	1.7765	1.8083	1.7574	1.7936
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.1229	0.1108	0.1229	0.1193	0.1231	0.1189
	0.1227	0.1224	0.1183	0.1221	0.1182	0.1220

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 4	92.071	90.591	91.641	93.856	93.120	91.489
	90.722	89.360	88.165	87.482	87.673	86.928
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 4	0.483	0.389	3.480	0.364	0.527	0.417
	0.399	0.377	0.316	0.250	0.236	3.047

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ANNUAL TOTALS FOR YEAR 13

	INCHES	CU. FEET	PERCENT
PRECIPITATION	38.43	139500.906	100.00
RUNOFF	8.385	30436.768	21.82
EVAPOTRANSPIRATION	25.008	90778.477	65.07
SUBSURFACE INFLOW INTO LAYER 3	9.380000	34049.398	24.41
DRAINAGE COLLECTED FROM LAYER 3	22.6438	82196.937	58.92
PERC./LEAKAGE THROUGH LAYER 4	1.443533	5240.023	3.76
AVG. HEAD ON TOP OF LAYER 4	90.2582		
CHANGE IN WATER STORAGE	-0.290	-1052.690	-0.75
SOIL WATER AT START OF YEAR	622.395	2259294.250	

SOIL WATER AT END OF YEAR	622.035	2257986.750	
SNOW WATER AT START OF YEAR	2.196	7972.360	5.71
SNOW WATER AT END OF YEAR	2.266	8227.081	5.90
ANNUAL WATER BUDGET BALANCE	-9.3800	-34049.219	-24.41

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MONTHLY TOTALS (IN INCHES) FOR YEAR 13

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	0.95	4.60	4.04	0.69	3.91	2.40
	2.68	12.91	4.59	3.00	3.10	4.24
RUNOFF	0.539	2.027	3.753	0.000	1.585	0.513
	0.297	7.140	1.395	0.363	0.119	2.524
EVAPOTRANSPIRATION	0.543	0.536	2.511	0.776	1.654	1.509
	2.794	5.462	2.675	2.216	1.355	0.917
SUBSURFACE INFLOW INTO LAYER 3	0.7967	0.7196	0.7967	0.7710	0.7967	0.7710
	0.7967	0.7967	0.7710	0.7967	0.7710	0.7967
LATERAL DRAINAGE COLLECTED FROM LAYER 3	2.0804	1.9150	2.1074	2.0039	2.0059	1.9585
	1.9606	1.9371	1.8381	1.8488	1.7466	1.8673
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.1233	0.1115	0.1234	0.1193	0.1230	0.1191
	0.1228	0.1227	0.1186	0.1223	0.1181	0.1224

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 4	93.833	94.983	94.687	93.830	92.303	92.727
	91.219	90.652	89.734	88.490	87.394	88.945
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 4	3.778	0.542	0.667	0.537	0.497	0.459
	0.401	0.223	0.384	0.350	0.296	0.721

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SUBSURFACE INFLOW INTO LAYER 3	0.7967	0.7196	0.7967	0.7710	0.7967	0.7710
	0.7967	0.7967	0.7710	0.7967	0.7710	0.7967
LATERAL DRAINAGE COLLECTED FROM LAYER 3	1.9620	1.7491	1.9803	1.9266	1.9321	1.8199
	1.8641	1.8807	1.7811	1.7975	1.7031	1.8057
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.1227	0.1108	0.1229	0.1190	0.1227	0.1185
	0.1223	0.1224	0.1183	0.1220	0.1179	0.1221

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 4	90.865	90.638	91.690	91.944	90.530	89.274
	88.868	89.278	88.285	87.211	86.261	87.408
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 4	6.210	0.384	0.526	0.341	0.428	0.289
	0.350	0.347	0.331	0.301	0.253	1.218

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ANNUAL TOTALS FOR YEAR 14

	INCHES	CU. FEET	PERCENT
PRECIPITATION	37.80	137213.984	100.00
RUNOFF	8.785	31889.518	23.24
EVAPOTRANSPIRATION	24.973	90651.945	66.07
SUBSURFACE INFLOW INTO LAYER 3	9.380000	34049.398	24.81
DRAINAGE COLLECTED FROM LAYER 3	22.2023	80594.367	58.74
PERC./LEAKAGE THROUGH LAYER 4	1.441502	5232.654	3.81
AVG. HEAD ON TOP OF LAYER 4	89.3542		
CHANGE IN WATER STORAGE	-0.842	-3055.501	-2.23
SOIL WATER AT START OF YEAR	622.250	2258768.500	
SOIL WATER AT END OF YEAR	621.409	2255713.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	-9.3801	-34049.602	-24.81

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ANNUAL TOTALS FOR YEAR 13

	INCHES	CU. FEET	PERCENT
PRECIPITATION	47.11	171009.375	100.00
RUNOFF	20.255	73526.867	43.00
EVAPOTRANSPIRATION	22.950	83307.383	48.72
SUBSURFACE INFLOW INTO LAYER 3	9.380000	34049.398	19.91
DRAINAGE COLLECTED FROM LAYER 3	23.2696	84468.828	49.39
PERC./LEAKAGE THROUGH LAYER 4	1.446419	5250.500	3.07
AVG. HEAD ON TOP OF LAYER 4	91.5665		
CHANGE IN WATER STORAGE	-2.051	-7445.426	-4.35
SOIL WATER AT START OF YEAR	622.035	2257986.750	
SOIL WATER AT END OF YEAR	622.250	2258768.500	
SNOW WATER AT START OF YEAR	2.266	8227.081	4.81
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	-9.3800	-34049.379	-19.91

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MONTHLY TOTALS (IN INCHES) FOR YEAR 14

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	3.42	2.71	4.10	3.03	1.63	4.32
	5.60	3.22	2.02	1.94	2.77	3.04
RUNOFF	0.000	4.009	0.579	0.301	0.039	0.878
	1.156	0.491	0.131	0.330	0.239	0.632
EVAPOTRANSPIRATION	0.929	0.395	2.814	3.643	1.633	3.326
	3.070	3.510	1.440	2.073	1.126	1.014

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MONTHLY TOTALS (IN INCHES) FOR YEAR 15

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	0.66	1.49	3.09	2.64	1.65	2.73
	2.67	1.56	3.30	2.64	5.00	1.38
RUNOFF	0.115	0.837	0.588	0.042	0.025	0.384
	0.270	0.005	0.266	0.434	0.953	0.004
EVAPOTRANSPIRATION	0.369	0.436	2.628	1.730	1.966	2.681
	2.478	1.221	3.475	1.183	1.435	1.037
SUBSURFACE INFLOW INTO LAYER 3	0.7967	0.7196	0.7967	0.7710	0.7967	0.7710
	0.7967	0.7967	0.7710	0.7967	0.7710	0.7967
LATERAL DRAINAGE COLLECTED FROM LAYER 3	1.8960	1.6703	1.8881	1.8491	1.8588	1.7550
	1.7740	1.7388	1.6533	1.6817	1.6830	1.9392
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.1225	0.1104	0.1224	0.1186	0.1223	0.1182
	0.1219	0.1217	0.1177	0.1215	0.1177	0.1227

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 4	89.653	88.501	89.453	90.013	88.737	87.612
	86.617	85.722	84.943	84.253	84.978	90.704
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 4	0.323	0.320	1.159	0.396	0.357	0.306
	0.276	0.245	0.208	0.189	8.215	0.410

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ANNUAL TOTALS FOR YEAR 15

	INCHES	CU. FEET	PERCENT
PRECIPITATION	28.81	104580.328	100.00

RUNOFF	3.924	14244.004	13.62
EVAPOTRANSPIRATION	20.640	74923.391	71.64
SUBSURFACE INFLOW INTO LAYER 3	9.380000	34049.398	32.56
DRAINAGE COLLECTED FROM LAYER 3	21.3875	77636.461	74.24
PERC./LEAKAGE THROUGH LAYER 4	1.437588	5218.443	4.99
AVG. HEAD ON TOP OF LAYER 4	87.5987		
CHANGE IN WATER STORAGE	0.181	656.918	0.63
SOIL WATER AT START OF YEAR	621.409	2255713.000	
SOIL WATER AT END OF YEAR	621.589	2256369.750	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	-9.3800	-34049.492	-32.56

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AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1 THROUGH 15

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	3.73	2.37	4.56	3.69	3.31	4.44
	4.71	4.91	4.82	3.24	3.36	3.33
STD. DEVIATIONS	2.20	1.18	1.88	1.64	1.54	1.88
	2.46	3.12	3.55	1.77	1.55	1.95
RUNOFF						
TOTALS	1.566	1.543	1.473	0.537	0.507	0.924
	1.496	1.514	1.647	0.838	0.647	0.763
STD. DEVIATIONS	1.735	1.348	1.187	0.714	0.618	0.700
	1.453	1.769	2.189	0.936	0.693	0.907
EVAPOTRANSPIRATION						
TOTALS	0.696	0.862	2.529	3.202	2.526	3.273
	2.898	3.304	2.313	1.842	1.486	0.950
STD. DEVIATIONS	0.297	0.461	0.389	1.070	0.800	1.177
	1.148	1.384	1.014	0.639	0.239	0.150
SUBSURFACE INFLOW INTO LAYER 3						
TOTALS	0.7967	0.7196	0.7967	0.7710	0.7967	0.7710
	0.7967	0.7967	0.7710	0.7967	0.7710	0.7967
LATERAL DRAINAGE COLLECTED FROM LAYER 3						
TOTALS	1.0468	0.9503	1.0800	1.0842	1.1024	1.0484
	1.0711	1.0597	1.0116	1.0744	1.0566	1.1344
STD. DEVIATIONS	0.9403	0.8397	0.9504	0.9496	0.9568	0.9039
	0.9166	0.8959	0.8366	0.8705	0.8517	0.9011
PERCOLATION/LEAKAGE THROUGH LAYER 4						
TOTALS	0.1091	0.1011	0.1164	0.1129	0.1166	0.1127
	0.1165	0.1165	0.1127	0.1167	0.1130	0.1170
STD. DEVIATIONS	0.0308	0.0205	0.0069	0.0067	0.0068	0.0065
	0.0066	0.0065	0.0060	0.0062	0.0060	0.0063

AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)

DAILY AVERAGE HEAD ON TOP OF LAYER 4						
AVERAGES	56.1854	56.4358	57.4240	58.7459	58.5808	58.1582
	57.9801	57.9587	58.0213	59.0560	59.6396	61.0218
STD. DEVIATIONS	36.2752	36.1384	36.2845	36.6372	35.8326	35.3073
	34.7929	34.0305	32.8288	32.6916	32.8456	33.2691

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AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1 THROUGH 15

	INCHES		CU. FEET	PERCENT
PRECIPITATION	46.46	(10.038)	168659.5	100.00
RUNOFF	13.455	(5.5793)	48841.87	28.959
EVAPOTRANSPIRATION	25.882	(2.9389)	93951.54	55.705
SUBSURFACE INFLOW INTO LAYER 3	9.38000		34049.402	20.18825
LATERAL DRAINAGE COLLECTED FROM LAYER 3	12.71994	(10.73416)	46173.375	27.37669
PERCOLATION/LEAKAGE THROUGH LAYER 4	1.36106	(0.10173)	4940.665	2.92937
AVERAGE HEAD ON TOP OF LAYER 4	58.267	(34.524)		
CHANGE IN WATER STORAGE	11.811	(12.0847)	42875.71	25.421

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PEAK DAILY VALUES FOR YEARS 1 THROUGH 15

	(INCHES)	(CU. FT.)
PRECIPITATION	5.15	18694.500
RUNOFF	4.187	15198.3193
DRAINAGE COLLECTED FROM LAYER 3	0.07898	286.69324
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.004029	14.62435
AVERAGE HEAD ON TOP OF LAYER 4	102.303	
MAXIMUM HEAD ON TOP OF LAYER 4	125.212	
LOCATION OF MAXIMUM HEAD IN LAYER 3 (DISTANCE FROM DRAIN)	216.5 FEET	
SNOW WATER	3.68	13370.2363

MAXIMUM VEG. SOIL WATER (VOL/VOL) 0.4017

MINIMUM VEG. SOIL WATER (VOL/VOL) 0.1800

*** Maximum heads are computed using McEnroe's equations. ***

Reference: Maximum Saturated Depth over Landfill Liner
by Bruce M. McEnroe, University of Kansas
ASCE Journal of Environmental Engineering
Vol. 119, No. 2, March 1993, pp. 262-270.

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FINAL WATER STORAGE AT END OF YEAR 15

LAYER	(INCHES)	(VOL/VOL)
1	3.8614	0.3218
2	223.7125	0.3284
3	7.3200	0.6100
4	386.6956	0.6970
SNOW WATER	0.000	

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**                                                                          **
**                                                                          **
**              HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE               **
**                HELP MODEL VERSION 3.07  (1 NOVEMBER 1997)                **
**                 DEVELOPED BY ENVIRONMENTAL LABORATORY                    **
**                   USAE WATERWAYS EXPERIMENT STATION                      **
**             FOR USEPA RISK REDUCTION ENGINEERING LABORATORY              **
**                                                                          **
**                                                                          **
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PRECIPITATION DATA FILE:      P:\PRJ1\MDENG\HELP3\ME0250\PHASE3.D4
TEMPERATURE DATA FILE:        P:\PRJ1\MDENG\HELP3\ME0250\PHASE3.D7
SOLAR RADIATION DATA FILE:    P:\PRJ1\MDENG\HELP3\ME0250\PHASE3.D13
EVAPOTRANSPIRATION DATA:      P:\PRJ1\MDENG\HELP3\ME0250\PHASE3.D11
SOIL AND DESIGN DATA FILE:    P:\PRJ1\MDENG\HELP3\ME0250\CIL3B-3.D10
OUTPUT DATA FILE:             P:\PRJ1\MDENG\HELP3\ME0250\CIL3B-3.OUT


TIME:  11:20      DATE:   2/19/2003


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     TITLE:  CHERRY ISLAND LANDFILL PHASE III - RUN B

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     NOTE:  INITIAL MOISTURE CONTENT OF THE LAYERS AND SNOW WATER
              WERE SPECIFIED BY THE USER.


                                  LAYER  1
                                  --------

                   TYPE 1 - VERTICAL PERCOLATION LAYER
                       MATERIAL TEXTURE NUMBER  22
     THICKNESS                    =     12.00   INCHES
     POROSITY                     =      0.4190 VOL/VOL
     FIELD CAPACITY               =      0.3070 VOL/VOL
     WILTING POINT                =      0.1800 VOL/VOL
     INITIAL SOIL WATER CONTENT   =      0.3621 VOL/VOL
     EFFECTIVE SAT. HYD. COND.    = 0.189999992000E-04 CM/SEC
   NOTE:  SATURATED HYDRAULIC CONDUCTIVITY IS MULTIPLIED BY  1.80
            FOR ROOT CHANNELS IN TOP HALF OF EVAPORATIVE ZONE.


                                  LAYER  2
                                  --------

                   TYPE 1 - VERTICAL PERCOLATION LAYER
                       MATERIAL TEXTURE NUMBER   0
     THICKNESS                    =    321.10   INCHES
     POROSITY                     =      0.6100 VOL/VOL
     FIELD CAPACITY               =      0.2920 VOL/VOL
     WILTING POINT                =      0.0770 VOL/VOL
     INITIAL SOIL WATER CONTENT   =      0.0770 VOL/VOL
     EFFECTIVE SAT. HYD. COND.    = 0.100000005000E-02 CM/SEC


                                  LAYER  3
                                  --------

                   TYPE 2 - LATERAL DRAINAGE LAYER
                       MATERIAL TEXTURE NUMBER   1
     THICKNESS                    =     12.00   INCHES
     POROSITY                     =      0.4170 VOL/VOL
     FIELD CAPACITY               =      0.0450 VOL/VOL
     WILTING POINT                =      0.0180 VOL/VOL
     INITIAL SOIL WATER CONTENT   =      0.4170 VOL/VOL
     EFFECTIVE SAT. HYD. COND.    = 0.999999978000E-02 CM/SEC
     SLOPE                        =      1.50   PERCENT
     DRAINAGE LENGTH              =    230.0    FEET
     SUBSURFACE INFLOW            =      4.77   INCHES/YR


                                  LAYER  4
                                  --------

                   TYPE 3 - BARRIER SOIL LINER
                       MATERIAL TEXTURE NUMBER   0
     THICKNESS                    =    904.90   INCHES
     POROSITY                     =      0.6970 VOL/VOL
     FIELD CAPACITY               =      0.4180 VOL/VOL
     WILTING POINT                =      0.3670 VOL/VOL
     INITIAL SOIL WATER CONTENT   =      0.6970 VOL/VOL
     EFFECTIVE SAT. HYD. COND.    = 0.100000001000E-06 CM/SEC


                   GENERAL DESIGN AND EVAPORATIVE ZONE DATA
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     NOTE:  SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT
            SOIL DATA BASE USING SOIL TEXTURE #22 WITH A
            POOR STAND OF GRASS, A SURFACE SLOPE OF  2.%
            AND A SLOPE LENGTH OF 1200. FEET.

     SCS RUNOFF CURVE NUMBER                =     93.10
     FRACTION OF AREA ALLOWING RUNOFF       =    100.0    PERCENT
     AREA PROJECTED ON HORIZONTAL PLANE     =      1.000  ACRES
     EVAPORATIVE ZONE DEPTH                 =      9.0    INCHES
     INITIAL WATER IN EVAPORATIVE ZONE      =      3.259  INCHES
     UPPER LIMIT OF EVAPORATIVE STORAGE     =      3.771  INCHES
     LOWER LIMIT OF EVAPORATIVE STORAGE     =      1.620  INCHES
     INITIAL SNOW WATER                     =      0.000  INCHES
     INITIAL WATER IN LAYER MATERIALS       =    664.789  INCHES
     TOTAL INITIAL WATER                    =    664.789  INCHES
     TOTAL SUBSURFACE INFLOW                =      4.77   INCHES/YEAR


                   EVAPOTRANSPIRATION AND WEATHER DATA
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     NOTE:  EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
              WILMINGTON              DELAWARE

     STATION LATITUDE                       =  39.80 DEGREES
     MAXIMUM LEAF AREA INDEX                =   1.00
     START OF GROWING SEASON (JULIAN DATE)  =    107
     END OF GROWING SEASON (JULIAN DATE)    =    298
     EVAPORATIVE ZONE DEPTH                 =    9.0  INCHES
     AVERAGE ANNUAL WIND SPEED              =   9.20 MPH
     AVERAGE 1ST QUARTER RELATIVE HUMIDITY  =  67.00 %
     AVERAGE 2ND QUARTER RELATIVE HUMIDITY  =  67.00 %
     AVERAGE 3RD QUARTER RELATIVE HUMIDITY  =  72.00 %
     AVERAGE 4TH QUARTER RELATIVE HUMIDITY  =  71.00 %


     NOTE:  PRECIPITATION DATA FOR      CHERRY ISLAND LF
              WAS ENTERED BY THE USER.


     NOTE:  TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING
              COEFFICIENTS FOR     WILMINGTON          DELAWARE

            NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

     JAN/JUL   FEB/AUG   MAR/SEP   APR/OCT   MAY/NOV   JUN/DEC
     -------   -------   -------   -------   -------   -------
      33.20     41.80     52.40     62.20     71.20     35.50
      76.00     74.80     67.80     56.30     45.60     35.50


     NOTE:  SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
              COEFFICIENTS FOR     WILMINGTON          DELAWARE

            AND STATION LATITUDE  =  39.80 DEGREES


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                   MONTHLY TOTALS (IN INCHES) FOR YEAR    1
------------------------------------------------------------------------------

                          JAN/JUL  FEB/AUG  MAR/SEP  APR/OCT  MAY/NOV  JUN/DEC
                          -------  -------  -------  -------  -------  -------
PRECIPITATION              5.72     2.50     3.55     6.62     2.37     3.40
                           1.71     4.59     1.64     3.14     2.70     3.09

RUNOFF                     1.331    0.667    0.324    2.028    0.065    0.450
                           0.179    0.870    0.145    0.779    0.638    0.172

EVAPOTRANSPIRATION         0.919    1.789    2.389    4.043    2.405    3.069
                           1.547    3.817    1.594    1.383    1.810    1.124

SUBSURFACE INFLOW INTO     0.4051   0.3659   0.4051   0.3921   0.4051   0.3921
  LAYER  3                 0.4051   0.4051   0.3921   0.4051   0.3921   0.4051

LATERAL DRAINAGE COLLECTED 1.2953   1.0253   1.0223   0.9080   0.8769   0.8048
  FROM LAYER  3            0.7982   0.7732   0.7307   0.7417   0.7083   0.7246

PERCOLATION/LEAKAGE THROUGH 0.1067  0.0963   0.1065   0.1030   0.1063   0.1029
  LAYER  4                 0.1063   0.1062   0.1028   0.1062   0.1028   0.1062

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                   MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)
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AVERAGE DAILY HEAD ON     11.166   9.864    8.914    8.187    7.653    7.257
  TOP OF LAYER  4          6.966   6.748    6.590    6.473    6.387    6.323

STD. DEVIATION OF DAILY    0.467   0.308    0.251    0.179    0.136    0.097
  HEAD ON TOP OF LAYER  4  0.074   0.055    0.039    0.030    0.021    0.016
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                   ANNUAL TOTALS FOR YEAR    1
------------------------------------------------------------------------------
                                  INCHES        CU. FEET       PERCENT
                                  --------    ----------       -------
PRECIPITATION                      41.03      148938.891       100.00
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RUNOFF	7.648	27761.605	18.64
EVAPOTRANSPIRATION	25.889	93977.172	63.10
SUBSURFACE INFLOW INTO LAYER 3	4.770000	17315.100	11.63
DRAINAGE COLLECTED FROM LAYER 3	10.4094	37786.199	25.37
PERC./LEAKAGE THROUGH LAYER 4	1.252119	4545.192	3.05
AVG. HEAD ON TOP OF LAYER 4	7.7107		
CHANGE IN WATER STORAGE	5.372	19498.844	13.09
SOIL WATER AT START OF YEAR	664.789	2413184.750	
SOIL WATER AT END OF YEAR	670.161	2432683.500	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	-4.7700	-17315.016	-11.63

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MONTHLY TOTALS (IN INCHES) FOR YEAR 2

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	4.63	2.81	2.61	4.64	3.92	5.10
	5.22	6.98	10.80	0.60	4.39	3.09
RUNOFF	0.224	2.305	2.313	0.608	0.138	1.118
	1.935	2.555	4.683	0.009	0.702	0.365
EVAPOTRANSPIRATION	0.836	0.598	1.757	4.166	3.543	3.019
	2.872	3.648	4.301	0.670	1.128	0.743
SUBSURFACE INFLOW INTO LAYER 3	0.4051	0.3659	0.4051	0.3921	0.4051	0.3921
	0.4051	0.4051	0.3921	0.4051	0.3921	0.4051
LATERAL DRAINAGE COLLECTED FROM LAYER 3	0.7191	0.6461	0.7125	0.6873	0.7086	0.6846
	0.7066	0.7059	0.6827	0.7051	0.6821	0.7046
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.1062	0.0959	0.1062	0.1027	0.1062	0.1027
	0.1062	0.1062	0.1027	0.1062	0.1027	0.1062

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 4	6.276	6.242	6.217	6.198	6.184	6.174
	6.166	6.160	6.156	6.153	6.151	6.149
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 4	0.012	0.008	0.007	0.004	0.002	0.002
	0.000	0.000	0.002	0.003	0.002	0.000

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ANNUAL TOTALS FOR YEAR 2

	INCHES	CU. FEET	PERCENT
PRECIPITATION	54.79	198887.719	100.00
RUNOFF	16.955	61545.633	30.94
EVAPOTRANSPIRATION	27.282	99035.000	49.79
SUBSURFACE INFLOW INTO LAYER 3	4.770000	17315.100	8.71
DRAINAGE COLLECTED FROM LAYER 3	8.3452	30293.191	15.23
PERC./LEAKAGE THROUGH LAYER 4	1.250041	4537.650	2.28
AVG. HEAD ON TOP OF LAYER 4	6.1856		
CHANGE IN WATER STORAGE	10.498	38106.473	19.16
SOIL WATER AT START OF YEAR	670.161	2432683.500	
SOIL WATER AT END OF YEAR	680.234	2469250.750	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.424	1539.274	0.77
ANNUAL WATER BUDGET BALANCE	-4.7700	-17315.129	-8.71

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MONTHLY TOTALS (IN INCHES) FOR YEAR 3

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	3.98	2.12	4.68	3.52	3.38	4.46
	6.20	5.67	11.97	7.03	2.02	2.41
RUNOFF	2.601	0.056	1.851	0.529	0.149	0.650
	3.075	1.660	6.756	2.136	0.035	0.221
EVAPOTRANSPIRATION	0.977	1.488	2.428	2.267	2.970	4.532
	2.293	3.699	3.010	2.425	1.575	0.652
SUBSURFACE INFLOW INTO LAYER 3	0.4051	0.3659	0.4051	0.3921	0.4051	0.3921
	0.4051	0.4051	0.3921	0.4051	0.3921	0.4051
LATERAL DRAINAGE COLLECTED FROM LAYER 3	0.7045	0.6362	0.7043	0.6815	0.7042	0.6815
	0.7041	0.7041	0.6814	0.7041	0.6814	0.7041
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.1062	0.0959	0.1062	0.1027	0.1062	0.1027
	0.1062	0.1062	0.1027	0.1062	0.1027	0.1062

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 4	6.148	6.147	6.146	6.146	6.145	6.145
	6.145	6.145	6.145	6.145	6.145	6.144
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 4	0.004	0.002	0.000	0.000	0.000	0.001
	0.002	0.000	0.000	0.001	0.000	0.001

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ANNUAL TOTALS FOR YEAR 3

	INCHES	CU. FEET	PERCENT
PRECIPITATION	57.44	208507.234	100.00
RUNOFF	19.719	71580.711	34.33
EVAPOTRANSPIRATION	28.317	102790.859	49.30
SUBSURFACE INFLOW INTO LAYER 3	4.770000	17315.100	8.30
DRAINAGE COLLECTED FROM LAYER 3	8.2915	30098.035	14.44
PERC./LEAKAGE THROUGH LAYER 4	1.249992	4537.471	2.18
AVG. HEAD ON TOP OF LAYER 4	6.1454		
CHANGE IN WATER STORAGE	9.402	34130.172	16.37
SOIL WATER AT START OF YEAR	680.234	2469250.750	
SOIL WATER AT END OF YEAR	690.061	2504920.250	
SNOW WATER AT START OF YEAR	0.424	1539.274	0.74
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	-4.7699	-17314.912	-8.30

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MONTHLY TOTALS (IN INCHES) FOR YEAR 4

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	3.93	3.22	4.40	2.25	2.75	5.82
	10.86	3.65	1.43	1.67	2.93	2.27
RUNOFF	2.833	1.896	0.571	0.251	0.236	0.975
	4.690	0.721	0.219	0.241	0.588	0.544
EVAPOTRANSPIRATION	0.327	0.913	2.401	3.278	1.749	5.157
	5.907	2.744	0.597	1.788	1.575	0.925
SUBSURFACE INFLOW INTO LAYER 3	0.4051	0.3790	0.4051	0.3921	0.4051	0.3921
	0.4051	0.4051	0.3921	0.4051	0.3921	0.4051
LATERAL DRAINAGE COLLECTED FROM LAYER 3	0.7041	0.6587	0.7041	0.6814	0.7041	0.6814
	0.7041	0.7041	0.6814	0.7041	0.6814	0.7041
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.1062	0.0993	0.1062	0.1027	0.1062	0.1027
	0.1062	0.1062	0.1027	0.1062	0.1027	0.1062

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 4	6.144	6.144	6.144	6.144	6.144	6.144
	6.144	6.144	6.144	6.144	6.144	6.144

STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 4	0.000 0.005	0.003 0.000	0.003 0.000	0.006 0.000	0.000 0.006	0.005 0.006

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ANNUAL TOTALS FOR YEAR 4

	INCHES	CU. FEET	PERCENT
PRECIPITATION	45.18	164003.359	100.00
RUNOFF	13.766	49969.305	30.47
EVAPOTRANSPIRATION	27.359	99314.500	60.56
SUBSURFACE INFLOW INTO LAYER 3	4.783069	17362.539	10.59
DRAINAGE COLLECTED FROM LAYER 3	8.3127	30175.248	18.40
PERC./LEAKAGE THROUGH LAYER 4	1.253416	4549.898	2.77
AVG. HEAD ON TOP OF LAYER 4	6.1444		
CHANGE IN WATER STORAGE	4.055	14719.623	8.98
SOIL WATER AT START OF YEAR	690.061	2504920.250	
SOIL WATER AT END OF YEAR	694.116	2519639.750	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	-4.7831	-17362.672	-10.59

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MONTHLY TOTALS (IN INCHES) FOR YEAR 5

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	8.05 5.35	2.10 3.72	8.59 2.36	7.13 6.26	6.01 5.12	8.31 5.36
RUNOFF	3.667 1.937	1.947 0.658	3.621 0.475	2.519 2.495	1.370 1.831	3.046 2.224
EVAPOTRANSPIRATION	0.645 3.313	0.682 3.059	2.600 0.968	3.797 2.337	4.410 1.857	4.609 1.165
SUBSURFACE INFLOW INTO LAYER 3	0.4051 0.4051	0.3659 0.4051	0.4051 0.3921	0.3921 0.4051	0.4051 0.3921	0.3921 0.4051
LATERAL DRAINAGE COLLECTED FROM LAYER 3	0.7041 0.7041	0.6359 0.7041	0.7041 0.6814	0.6814 0.7041	0.7041 0.6814	0.6814 0.7041
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.1062 0.1062	0.0959 0.1062	0.1062 0.1027	0.1027 0.1062	0.1062 0.1027	0.1027 0.1062

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 4	6.144 6.144	6.144 6.144	6.144 6.144	6.144 6.144	6.144 6.144	6.144 6.144
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 4	0.002 0.004	0.001 0.004	0.003 0.004	0.000 0.004	0.002 0.004	0.006 0.004

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ANNUAL TOTALS FOR YEAR 5

	INCHES	CU. FEET	PERCENT
PRECIPITATION	68.36	248146.750	100.00
RUNOFF	25.791	93622.937	37.73
EVAPOTRANSPIRATION	29.442	106874.102	43.07
SUBSURFACE INFLOW INTO LAYER 3	4.770000	17315.100	6.98
DRAINAGE COLLECTED FROM LAYER 3	8.2900	30092.711	12.13
PERC./LEAKAGE THROUGH LAYER 4	1.249991	4537.467	1.83
AVG. HEAD ON TOP OF LAYER 4	6.1443		
CHANGE IN WATER STORAGE	13.127	47649.730	19.20
SOIL WATER AT START OF YEAR	694.116	2519639.750	
SOIL WATER AT END OF YEAR	707.242	2567289.500	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	-4.7700	-17315.105	-6.98

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MONTHLY TOTALS (IN INCHES) FOR YEAR 6

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	2.02 3.99	1.24 0.38	5.86 6.34	2.65 6.41	2.08 1.89	1.82 4.28
RUNOFF	0.298 1.605	0.464 0.000	0.947 1.925	0.226 3.251	0.030 0.066	0.193 1.322
EVAPOTRANSPIRATION	0.901 1.868	0.909 0.379	2.652 2.185	2.708 2.387	2.086 1.827	1.964 1.081
SUBSURFACE INFLOW INTO LAYER 3	0.4051 0.4051	0.3659 0.4051	0.4051 0.3921	0.3921 0.4051	0.4051 0.3921	0.3921 0.4051
LATERAL DRAINAGE COLLECTED FROM LAYER 3	0.7041 0.7041	0.6359 0.7041	0.7041 0.6814	0.6814 0.7041	0.7041 0.6814	0.6814 0.7041
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.1062 0.1062	0.0959 0.1062	0.1062 0.1027	0.1027 0.1062	0.1062 0.1027	0.1027 0.1062

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 4	6.144 6.144	6.144 6.144	6.144 6.144	6.144 6.144	6.144 6.144	6.144 6.144
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 4	0.004 0.004	0.005 0.004	0.004 0.004	0.004 0.004	0.004 0.004	0.004 0.004

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ANNUAL TOTALS FOR YEAR 6

	INCHES	CU. FEET	PERCENT
PRECIPITATION	38.96	141424.828	100.00
RUNOFF	10.327	37487.426	26.51
EVAPOTRANSPIRATION	20.946	76033.820	53.76
SUBSURFACE INFLOW INTO LAYER 3	4.770000	17315.100	12.24
DRAINAGE COLLECTED FROM LAYER 3	8.2900	30092.707	21.28
PERC./LEAKAGE THROUGH LAYER 4	1.249991	4537.467	3.21
AVG. HEAD ON TOP OF LAYER 4	6.1443		
CHANGE IN WATER STORAGE	7.687	27903.533	19.73
SOIL WATER AT START OF YEAR	707.242	2567289.500	
SOIL WATER AT END OF YEAR	714.498	2593629.500	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.431	1563.654	1.11
ANNUAL WATER BUDGET BALANCE	-4.7700	-17315.021	-12.24

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WARNING: TEMPERATURE FOR YEAR 7 USED WITH PRECIPITATION FOR YEAR 8

WARNING: SOLAR RADIATION FOR YEAR 7 USED WITH PRECIPITATION FOR YEAR 8

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MONTHLY TOTALS (IN INCHES) FOR YEAR 8

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	1.68 2.56	0.64 2.17	4.01 2.55	4.21 2.88	3.90 1.21	3.86 9.91
RUNOFF	0.511 0.392	0.194 0.236	0.606 0.267	0.407 0.170	0.217 0.046	0.448 3.966

EVAPOTRANSPIRATION	0.768	0.528	2.491	3.753	3.023	3.444
	2.354	1.705	2.341	1.853	1.591	1.121
SUBSURFACE INFLOW INTO LAYER 3	0.4051	0.3790	0.4051	0.3921	0.4051	0.3921
	0.4051	0.4051	0.3921	0.4051	0.3921	0.4051
LATERAL DRAINAGE COLLECTED FROM LAYER 3	0.7041	0.6587	0.7041	0.6814	0.7041	0.6814
	0.7041	0.7041	0.6814	0.7041	0.6814	0.7041
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.1062	0.0993	0.1062	0.1027	0.1062	0.1027
	0.1062	0.1062	0.1027	0.1062	0.1027	0.1062

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 4	6.144	6.144	6.144	6.144	6.144	6.144
	6.144	6.144	6.144	6.144	6.144	6.144
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 4	0.004	0.005	0.004	0.004	0.004	0.004
	0.004	0.004	0.004	0.004	0.004	0.004

ANNUAL TOTALS FOR YEAR 8

	INCHES	CU. FEET	PERCENT
PRECIPITATION	39.58	143675.406	100.00
RUNOFF	7.460	27078.967	18.85
EVAPOTRANSPIRATION	24.971	90644.437	63.09
SUBSURFACE INFLOW INTO LAYER 3	4.783069	17362.539	12.08
DRAINAGE COLLECTED FROM LAYER 3	8.3127	30175.154	21.00
PERC./LEAKAGE THROUGH LAYER 4	1.253416	4549.898	3.17
AVG. HEAD ON TOP OF LAYER 4	6.1443		
CHANGE IN WATER STORAGE	7.149	25951.896	18.06
SOIL WATER AT START OF YEAR	714.498	2593629.500	
SOIL WATER AT END OF YEAR	720.979	2617152.500	
SNOW WATER AT START OF YEAR	0.431	1563.654	1.09
SNOW WATER AT END OF YEAR	1.100	3992.557	2.78
ANNUAL WATER BUDGET BALANCE	-4.7830	-17362.404	-12.08

MONTHLY TOTALS (IN INCHES) FOR YEAR 8

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	0.95	4.60	4.09	0.64	3.91	2.40
	7.38	8.21	4.59	3.00	3.10	4.24
RUNOFF	0.023	0.849	0.477	0.000	1.578	0.499
	3.737	3.662	1.354	0.346	0.547	2.321
EVAPOTRANSPIRATION	1.364	1.691	2.815	0.812	1.810	1.361
	2.561	5.597	2.769	2.370	1.364	0.606
SUBSURFACE INFLOW INTO LAYER 3	0.4051	0.3790	0.4051	0.3921	0.4051	0.3921
	0.4051	0.4051	0.3921	0.4051	0.3921	0.4051
LATERAL DRAINAGE COLLECTED FROM LAYER 3	0.7041	0.6587	0.7041	0.6814	0.7041	0.6814
	0.7041	0.7041	0.6814	0.7041	0.6814	0.7041
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.1062	0.0993	0.1062	0.1027	0.1062	0.1027
	0.1062	0.1062	0.1027	0.1062	0.1027	0.1062

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 4	6.144	6.144	6.144	6.144	6.144	6.144
	6.144	6.144	6.144	6.144	6.144	6.144
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 4	0.004	0.005	0.004	0.004	0.004	0.004
	0.004	0.004	0.004	0.004	0.004	0.004

ANNUAL TOTALS FOR YEAR 8

	INCHES	CU. FEET	PERCENT
PRECIPITATION	47.11	171009.375	100.00
RUNOFF	15.393	55877.836	32.68
EVAPOTRANSPIRATION	25.121	91187.523	53.32
SUBSURFACE INFLOW INTO LAYER 3	4.783069	17362.539	10.15
DRAINAGE COLLECTED FROM LAYER 3	8.3127	30175.154	17.65
PERC./LEAKAGE THROUGH LAYER 4	1.253416	4549.898	2.66
AVG. HEAD ON TOP OF LAYER 4	6.1443		
CHANGE IN WATER STORAGE	6.596	23944.029	14.00
SOIL WATER AT START OF YEAR	720.979	2617152.500	
SOIL WATER AT END OF YEAR	727.899	2642274.000	
SNOW WATER AT START OF YEAR	1.100	3992.557	2.33
SNOW WATER AT END OF YEAR	0.775	2815.055	1.65
ANNUAL WATER BUDGET BALANCE	-4.7831	-17362.527	-10.15

MONTHLY TOTALS (IN INCHES) FOR YEAR 9

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	3.42	2.71	4.10	3.03	1.63	4.32
	5.60	3.22	2.02	1.94	2.77	3.04
RUNOFF	2.938	2.016	2.423	0.292	0.035	0.880
	1.175	0.457	0.121	0.312	0.106	0.325
EVAPOTRANSPIRATION	0.486	0.273	1.878	3.526	1.758	3.240
	2.990	3.679	1.441	2.096	1.166	0.724
SUBSURFACE INFLOW INTO LAYER 3	0.4051	0.3659	0.4051	0.3921	0.4051	0.3921
	0.4051	0.4051	0.3921	0.4051	0.3921	0.4051
LATERAL DRAINAGE COLLECTED FROM LAYER 3	0.7041	0.6359	0.7041	0.6814	0.7041	0.6814
	0.7041	0.7041	0.6814	0.7041	0.6814	0.7321
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.1062	0.0959	0.1062	0.1027	0.1062	0.1027
	0.1062	0.1062	0.1027	0.1062	0.1027	0.1062

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 4	6.144	6.144	6.144	6.144	6.144	6.144
	6.144	6.144	6.144	6.144	6.144	6.389
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 4	0.004	0.005	0.004	0.004	0.004	0.004
	0.004	0.004	0.004	0.004	0.004	0.487

ANNUAL TOTALS FOR YEAR 9

	INCHES	CU. FEET	PERCENT
PRECIPITATION	37.80	137213.984	100.00
RUNOFF	11.080	40221.016	29.31
EVAPOTRANSPIRATION	23.256	84420.398	61.52
SUBSURFACE INFLOW INTO LAYER 3	4.770000	17315.100	12.62
DRAINAGE COLLECTED FROM LAYER 3	8.3180	30194.402	22.01
PERC./LEAKAGE THROUGH LAYER 4	1.250019	4537.569	3.31
AVG. HEAD ON TOP OF LAYER 4	6.1647		
CHANGE IN WATER STORAGE	3.435	12470.768	9.09
SOIL WATER AT START OF YEAR	727.899	2642274.000	
SOIL WATER AT END OF YEAR	731.525	2655437.250	
SNOW WATER AT START OF YEAR	0.775	2815.055	2.05
SNOW WATER AT END OF YEAR	0.585	2122.642	1.55
ANNUAL WATER BUDGET BALANCE	-4.7700	-17315.066	-12.62

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MONTHLY TOTALS (IN INCHES) FOR YEAR 10

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	0.66	1.49	3.09	2.64	1.65	2.73
	2.67	1.56	3.30	2.64	5.00	1.38
RUNOFF	0.351	0.067	0.100	0.037	0.022	0.361
	0.261	0.005	0.247	0.409	1.353	0.149
EVAPOTRANSPIRATION	0.465	1.179	2.921	1.810	1.796	2.579
	2.516	1.488	3.333	1.213	1.440	0.826
SUBSURFACE INFLOW INTO LAYER 3	0.4051	0.3659	0.4051	0.3921	0.4051	0.3921
	0.4051	0.4051	0.3921	0.4051	0.3921	0.4051
LATERAL DRAINAGE COLLECTED FROM LAYER 3	0.8464	0.8116	1.1226	1.1213	1.0356	0.9189
	0.8875	0.8389	0.7861	0.7968	0.9979	1.3077
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.1063	0.0961	0.1066	0.1032	0.1065	0.1030
	0.1063	0.1063	0.1028	0.1063	0.1031	0.1068

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 4	7.386	7.841	9.752	10.059	9.027	8.286
	7.745	7.320	7.089	6.953	8.964	11.264
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 4	0.112	0.443	0.816	0.348	0.262	0.176
	0.145	0.106	0.041	0.073	1.473	0.461

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ANNUAL TOTALS FOR YEAR 10

	INCHES	CU. FEET	PERCENT
PRECIPITATION	28.81	104580.328	100.00
RUNOFF	3.361	12201.744	11.67
EVAPOTRANSPIRATION	21.566	78285.945	74.86
SUBSURFACE INFLOW INTO LAYER 3	4.770000	17315.100	16.56
DRAINAGE COLLECTED FROM LAYER 3	11.4714	41641.285	39.82
PERC./LEAKAGE THROUGH LAYER 4	1.253186	4.549.065	4.35
AVG. HEAD ON TOP OF LAYER 4	8.4740		
CHANGE IN WATER STORAGE	0.698	2532.373	2.42
SOIL WATER AT START OF YEAR	731.525	2655437.250	
SOIL WATER AT END OF YEAR	732.555	2659174.000	
SNOW WATER AT START OF YEAR	0.585	2122.642	2.03
SNOW WATER AT END OF YEAR	0.253	918.224	0.88
ANNUAL WATER BUDGET BALANCE	-4.7700	-17314.982	-16.56

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AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1 THROUGH 10

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	3.50	2.34	4.50	3.73	3.16	4.22
	5.15	4.02	4.70	3.56	3.11	3.91
STD. DEVIATIONS	2.29	1.12	1.69	1.99	1.35	1.89
	2.69	2.43	3.83	2.22	1.33	2.40
RUNOFF						
TOTALS	1.478	1.046	1.323	0.690	0.384	0.862
	1.899	1.082	1.619	1.015	0.591	1.161
STD. DEVIATIONS	1.388	0.897	1.163	0.864	0.581	0.821
	1.530	1.200	2.293	1.161	0.601	1.290
EVAPOTRANSPIRATION						
TOTALS	0.769	1.005	2.433	3.016	2.555	3.297
	2.822	2.981	2.254	1.852	1.533	0.897
STD. DEVIATIONS	0.303	0.516	0.370	1.097	0.911	1.197
	1.201	1.479	1.140	0.597	0.261	0.214
SUBSURFACE INFLOW INTO LAYER 3						
TOTALS	0.4051	0.3659	0.4051	0.3921	0.4051	0.3921
	0.4051	0.4051	0.3921	0.4051	0.3921	0.4051
LATERAL DRAINAGE COLLECTED FROM LAYER 3						
TOTALS	0.7790	0.7003	0.7786	0.7486	0.7550	0.7178
	0.7321	0.7247	0.6969	0.7172	0.7158	0.7694
STD. DEVIATIONS	0.1868	0.1259	0.1567	0.1490	0.1125	0.0806
	0.0621	0.0456	0.0350	0.0303	0.0995	0.1894
PERCOLATION/LEAKAGE THROUGH LAYER 4						
TOTALS	0.1062	0.0970	0.1062	0.1028	0.1062	0.1028
	0.1062	0.1062	0.1028	0.1062	0.1028	0.1062
STD. DEVIATIONS	0.0002	0.0016	0.0002	0.0002	0.0001	0.0001
	0.0001	0.0001	0.0000	0.0001	0.0001	0.0002

AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)

DAILY AVERAGE HEAD ON TOP OF LAYER 4						
AVERAGES	6.7842	6.6961	6.7896	6.7457	6.5876	6.4728
	6.3888	6.3239	6.2845	6.2590	6.4512	6.6991
STD. DEVIATIONS	1.5876	1.2331	1.3551	1.3286	0.9789	0.7263
	0.5417	0.3979	0.3152	0.2648	0.8861	1.6064

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AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1 THROUGH 10

	INCHES		CU. FEET	PERCENT
PRECIPITATION	45.91	(11.490)	166638.8	100.00
RUNOFF	13.150	(6.6129)	47734.71	28.646
EVAPOTRANSPIRATION	25.415	(2.8257)	92256.37	55.363
SUBSURFACE INFLOW INTO LAYER 3	4.77000		17315.100	10.39080
LATERAL DRAINAGE COLLECTED FROM LAYER 3	8.83537	(1.13747)	32072.406	19.24666
PERCOLATION/LEAKAGE THROUGH LAYER 4	1.25156	(0.00169)	4543.158	2.72635
AVERAGE HEAD ON TOP OF LAYER 4	6.540	(0.838)		
CHANGE IN WATER STORAGE	6.802	(3.6447)	24690.74	14.817

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PEAK DAILY VALUES FOR YEARS 1 THROUGH 10

	(INCHES)	(CU. FT.)
PRECIPITATION	5.15	18694.500
RUNOFF	4.059	14734.7588
DRAINAGE COLLECTED FROM LAYER 3	0.04513	163.82652
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.003447	12.51095
AVERAGE HEAD ON TOP OF LAYER 4	11.977	
MAXIMUM HEAD ON TOP OF LAYER 4	15.183	
LOCATION OF MAXIMUM HEAD IN LAYER 3 (DISTANCE FROM DRAIN)	87.0 FEET	
SNOW WATER	4.52	16418.6836

MAXIMUM VEG. SOIL WATER (VOL/VOL)	0.4069
MINIMUM VEG. SOIL WATER (VOL/VOL)	0.1800

*** Maximum heads are computed using McEnroe's equations. ***

Reference: Maximum Saturated Depth over Landfill Liner
by Bruce M. McEnroe, University of Kansas
ASCE Journal of Environmental Engineering
Vol. 119, No. 2, March 1993, pp. 262-270.

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FINAL WATER STORAGE AT END OF YEAR 10

LAYER	(INCHES)	(VOL/VOL)
1	3.6324	0.3027
2	93.7612	0.2920
3	4.4459	0.3705
4	630.7153	0.6970
SNOW WATER	0.253	

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**              HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE               **
**                   HELP MODEL VERSION 3.07  (1 NOVEMBER 1997)             **
**                     DEVELOPED BY ENVIRONMENTAL LABORATORY                **
**                       USAE WATERWAYS EXPERIMENT STATION                  **
**              FOR USEPA RISK REDUCTION ENGINEERING LABORATORY             **
**                                                                          **
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PRECIPITATION DATA FILE:      P:\PRJ1\MDENG\HELP3\ME0250\PHASE4.D4
TEMPERATURE DATA FILE:        P:\PRJ1\MDENG\HELP3\ME0250\PHASE4.D7
SOLAR RADIATION DATA FILE:    P:\PRJ1\MDENG\HELP3\ME0250\PHASE4.D13
EVAPOTRANSPIRATION DATA:      P:\PRJ1\MDENG\HELP3\ME0250\PHASE4.D11
SOIL AND DESIGN DATA FILE:    P:\PRJ1\MDENG\HELP3\ME0250\CIL4B-3.D10
OUTPUT DATA FILE:             P:\PRJ1\MDENG\HELP3\ME0250\CIL4B-3.OUT


TIME:  15:17      DATE:  12/20/2002


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     TITLE:  CHERRY ISLAND LANDFILL PHASE IV - RUN B

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     NOTE:  INITIAL MOISTURE CONTENT OF THE LAYERS AND SNOW WATER
              WERE SPECIFIED BY THE USER.


                                  LAYER  1
                                  --------

                     TYPE 1 - VERTICAL PERCOLATION LAYER
                        MATERIAL TEXTURE NUMBER  22
   THICKNESS                    =      12.00   INCHES
   POROSITY                     =       0.4190 VOL/VOL
   FIELD CAPACITY               =       0.3070 VOL/VOL
   WILTING POINT                =       0.1800 VOL/VOL
   INITIAL SOIL WATER CONTENT   =       0.3621 VOL/VOL
   EFFECTIVE SAT. HYD. COND.    =  0.189999992000E-04 CM/SEC
  NOTE:  SATURATED HYDRAULIC CONDUCTIVITY IS MULTIPLIED BY  1.80
           FOR ROOT CHANNELS IN TOP HALF OF EVAPORATIVE ZONE.


                                  LAYER  2
                                  --------

                     TYPE 1 - VERTICAL PERCOLATION LAYER
                        MATERIAL TEXTURE NUMBER   0
   THICKNESS                    =     302.20   INCHES
   POROSITY                     =       0.6100 VOL/VOL
   FIELD CAPACITY               =       0.2920 VOL/VOL
   WILTING POINT                =       0.0770 VOL/VOL
   INITIAL SOIL WATER CONTENT   =       0.0770 VOL/VOL
   EFFECTIVE SAT. HYD. COND.    =  0.100000005000E-02 CM/SEC


                                  LAYER  3
                                  --------

                     TYPE 2 - LATERAL DRAINAGE LAYER
                        MATERIAL TEXTURE NUMBER   1
   THICKNESS                    =      12.00   INCHES
   POROSITY                     =       0.4170 VOL/VOL
   FIELD CAPACITY               =       0.0450 VOL/VOL
   WILTING POINT                =       0.0180 VOL/VOL
   INITIAL SOIL WATER CONTENT   =       0.4170 VOL/VOL
   EFFECTIVE SAT. HYD. COND.    =  0.999999978000E-02 CM/SEC
   SLOPE                        =       2.00   PERCENT
   DRAINAGE LENGTH              =      60.0    FEET
   SUBSURFACE INFLOW            =       6.23   INCHES/YR


                                  LAYER  4
                                  --------

                     TYPE 3 - BARRIER SOIL LINER
                        MATERIAL TEXTURE NUMBER   0
   THICKNESS                    =     947.80   INCHES
   POROSITY                     =       0.6970 VOL/VOL
   FIELD CAPACITY               =       0.4180 VOL/VOL
   WILTING POINT                =       0.3670 VOL/VOL
   INITIAL SOIL WATER CONTENT   =       0.6970 VOL/VOL
   EFFECTIVE SAT. HYD. COND.    =  0.100000001000E-06 CM/SEC


                     GENERAL DESIGN AND EVAPORATIVE ZONE DATA
                     ----------------------------------------

     NOTE:  SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT

            SOIL DATA BASE USING SOIL TEXTURE #22 WITH A
            POOR STAND OF GRASS, A SURFACE SLOPE OF  2.%
            AND A SLOPE LENGTH OF 1200. FEET.

   SCS RUNOFF CURVE NUMBER                =     93.10
   FRACTION OF AREA ALLOWING RUNOFF       =    100.0    PERCENT
   AREA PROJECTED ON HORIZONTAL PLANE     =      1.000  ACRES
   EVAPORATIVE ZONE DEPTH                 =      9.0    INCHES
   INITIAL WATER IN EVAPORATIVE ZONE      =      3.259  INCHES
   UPPER LIMIT OF EVAPORATIVE STORAGE     =      3.771  INCHES
   LOWER LIMIT OF EVAPORATIVE STORAGE     =      1.620  INCHES
   INITIAL SNOW WATER                     =      0.000  INCHES
   INITIAL WATER IN LAYER MATERIALS       =    693.235  INCHES
   TOTAL INITIAL WATER                    =    693.235  INCHES
   TOTAL SUBSURFACE INFLOW                =      6.23   INCHES/YEAR


                     EVAPOTRANSPIRATION AND WEATHER DATA
                     -----------------------------------

     NOTE:  EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
              WILMINGTON              DELAWARE

       STATION LATITUDE                          =  39.80 DEGREES
       MAXIMUM LEAF AREA INDEX                   =   1.00
       START OF GROWING SEASON (JULIAN DATE)     =    107
       END OF GROWING SEASON (JULIAN DATE)       =    298
       EVAPORATIVE ZONE DEPTH                    =   9.0  INCHES
       AVERAGE ANNUAL WIND SPEED                 =   9.20 MPH
       AVERAGE 1ST QUARTER RELATIVE HUMIDITY     =  67.00 %
       AVERAGE 2ND QUARTER RELATIVE HUMIDITY     =  67.00 %
       AVERAGE 3RD QUARTER RELATIVE HUMIDITY     =  72.00 %
       AVERAGE 4TH QUARTER RELATIVE HUMIDITY     =  71.00 %

     NOTE:  PRECIPITATION DATA FOR     CHERRY ISLAND LF
              WAS ENTERED BY THE USER.

     NOTE:  TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING
              COEFFICIENTS FOR     WILMINGTON          DELAWARE

            NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

   JAN/JUL   FEB/AUG   MAR/SEP   APR/OCT   MAY/NOV   JUN/DEC
   -------   -------   -------   -------   -------   -------
   31.20     33.20     41.80     52.40     62.20     71.20
   76.00     74.80     67.80     56.30     45.60     35.50

     NOTE:  SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
              COEFFICIENTS FOR     WILMINGTON          DELAWARE

            AND STATION LATITUDE  =  39.80 DEGREES

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                     MONTHLY TOTALS (IN INCHES) FOR YEAR    1
------------------------------------------------------------------------------

                          JAN/JUL  FEB/AUG  MAR/SEP  APR/OCT  MAY/NOV  JUN/DEC
                          -------  -------  -------  -------  -------  -------
PRECIPITATION             4.63     2.81     2.61     4.64     3.92     5.10
                          5.22     6.98    10.80     0.60     4.39     3.09

RUNOFF                    0.929    0.305    0.060    0.621    0.153    1.316
                          1.848    2.596    4.728    0.009    0.703    0.293

EVAPOTRANSPIRATION        1.264    1.484    2.474    3.492    3.623    2.505
                          2.548    3.316    3.794    0.671    1.128    1.057

SUBSURFACE INFLOW INTO    0.5291   0.4779   0.5291   0.5121   0.5291   0.5121
  LAYER  3                0.5291   0.5291   0.5121   0.5291   0.5121   0.5291

LATERAL DRAINAGE COLLECTED 4.1664  1.3509   1.0750   0.9466   0.9580   0.9230
  FROM LAYER  3           0.9529   0.9527   0.9219   0.9526   0.9219   0.9526

PERCOLATION/LEAKAGE THROUGH 0.1061 0.0955   0.1057   0.1022   0.1056   0.1022
  LAYER  4                0.1056   0.1056   0.1022   0.1056   0.1022   0.1056

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                     MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)
------------------------------------------------------------------------------

AVERAGE DAILY HEAD ON     6.255    2.553    1.836    1.670    1.636    1.629
  TOP OF LAYER  4         1.627    1.627    1.627    1.627    1.627    1.627

STD. DEVIATION OF DAILY   2.411    0.383    0.095    0.019    0.004    0.001
  HEAD ON TOP OF LAYER  4 0.001    0.001    0.000    0.000    0.001    0.001

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                     ANNUAL TOTALS FOR YEAR    1
------------------------------------------------------------------------------
                          INCHES        CU. FEET      PERCENT
                          --------      ----------    -------
PRECIPITATION               54.79       198887.719    100.00
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RUNOFF	13.562	49228.465	24.75
EVAPOTRANSPIRATION	27.357	99305.359	49.93
SUBSURFACE INFLOW INTO LAYER 3	6.230000	22614.900	11.37
DRAINAGE COLLECTED FROM LAYER 3	15.0745	54720.383	27.51
PERC./LEAKAGE THROUGH LAYER 4	1.244323	4516.893	2.27
AVG. HEAD ON TOP OF LAYER 4	2.1117		
CHANGE IN WATER STORAGE	10.013	36346.305	18.27
SOIL WATER AT START OF YEAR	693.235	2516443.750	
SOIL WATER AT END OF YEAR	703.248	2552790.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	-6.2300	-22614.783	-11.37

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MONTHLY TOTALS (IN INCHES) FOR YEAR 2

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	3.98	2.12	4.68	3.52	3.38	4.46
	6.20	5.67	11.97	7.03	2.02	2.41
RUNOFF	0.135	2.446	3.561	0.500	0.155	0.669
	3.151	1.641	6.778	2.206	0.034	0.264
EVAPOTRANSPIRATION	0.696	0.637	1.903	2.629	2.679	4.604
	2.055	3.652	3.200	2.482	1.675	0.835
SUBSURFACE INFLOW INTO LAYER 3	0.5291	0.4779	0.5291	0.5121	0.5291	0.5121
	0.5291	0.5291	0.5121	0.5291	0.5121	0.5291
LATERAL DRAINAGE COLLECTED FROM LAYER 3	0.9526	0.8604	0.9526	0.9219	0.9526	0.9219
	0.9526	0.9526	0.9219	0.9526	0.9219	0.9526
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.1056	0.0954	0.1056	0.1022	0.1056	0.1022
	0.1056	0.1056	0.1022	0.1056	0.1022	0.1056

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 4	1.627	1.627	1.627	1.627	1.627	1.627
	1.627	1.627	1.627	1.627	1.627	1.627
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 4	0.001	0.001	0.001	0.001	0.001	0.001
	0.001	0.001	0.001	0.001	0.001	0.001

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ANNUAL TOTALS FOR YEAR 2

	INCHES	CU. FEET	PERCENT
PRECIPITATION	57.44	208507.234	100.00
RUNOFF	21.542	78196.078	37.50
EVAPOTRANSPIRATION	27.048	98182.844	47.09
SUBSURFACE INFLOW INTO LAYER 3	6.230000	22614.900	10.85
DRAINAGE COLLECTED FROM LAYER 3	11.2163	40715.141	19.53
PERC./LEAKAGE THROUGH LAYER 4	1.243686	4514.580	2.17
AVG. HEAD ON TOP OF LAYER 4	1.6268		
CHANGE IN WATER STORAGE	8.851	32128.303	15.41
SOIL WATER AT START OF YEAR	703.248	2552790.000	
SOIL WATER AT END OF YEAR	711.576	2583021.500	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.523	1896.765	0.91
ANNUAL WATER BUDGET BALANCE	-6.2300	-22614.801	-10.85

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MONTHLY TOTALS (IN INCHES) FOR YEAR 3

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	3.93	3.22	3.86	2.79	1.90	6.67
	10.86	3.62	1.46	1.67	2.93	2.27
RUNOFF	2.615	0.314	0.474	0.328	0.146	1.093
	4.685	0.709	0.217	0.181	0.595	0.433
EVAPOTRANSPIRATION	0.976	1.274	2.299	3.352	1.647	4.949
	5.809	3.019	0.661	2.049	1.422	0.715
SUBSURFACE INFLOW INTO LAYER 3	0.5291	0.4779	0.5291	0.5121	0.5291	0.5121
	0.5291	0.5291	0.5121	0.5291	0.5121	0.5291
LATERAL DRAINAGE COLLECTED FROM LAYER 3	0.9526	0.8604	0.9526	0.9219	0.9526	0.9219
	0.9526	0.9526	0.9219	0.9526	0.9219	0.9526
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.1056	0.0954	0.1056	0.1022	0.1056	0.1022
	0.1056	0.1056	0.1022	0.1056	0.1022	0.1056

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 4	1.627	1.627	1.627	1.627	1.627	1.627
	1.627	1.627	1.627	1.627	1.627	1.627
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 4	0.001	0.001	0.001	0.001	0.001	0.001
	0.001	0.001	0.001	0.001	0.001	0.001

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ANNUAL TOTALS FOR YEAR 3

	INCHES	CU. FEET	PERCENT
PRECIPITATION	45.18	164003.359	100.00
RUNOFF	11.791	42799.824	26.10
EVAPOTRANSPIRATION	28.170	102257.172	62.35
SUBSURFACE INFLOW INTO LAYER 3	6.230000	22614.900	13.79
DRAINAGE COLLECTED FROM LAYER 3	11.2163	40715.141	24.83
PERC./LEAKAGE THROUGH LAYER 4	1.243686	4514.580	2.75
AVG. HEAD ON TOP OF LAYER 4	1.6268		
CHANGE IN WATER STORAGE	5.219	18946.488	11.55
SOIL WATER AT START OF YEAR	711.576	2583021.500	
SOIL WATER AT END OF YEAR	717.318	2603864.750	
SNOW WATER AT START OF YEAR	0.523	1896.765	1.16
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	-6.2300	-22614.943	-13.79

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MONTHLY TOTALS (IN INCHES) FOR YEAR 4

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	8.05	2.10	8.59	9.03	4.39	8.03
	5.35	3.72	2.36	6.26	5.12	5.83
RUNOFF	4.322	3.488	2.832	3.263	0.597	3.065
	1.937	0.670	0.473	2.486	1.845	2.192
EVAPOTRANSPIRATION	0.480	1.223	1.926	4.035	4.222	4.537
	3.407	2.904	1.059	2.347	1.676	1.085
SUBSURFACE INFLOW INTO LAYER 3	0.5291	0.4950	0.5291	0.5121	0.5291	0.5121
	0.5291	0.5291	0.5121	0.5291	0.5121	0.5291
LATERAL DRAINAGE COLLECTED FROM LAYER 3	0.9526	0.8912	0.9526	0.9219	0.9526	0.9219
	0.9526	0.9526	0.9219	0.9526	0.9219	0.9526
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.1056	0.0988	0.1056	0.1022	0.1056	0.1022
	0.1056	0.1056	0.1022	0.1056	0.1022	0.1056

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 4	1.627	1.627	1.627	1.627	1.627	1.627
	1.627	1.627	1.627	1.627	1.627	1.627

STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 4	0.001 0.001	0.001 0.001	0.001 0.001	0.001 0.001	0.001 0.001	0.001 0.001

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ANNUAL TOTALS FOR YEAR 4

	INCHES	CU. FEET	PERCENT
PRECIPITATION	68.83	249852.844	100.00
RUNOFF	27.171	98630.359	39.48
EVAPOTRANSPIRATION	28.899	104904.781	41.99
SUBSURFACE INFLOW INTO LAYER 3	6.247069	22676.859	9.08
DRAINAGE COLLECTED FROM LAYER 3	11.2470	40826.687	16.34
PERC./LEAKAGE THROUGH LAYER 4	1.247093	4526.949	1.81
AVG. HEAD ON TOP OF LAYER 4	1.6268		
CHANGE IN WATER STORAGE	12.760	46317.789	18.54
SOIL WATER AT START OF YEAR	717.318	2603864.750	
SOIL WATER AT END OF YEAR	729.658	2648658.500	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.420	1524.157	0.61
ANNUAL WATER BUDGET BALANCE	-6.2471	-22676.859	-9.08

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MONTHLY TOTALS (IN INCHES) FOR YEAR 5

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	2.02 3.99	1.24 0.38	5.86 6.34	2.65 6.41	2.08 1.89	1.82 4.28
RUNOFF	0.569 1.656	0.613 0.000	0.956 1.939	0.278 3.211	0.029 0.069	0.193 0.926
EVAPOTRANSPIRATION	0.783 1.744	0.573 0.326	2.731 1.930	2.413 2.714	2.164 1.977	1.885 1.074
SUBSURFACE INFLOW INTO LAYER 3	0.5291 0.5291	0.4779 0.5291	0.5291 0.5121	0.5121 0.5291	0.5291 0.5121	0.5121 0.5291
LATERAL DRAINAGE COLLECTED FROM LAYER 3	0.9526 0.9526	0.8604 0.9526	0.9526 0.9219	0.9219 0.9526	0.9526 0.9219	0.9219 0.9526
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.1056 0.1056	0.0954 0.1056	0.1056 0.1022	0.1022 0.1056	0.1056 0.1022	0.1022 0.1056

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 4	1.627 1.627	1.627 1.627	1.627 1.627	1.627 1.627	1.627 1.627	1.627 1.627
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 4	0.001 0.001	0.001 0.001	0.001 0.001	0.001 0.001	0.001 0.001	0.001 0.001

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ANNUAL TOTALS FOR YEAR 5

	INCHES	CU. FEET	PERCENT
PRECIPITATION	38.96	141424.828	100.00
RUNOFF	10.438	37890.098	26.79
EVAPOTRANSPIRATION	20.314	73741.281	52.14
SUBSURFACE INFLOW INTO LAYER 3	6.230000	22614.900	15.99
DRAINAGE COLLECTED FROM LAYER 3	11.2163	40715.141	28.79
PERC./LEAKAGE THROUGH LAYER 4	1.243686	4514.580	3.19
AVG. HEAD ON TOP OF LAYER 4	1.6268		
CHANGE IN WATER STORAGE	8.208	29793.455	21.07
SOIL WATER AT START OF YEAR	729.658	2648658.500	
SOIL WATER AT END OF YEAR	738.285	2679976.000	
SNOW WATER AT START OF YEAR	0.420	1524.157	1.08
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	-6.2300	-22614.832	-15.99

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MONTHLY TOTALS (IN INCHES) FOR YEAR 6

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	1.68 2.56	0.64 1.74	4.01 2.98	4.21 2.88	3.90 1.21	3.86 8.76
RUNOFF	0.280 0.409	0.302 0.230	0.434 0.269	0.395 0.168	0.234 0.045	0.497 4.493
EVAPOTRANSPIRATION	0.867 2.004	1.075 2.062	2.603 2.259	4.268 1.934	2.634 1.751	3.559 1.064
SUBSURFACE INFLOW INTO LAYER 3	0.5291 0.5291	0.4779 0.5291	0.5291 0.5121	0.5121 0.5291	0.5291 0.5121	0.5121 0.5291
LATERAL DRAINAGE COLLECTED FROM LAYER 3	0.9526 0.9526	0.8604 0.9526	0.9526 0.9219	0.9219 0.9526	0.9526 0.9219	0.9219 0.9526
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.1056 0.1056	0.0954 0.1056	0.1056 0.1022	0.1022 0.1056	0.1056 0.1022	0.1022 0.1056

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 4	1.627 1.627	1.627 1.627	1.627 1.627	1.627 1.627	1.627 1.627	1.627 1.627
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 4	0.001 0.001	0.001 0.001	0.001 0.001	0.001 0.001	0.001 0.001	0.001 0.001

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ANNUAL TOTALS FOR YEAR 6

	INCHES	CU. FEET	PERCENT
PRECIPITATION	38.43	139500.906	100.00
RUNOFF	7.756	28153.234	20.18
EVAPOTRANSPIRATION	26.081	94674.023	67.87
SUBSURFACE INFLOW INTO LAYER 3	6.230000	22614.900	16.21
DRAINAGE COLLECTED FROM LAYER 3	11.2163	40715.141	29.19
PERC./LEAKAGE THROUGH LAYER 4	1.243686	4514.580	3.24
AVG. HEAD ON TOP OF LAYER 4	1.6268		
CHANGE IN WATER STORAGE	4.593	16673.584	11.95
SOIL WATER AT START OF YEAR	738.285	2679976.000	
SOIL WATER AT END OF YEAR	742.488	2695231.250	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.391	1418.454	1.02
ANNUAL WATER BUDGET BALANCE	-6.2300	-22614.756	-16.21

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MONTHLY TOTALS (IN INCHES) FOR YEAR 7

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	0.95 2.68	4.60 12.91	4.04 4.59	0.69 3.00	3.91 3.10	2.40 4.24
RUNOFF	0.000 0.281	3.856 7.192	1.053 1.354	0.000 0.321	1.578 0.532	0.497 1.794
EVAPOTRANSPIRATION	0.636 2.600	0.527 5.573	2.213 2.679	1.236 2.207	1.704 1.571	1.543 1.151
SUBSURFACE INFLOW INTO LAYER 3	0.5291 0.5291	0.4779 0.5291	0.5291 0.5121	0.5121 0.5291	0.5291 0.5121	0.5121 0.5291

LATERAL DRAINAGE COLLECTED	0.9526	0.8604	0.9526	0.9219	0.9526	0.9219
FROM LAYER 3	0.9526	0.9526	0.9219	0.9526	0.9219	0.9526
PERCOLATION/LEAKAGE THROUGH	0.1056	0.0954	0.1056	0.1022	0.1056	0.1022
LAYER 4	0.1056	0.1056	0.1022	0.1056	0.1022	0.1056

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON	1.627	1.627	1.627	1.627	1.627	1.627
TOP OF LAYER 4	1.627	1.627	1.627	1.627	1.627	1.627
STD. DEVIATION OF DAILY	0.001	0.001	0.001	0.001	0.001	0.001
HEAD ON TOP OF LAYER 4	0.001	0.001	0.001	0.001	0.001	0.001

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ANNUAL TOTALS FOR YEAR 7

	INCHES	CU. FEET	PERCENT
PRECIPITATION	47.11	171009.375	100.00
RUNOFF	18.457	66999.781	39.18
EVAPOTRANSPIRATION	23.640	85813.102	50.18
SUBSURFACE INFLOW INTO LAYER 3	6.230000	22614.900	13.22
DRAINAGE COLLECTED FROM LAYER 3	11.2163	40715.141	23.81
PERC./LEAKAGE THROUGH LAYER 4	1.243686	4514.580	2.64
AVG. HEAD ON TOP OF LAYER 4	1.6268		
CHANGE IN WATER STORAGE	5.013	18196.445	10.64
SOIL WATER AT START OF YEAR	742.488	2695231.250	
SOIL WATER AT END OF YEAR	747.211	2712376.000	
SNOW WATER AT START OF YEAR	0.391	1418.454	0.83
SNOW WATER AT END OF YEAR	0.680	2470.108	1.44
ANNUAL WATER BUDGET BALANCE	-6.2300	-22614.773	-13.22

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SUBSURFACE INFLOW INTO LAYER 3	6.247069	22676.859	16.53
DRAINAGE COLLECTED FROM LAYER 3	11.2470	40826.687	29.75
PERC./LEAKAGE THROUGH LAYER 4	1.247093	4526.949	3.30
AVG. HEAD ON TOP OF LAYER 4	1.6268		
CHANGE IN WATER STORAGE	5.519	20033.779	14.60
SOIL WATER AT START OF YEAR	747.211	2712376.000	
SOIL WATER AT END OF YEAR	752.691	2732267.250	
SNOW WATER AT START OF YEAR	0.680	2470.108	1.80
SNOW WATER AT END OF YEAR	0.720	2612.444	1.90
ANNUAL WATER BUDGET BALANCE	-6.2470	-22676.781	-16.53

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MONTHLY TOTALS (IN INCHES) FOR YEAR 9

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	0.66	1.49	3.09	2.64	1.65	2.73
	2.67	1.56	3.30	2.64	5.00	1.38
RUNOFF	0.742	0.952	2.548	0.039	0.022	0.382
	0.255	0.004	0.232	0.408	1.178	0.000
EVAPOTHANSPIRATION	0.320	0.194	1.562	1.786	1.864	2.824
	2.301	1.358	3.375	1.225	1.550	0.900
SUBSURFACE INFLOW INTO	0.5291	0.4779	0.5291	0.5121	0.5291	0.5121
LAYER 3	0.5291	0.5291	0.5121	0.5291	0.5121	0.5291
LATERAL DRAINAGE COLLECTED	0.9526	0.8604	0.9526	0.9219	0.9526	0.9219
FROM LAYER 3	0.9526	0.9526	0.9219	0.9526	1.8789	1.9596
PERCOLATION/LEAKAGE THROUGH	0.1056	0.0954	0.1056	0.1022	0.1056	0.1022
LAYER 4	0.1056	0.1056	0.1022	0.1056	0.1024	0.1058

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

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MONTHLY TOTALS (IN INCHES) FOR YEAR 8

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	3.42	2.71	4.10	3.22	1.44	4.36
	5.56	3.22	3.06	0.90	2.77	3.04
RUNOFF	0.897	0.300	0.541	0.286	0.035	0.850
	1.107	0.461	0.331	0.117	0.228	0.688
EVAPOTRANSPIRATION	1.418	1.708	2.800	3.688	1.448	3.384
	3.262	3.411	1.429	2.007	1.282	0.604
SUBSURFACE INFLOW INTO	0.5291	0.4950	0.5291	0.5121	0.5291	0.5121
LAYER 3	0.5291	0.5291	0.5121	0.5291	0.5121	0.5291
LATERAL DRAINAGE COLLECTED	0.9526	0.8912	0.9526	0.9219	0.9526	0.9219
FROM LAYER 3	0.9526	0.9526	0.9219	0.9526	0.9219	0.9526
PERCOLATION/LEAKAGE THROUGH	0.1056	0.0988	0.1056	0.1022	0.1056	0.1022
LAYER 4	0.1056	0.1056	0.1022	0.1056	0.1022	0.1056

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON	1.627	1.627	1.627	1.627	1.627	1.627
TOP OF LAYER 4	1.627	1.627	1.627	1.627	1.627	1.627
STD. DEVIATION OF DAILY	0.001	0.001	0.001	0.001	0.001	0.001
HEAD ON TOP OF LAYER 4	0.001	0.001	0.001	0.001	0.001	0.001

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ANNUAL TOTALS FOR YEAR 8

	INCHES	CU. FEET	PERCENT
PRECIPITATION	37.80	137213.984	100.00
RUNOFF	5.840	21197.646	15.45
EVAPOTRANSPIRATION	26.441	95982.562	69.95

AVERAGE DAILY HEAD ON	1.627	1.627	1.627	1.627	1.627	1.627
TOP OF LAYER 4	1.627	1.627	1.627	1.627	3.269	3.314
STD. DEVIATION OF DAILY	0.001	0.001	0.001	0.001	0.001	0.001
HEAD ON TOP OF LAYER 4	0.001	0.001	0.001	0.001	1.068	0.741

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ANNUAL TOTALS FOR YEAR 9

	INCHES	CU. FEET	PERCENT
PRECIPITATION	28.81	104580.328	100.00
RUNOFF	6.763	24550.859	23.48
EVAPOTRANSPIRATION	19.260	69912.078	66.85
SUBSURFACE INFLOW INTO LAYER 3	6.230000	22614.900	21.62
DRAINAGE COLLECTED FROM LAYER 3	13.1803	47844.332	45.75
PERC./LEAKAGE THROUGH LAYER 4	1.244050	4515.902	4.32
AVG. HEAD ON TOP OF LAYER 4	1.9042		
CHANGE IN WATER STORAGE	0.823	2986.977	2.86
SOIL WATER AT START OF YEAR	752.691	2732267.250	
SOIL WATER AT END OF YEAR	753.698	2735925.500	
SNOW WATER AT START OF YEAR	0.720	2612.444	2.50
SNOW WATER AT END OF YEAR	0.535	1941.283	1.86
ANNUAL WATER BUDGET BALANCE	-6.2300	-22614.920	-21.62

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AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1 THROUGH 9

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	3.26	2.33	4.54	3.71	2.95	4.38
	5.01	4.42	5.21	3.49	3.16	3.92
STD. DEVIATIONS	2.29	1.18	1.77	2.29	1.16	2.02
	2.60	3.78	3.78	2.46	1.40	2.24
RUNOFF						
TOTALS	1.165	1.398	1.384	0.634	0.328	0.952
	1.703	1.500	1.814	1.012	0.581	1.231
STD. DEVIATIONS	1.411	1.462	1.259	1.005	0.501	0.868
	1.467	2.294	2.366	1.249	0.607	1.425
EVAPOTRANSPIRATION						
TOTALS	0.827	0.966	2.279	2.989	2.443	3.310
	2.859	2.847	2.265	1.959	1.559	0.943
STD. DEVIATIONS	0.353	0.505	0.419	1.036	0.951	1.223
	1.238	1.493	1.087	0.639	0.255	0.190
SUBSURFACE INFLOW INTO LAYER 3						
TOTALS	0.5291	0.4779	0.5291	0.5121	0.5291	0.5121
	0.5291	0.5291	0.5121	0.5291	0.5121	0.5291
LATERAL DRAINAGE COLLECTED FROM LAYER 3						
TOTALS	1.3097	0.9218	0.9662	0.9246	0.9532	0.9220
	0.9526	0.9526	0.9219	0.9526	1.0282	1.0645
STD. DEVIATIONS	1.0713	0.1615	0.0408	0.0082	0.0019	0.0004
	0.0004	0.0004	0.0000	0.0005	0.3190	0.3357
PERCOLATION/LEAKAGE THROUGH LAYER 4						
TOTALS	0.1057	0.0962	0.1056	0.1022	0.1056	0.1022
	0.1056	0.1056	0.1022	0.1056	0.1022	0.1056
STD. DEVIATIONS	0.0002	0.0015	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0001	0.0001

AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)

DAILY AVERAGE HEAD ON TOP OF LAYER 4						
AVERAGES	2.1411	1.7297	1.6500	1.6316	1.6278	1.6270
	1.6268	1.6268	1.6268	1.6268	1.8092	1.8142
STD. DEVIATIONS	1.5428	0.3089	0.0697	0.0146	0.0032	0.0010
	0.0008	0.0008	0.0007	0.0006	0.5473	0.5623

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AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1 THROUGH 9

	INCHES		CU. FEET	PERCENT
PRECIPITATION	46.37	(12.245)	168331.2	100.00
RUNOFF	13.702	(7.2898)	49738.48	29.548
EVAPOTRANSPIRATION	25.246	(3.4363)	91641.46	54.441
SUBSURFACE INFLOW INTO LAYER 3	6.23000		22614.902	13.43477
LATERAL DRAINAGE COLLECTED FROM LAYER 3	11.87003	(1.36466)	43088.203	25.59728
PERCOLATION/LEAKAGE THROUGH LAYER 4	1.24455	(0.00151)	4517.732	2.68384
AVERAGE HEAD ON TOP OF LAYER 4	1.711	(0.176)		
CHANGE IN WATER STORAGE	6.778	(3.5347)	24602.57	14.616

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PEAK DAILY VALUES FOR YEARS 1 THROUGH 9

	(INCHES)	(CU. FT.)
PRECIPITATION	5.15	18694.500
RUNOFF	4.088	14839.9170
DRAINAGE COLLECTED FROM LAYER 3	0.29696	1077.95544
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.003444	12.50028
AVERAGE HEAD ON TOP OF LAYER 4	11.726	
MAXIMUM HEAD ON TOP OF LAYER 4	13.700	
LOCATION OF MAXIMUM HEAD IN LAYER 3 (DISTANCE FROM DRAIN)	33.8 FEET	
SNOW WATER	5.38	19535.8711

MAXIMUM VEG. SOIL WATER (VOL/VOL) 0.4012

MINIMUM VEG. SOIL WATER (VOL/VOL) 0.1800

*** Maximum heads are computed using McEnroe's equations. ***

Reference: Maximum Saturated Depth over Landfill Liner
by Bruce M. McEnroe, University of Kansas
ASCE Journal of Environmental Engineering
Vol. 119, No. 2, March 1993, pp. 262-270.

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FINAL WATER STORAGE AT END OF YEAR 9

LAYER	(INCHES)	(VOL/VOL)
1	3.4343	0.2862
2	88.2424	0.2920
3	1.4051	0.1171
4	660.6166	0.6970
SNOW WATER	0.535	

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**                                                                          **
**              HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE               **
**                HELP MODEL VERSION 3.07  (1 NOVEMBER 1997)                **
**                  DEVELOPED BY ENVIRONMENTAL LABORATORY                   **
**                    USAE WATERWAYS EXPERIMENT STATION                     **
**              FOR USEPA RISK REDUCTION ENGINEERING LABORATORY             **
**                                                                          **
**                                                                          **
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PRECIPITATION DATA FILE:      P:\PRJ1\MDENG\HELP3\ME0250\PHASE5.D4
TEMPERATURE DATA FILE:        P:\PRJ1\MDENG\HELP3\ME0250\PHASE5.D7
SOLAR RADIATION DATA FILE:    P:\PRJ1\MDENG\HELP3\ME0250\PHASE5.D13
EVAPOTRANSPIRATION DATA:      P:\PRJ1\MDENG\HELP3\ME0250\PHASE5.D11
SOIL AND DESIGN DATA FILE:    P:\PRJ1\MDENG\HELP3\ME0250\CIL5B-3.D10
OUTPUT DATA FILE:             P:\PRJ1\MDENG\HELP3\ME0250\CIL5B-3.OUT


TIME:  12:36      DATE:  12/18/2002


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     TITLE:  CHERRY ISLAND LANDFILL PHASE V - RUN B

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     NOTE:  INITIAL MOISTURE CONTENT OF THE LAYERS AND SNOW WATER
            WERE SPECIFIED BY THE USER.


                                   LAYER  1
                                   --------

                  TYPE 1 - VERTICAL PERCOLATION LAYER
                      MATERIAL TEXTURE NUMBER  22
       THICKNESS                    =     12.00   INCHES
       POROSITY                     =      0.4190 VOL/VOL
       FIELD CAPACITY               =      0.3070 VOL/VOL
       WILTING POINT                =      0.1800 VOL/VOL
       INITIAL SOIL WATER CONTENT   =      0.3621 VOL/VOL
       EFFECTIVE SAT. HYD. COND.    =  0.189999992000E-04 CM/SEC
     NOTE:  SATURATED HYDRAULIC CONDUCTIVITY IS MULTIPLIED BY  1.80
            FOR ROOT CHANNELS IN TOP HALF OF EVAPORATIVE ZONE.


                                   LAYER  2
                                   --------

                  TYPE 1 - VERTICAL PERCOLATION LAYER
                      MATERIAL TEXTURE NUMBER   0
       THICKNESS                    =    342.20   INCHES
       POROSITY                     =      0.6100 VOL/VOL
       FIELD CAPACITY               =      0.2920 VOL/VOL
       WILTING POINT                =      0.0770 VOL/VOL
       INITIAL SOIL WATER CONTENT   =      0.0770 VOL/VOL
       EFFECTIVE SAT. HYD. COND.    =  0.100000005000E-02 CM/SEC


                                   LAYER  3
                                   --------

                  TYPE 2 - LATERAL DRAINAGE LAYER
                      MATERIAL TEXTURE NUMBER   1
       THICKNESS                    =     12.00   INCHES
       POROSITY                     =      0.4170 VOL/VOL
       FIELD CAPACITY               =      0.0450 VOL/VOL
       WILTING POINT                =      0.0180 VOL/VOL
       INITIAL SOIL WATER CONTENT   =      0.4170 VOL/VOL
       EFFECTIVE SAT. HYD. COND.    =  0.999999978000E-02 CM/SEC
       SLOPE                        =      2.00    PERCENT
       DRAINAGE LENGTH              =     75.0     FEET
       SUBSURFACE INFLOW            =      8.04    INCHES/YR


                                   LAYER  4
                                   --------

                  TYPE 3 - BARRIER SOIL LINER
                      MATERIAL TEXTURE NUMBER   0
       THICKNESS                    =   1011.60   INCHES
       POROSITY                     =      0.6970 VOL/VOL
       FIELD CAPACITY               =      0.4180 VOL/VOL
       WILTING POINT                =      0.3670 VOL/VOL
       INITIAL SOIL WATER CONTENT   =      0.6970 VOL/VOL
       EFFECTIVE SAT. HYD. COND.    =  0.100000001000E-06 CM/SEC


                 GENERAL DESIGN AND EVAPORATIVE ZONE DATA
                 ----------------------------------------

     NOTE:  SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT

            SOIL DATA BASE USING SOIL TEXTURE #22 WITH A
            POOR STAND OF GRASS, A SURFACE SLOPE OF  2.%
            AND A SLOPE LENGTH OF 1200. FEET.

       SCS RUNOFF CURVE NUMBER              =     93.10
       FRACTION OF AREA ALLOWING RUNOFF     =    100.0    PERCENT
       AREA PROJECTED ON HORIZONTAL PLANE   =      1.000  ACRES
       EVAPORATIVE ZONE DEPTH               =      9.0    INCHES
       INITIAL WATER IN EVAPORATIVE ZONE    =      3.259  INCHES
       UPPER LIMIT OF EVAPORATIVE STORAGE   =      3.771  INCHES
       LOWER LIMIT OF EVAPORATIVE STORAGE   =      1.620  INCHES
       INITIAL SNOW WATER                   =      0.000  INCHES
       INITIAL WATER IN LAYER MATERIALS     =    740.784  INCHES
       TOTAL INITIAL WATER                  =    740.784  INCHES
       TOTAL SUBSURFACE INFLOW              =      8.04   INCHES/YEAR


                 EVAPOTRANSPIRATION AND WEATHER DATA
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     NOTE:  EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
            WILMINGTON              DELAWARE

         STATION LATITUDE                       =  39.80 DEGREES
         MAXIMUM LEAF AREA INDEX                =   1.00
         START OF GROWING SEASON (JULIAN DATE)  =    107
         END OF GROWING SEASON (JULIAN DATE)    =    298
         EVAPORATIVE ZONE DEPTH                 =   9.0  INCHES
         AVERAGE ANNUAL WIND SPEED              =   9.20 MPH
         AVERAGE 1ST QUARTER RELATIVE HUMIDITY  =  67.00 %
         AVERAGE 2ND QUARTER RELATIVE HUMIDITY  =  67.00 %
         AVERAGE 3RD QUARTER RELATIVE HUMIDITY  =  72.00 %
         AVERAGE 4TH QUARTER RELATIVE HUMIDITY  =  71.00 %

     NOTE:  PRECIPITATION DATA FOR     CHERRY ISLAND LF
            WAS ENTERED BY THE USER.

     NOTE:  TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING
            COEFFICIENTS FOR     WILMINGTON          DELAWARE

         NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

     JAN/JUL    FEB/AUG    MAR/SEP    APR/OCT    MAY/NOV    JUN/DEC
     -------    -------    -------    -------    -------    -------
      31.20      33.20      41.80      52.40      62.20      71.20
      76.00      74.80      67.80      56.30      45.60      35.50

     NOTE:  SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
            COEFFICIENTS FOR     WILMINGTON          DELAWARE

            AND STATION LATITUDE  =  39.80 DEGREES

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                 MONTHLY TOTALS (IN INCHES) FOR YEAR    1
------------------------------------------------------------------------------

                              JAN/JUL  FEB/AUG  MAR/SEP  APR/OCT  MAY/NOV  JUN/DEC
                              -------  -------  -------  -------  -------  -------
PRECIPITATION                  3.93     3.22     3.86     2.79     1.90     6.67
                              10.86     3.62     1.46     1.67     2.93     2.27

RUNOFF                         1.897    0.268    0.489    0.317    0.140    1.071
                               4.667    0.716    0.219    0.197    0.586    0.168

EVAPOTRANSPIRATION             1.249    1.745    2.507    3.191    1.701    5.071
                               5.546    2.973    0.643    1.963    1.742    0.974

SUBSURFACE INFLOW INTO         0.6828   0.6168   0.6828   0.6608   0.6828   0.6608
  LAYER  3                     0.6828   0.6828   0.6608   0.6828   0.6608   0.6828

LATERAL DRAINAGE COLLECTED     3.8939   1.7050   1.4481   1.2715   1.2755   1.2236
  FROM LAYER  3                1.2613   1.2603   1.2194   1.2600   1.2193   1.2600

PERCOLATION/LEAKAGE THROUGH    0.1062   0.0956   0.1058   0.1023   0.1057   0.1023
  LAYER  4                     0.1057   0.1057   0.1023   0.1057   0.1023   0.1057

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                 MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)
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AVERAGE DAILY HEAD ON          7.533    4.016    3.091    2.805    2.723    2.699
  TOP OF LAYER  4              2.692    2.690    2.690    2.690    2.690    2.690

STD. DEVIATION OF DAILY        2.020    0.444    0.147    0.041    0.012    0.004
  HEAD ON TOP OF LAYER  4      0.002    0.000    0.000    0.000    0.000    0.000

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                       ANNUAL TOTALS FOR YEAR    1
------------------------------------------------------------------------------
                                   INCHES        CU. FEET      PERCENT
                                  --------     ----------     -------
  PRECIPITATION                    45.18       164003.359     100.00
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RUNOFF	10.735	38966.312	23.76
EVAPOTRANSPIRATION	29.303	106370.484	64.86
SUBSURFACE INFLOW INTO LAYER 3	8.040000	29185.201	17.80
DRAINAGE COLLECTED FROM LAYER 3	18.2979	66421.375	40.50
PERC./LEAKAGE THROUGH LAYER 4	1.245546	4521.332	2.76
AVG. HEAD ON TOP OF LAYER 4	3.2507		
CHANGE IN WATER STORAGE	1.679	6094.164	3.72
SOIL WATER AT START OF YEAR	740.784	2689045.000	
SOIL WATER AT END OF YEAR	742.463	2695139.250	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	-8.0400	-29185.105	-17.80

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MONTHLY TOTALS (IN INCHES) FOR YEAR 2

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	8.05 5.35	2.10 3.72	8.59 2.36	7.13 6.26	6.01 5.12	8.31 5.36
RUNOFF	0.023 1.937	5.180 0.687	7.879 0.480	2.447 2.470	1.374 1.852	3.081 2.394
EVAPOTRANSPIRATION	0.685 3.368	0.638 3.053	1.655 0.869	4.201 2.460	4.277 1.699	4.489 0.886
SUBSURFACE INFLOW INTO LAYER 3	0.6828 0.6828	0.6168 0.6828	0.6828 0.6608	0.6608 0.6828	0.6828 0.6608	0.6608 0.6828
LATERAL DRAINAGE COLLECTED FROM LAYER 3	1.2600 1.2600	1.1380 1.2600	1.2600 1.2193	1.2193 1.2600	1.2600 1.2193	1.2193 1.2600
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.1057 0.1057	0.0955 0.1057	0.1057 0.1023	0.1023 0.1057	0.1057 0.1023	0.1023 0.1057

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 4	2.690 2.690	2.690 2.690	2.690 2.690	2.690 2.690	2.690 2.690	2.690 2.690
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 4	0.000 0.001	0.002 0.001	0.001 0.002	0.002 0.001	0.001 0.002	0.002 0.001

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ANNUAL TOTALS FOR YEAR 2

	INCHES	CU. FEET	PERCENT
PRECIPITATION	68.36	248146.750	100.00
RUNOFF	29.805	108193.367	43.60
EVAPOTRANSPIRATION	28.280	102656.055	41.37
SUBSURFACE INFLOW INTO LAYER 3	8.040000	29185.201	11.76
DRAINAGE COLLECTED FROM LAYER 3	14.8352	53851.801	21.70
PERC./LEAKAGE THROUGH LAYER 4	1.244860	4518.841	1.82
AVG. HEAD ON TOP OF LAYER 4	2.6896		
CHANGE IN WATER STORAGE	10.275	37297.230	15.03
SOIL WATER AT START OF YEAR	742.463	2695139.250	
SOIL WATER AT END OF YEAR	752.737	2732436.500	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	-8.0400	-29185.352	-11.76

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MONTHLY TOTALS (IN INCHES) FOR YEAR 3

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	2.02 3.99	1.24 0.38	5.86 6.34	2.65 6.41	2.08 1.89	1.82 4.28
RUNOFF	0.781 1.654	0.027 0.000	1.133 1.975	0.269 3.188	0.047 0.068	0.194 0.934
EVAPOTRANSPIRATION	0.818 1.728	1.616 0.380	2.257 1.833	2.500 2.697	1.996 1.720	2.014 0.812
SUBSURFACE INFLOW INTO LAYER 3	0.6828 0.6828	0.6168 0.6828	0.6828 0.6608	0.6608 0.6828	0.6828 0.6608	0.6608 0.6828
LATERAL DRAINAGE COLLECTED FROM LAYER 3	1.2600 1.2600	1.1380 1.2600	1.2600 1.2193	1.2193 1.2600	1.2600 1.2193	1.2193 1.2600
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.1057 0.1057	0.0955 0.1057	0.1057 0.1023	0.1023 0.1057	0.1057 0.1023	0.1023 0.1057

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 4	2.690 2.690	2.690 2.690	2.690 2.690	2.690 2.690	2.690 2.690	2.690 2.690
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 4	0.001 0.001	0.002 0.001	0.001 0.002	0.002 0.001	0.001 0.002	0.002 0.001

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ANNUAL TOTALS FOR YEAR 3

	INCHES	CU. FEET	PERCENT
PRECIPITATION	38.96	141424.828	100.00
RUNOFF	10.268	37274.273	26.36
EVAPOTRANSPIRATION	20.371	73945.672	52.29
SUBSURFACE INFLOW INTO LAYER 3	8.040000	29185.201	20.64
DRAINAGE COLLECTED FROM LAYER 3	14.8352	53851.801	38.08
PERC./LEAKAGE THROUGH LAYER 4	1.244860	4518.841	3.20
AVG. HEAD ON TOP OF LAYER 4	2.6896		
CHANGE IN WATER STORAGE	8.321	30204.832	21.36
SOIL WATER AT START OF YEAR	752.737	2732436.500	
SOIL WATER AT END OF YEAR	760.581	2760909.750	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.477	1731.575	1.22
ANNUAL WATER BUDGET BALANCE	-8.0401	-29185.395	-20.64

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MONTHLY TOTALS (IN INCHES) FOR YEAR 4

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	1.68 2.56	0.64 2.17	4.01 2.55	4.21 2.88	3.90 1.21	3.86 9.91
RUNOFF	0.988 0.404	0.137 0.231	0.285 0.270	0.447 0.153	0.231 0.044	0.487 3.709
EVAPOTRANSPIRATION	0.598 2.169	0.870 1.981	2.366 2.340	3.816 1.990	2.841 1.693	3.490 0.752
SUBSURFACE INFLOW INTO LAYER 3	0.6828 0.6828	0.6388 0.6828	0.6828 0.6608	0.6608 0.6828	0.6828 0.6608	0.6608 0.6828
LATERAL DRAINAGE COLLECTED FROM LAYER 3	1.2600 1.2600	1.1787 1.2600	1.2600 1.2193	1.2193 1.2600	1.2600 1.2193	1.2193 1.2600
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.1057 0.1057	0.0989 0.1057	0.1057 0.1023	0.1023 0.1057	0.1057 0.1023	0.1023 0.1057

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 4	2.690 2.690	2.690 2.690	2.690 2.690	2.690 2.690	2.690 2.690	2.690 2.690

STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 4	0.001	0.002	0.001	0.002	0.001	0.002
	0.001	0.001	0.002	0.001	0.002	0.001

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ANNUAL TOTALS FOR YEAR 4

	INCHES	CU. FEET	PERCENT
PRECIPITATION	39.58	143675.406	100.00
RUNOFF	7.388	26818.652	18.67
EVAPOTRANSPIRATION	24.907	90410.937	62.93
SUBSURFACE INFLOW INTO LAYER 3	8.062028	29265.160	20.37
DRAINAGE COLLECTED FROM LAYER 3	14.8759	53999.340	37.58
PERC./LEAKAGE THROUGH LAYER 4	1.248270	4531.222	3.15
AVG. HEAD ON TOP OF LAYER 4	2.6896		
CHANGE IN WATER STORAGE	7.285	26445.889	18.41
SOIL WATER AT START OF YEAR	760.581	2760909.750	
SOIL WATER AT END OF YEAR	766.821	2783561.000	
SNOW WATER AT START OF YEAR	0.477	1731.575	1.21
SNOW WATER AT END OF YEAR	1.522	5526.079	3.85
ANNUAL WATER BUDGET BALANCE	-8.0621	-29265.473	-20.37

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MONTHLY TOTALS (IN INCHES) FOR YEAR 5

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	0.95	4.60	4.04	0.69	3.91	2.40
	2.68	12.91	4.59	3.00	3.10	4.24
RUNOFF	0.557	3.317	0.497	0.000	1.573	0.499
	0.283	7.113	1.354	0.335	0.507	2.185
EVAPOTRANSPIRATION	0.345	0.562	2.741	1.055	1.642	1.553
	2.567	5.579	2.736	2.217	1.706	1.045
SUBSURFACE INFLOW INTO LAYER 3	0.6828	0.6168	0.6828	0.6608	0.6828	0.6608
	0.6828	0.6828	0.6608	0.6828	0.6608	0.6828
LATERAL DRAINAGE COLLECTED FROM LAYER 3	1.2600	1.1380	1.2600	1.2193	1.2600	1.2193
	1.2600	1.2600	1.2193	1.2600	1.2193	1.2600
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.1057	0.0955	0.1057	0.1023	0.1057	0.1023
	0.1057	0.1057	0.1023	0.1057	0.1023	0.1057

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 4	2.690	2.690	2.690	2.690	2.690	2.690
	2.690	2.690	2.690	2.690	2.690	2.690
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 4	0.001	0.002	0.001	0.002	0.001	0.002
	0.001	0.001	0.002	0.001	0.002	0.001

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ANNUAL TOTALS FOR YEAR 5

	INCHES	CU. FEET	PERCENT
PRECIPITATION	47.11	171009.375	100.00
RUNOFF	18.220	66138.195	38.68
EVAPOTRANSPIRATION	23.745	86195.398	50.40
SUBSURFACE INFLOW INTO LAYER 3	8.040000	29185.201	17.07
DRAINAGE COLLECTED FROM LAYER 3	14.8352	53851.801	31.49
PERC./LEAKAGE THROUGH LAYER 4	1.244860	4518.841	2.64
AVG. HEAD ON TOP OF LAYER 4	2.6896		
CHANGE IN WATER STORAGE	5.145	18675.768	10.92
SOIL WATER AT START OF YEAR	766.821	2783561.000	
SOIL WATER AT END OF YEAR	773.488	2807763.000	
SNOW WATER AT START OF YEAR	1.522	5526.079	3.23
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	-8.0401	-29185.432	-17.07

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MONTHLY TOTALS (IN INCHES) FOR YEAR 6

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	3.42	2.71	4.10	3.03	1.63	4.32
	5.60	3.22	2.02	1.94	2.77	3.04
RUNOFF	1.220	1.244	0.513	0.291	0.035	0.901
	1.139	0.459	0.121	0.320	0.218	0.053
EVAPOTRANSPIRATION	0.737	0.974	2.851	3.618	1.644	3.226
	2.938	3.644	1.392	2.092	1.340	0.895
SUBSURFACE INFLOW INTO LAYER 3	0.6828	0.6168	0.6828	0.6608	0.6828	0.6608
	0.6828	0.6828	0.6608	0.6828	0.6608	0.6828
LATERAL DRAINAGE COLLECTED FROM LAYER 3	1.2600	1.1380	1.2600	1.2193	1.2600	1.2193
	1.2600	1.2600	1.2193	1.2600	1.2193	1.2600
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.1057	0.0955	0.1057	0.1023	0.1057	0.1023
	0.1057	0.1057	0.1023	0.1057	0.1023	0.1057

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 4	2.690	2.690	2.690	2.690	2.690	2.690
	2.690	2.690	2.690	2.690	2.690	2.690
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 4	0.001	0.002	0.001	0.002	0.001	0.002
	0.001	0.001	0.002	0.001	0.002	0.001

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ANNUAL TOTALS FOR YEAR 6

	INCHES	CU. FEET	PERCENT
PRECIPITATION	37.80	137213.984	100.00
RUNOFF	6.515	23649.770	17.24
EVAPOTRANSPIRATION	25.351	92025.094	67.07
SUBSURFACE INFLOW INTO LAYER 3	8.040000	29185.201	21.27
DRAINAGE COLLECTED FROM LAYER 3	14.8352	53851.801	39.25
PERC./LEAKAGE THROUGH LAYER 4	1.244860	4518.841	3.29
AVG. HEAD ON TOP OF LAYER 4	2.6896		
CHANGE IN WATER STORAGE	5.934	21539.012	15.70
SOIL WATER AT START OF YEAR	773.488	2807763.000	
SOIL WATER AT END OF YEAR	778.571	2826211.750	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.851	3090.129	2.25
ANNUAL WATER BUDGET BALANCE	-8.0400	-29185.332	-21.27

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MONTHLY TOTALS (IN INCHES) FOR YEAR 7

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	0.66	1.49	3.09	2.64	1.65	2.73
	2.67	1.56	3.30	2.64	5.00	1.38
RUNOFF	0.122	0.569	0.614	0.026	0.023	0.361
	0.262	0.004	0.255	0.409	1.273	0.000
EVAPOTRANSPIRATION	0.698	0.534	2.388	2.167	1.627	2.554
	2.619	1.504	3.295	1.138	1.582	1.202
SUBSURFACE INFLOW INTO LAYER 3	0.6828	0.6168	0.6828	0.6608	0.6828	0.6608
	0.6828	0.6828	0.6608	0.6828	0.6608	0.6828

LATERAL DRAINAGE COLLECTED FROM LAYER 3	1.2600	1.1380	1.2600	1.2193	1.2600	1.2193
	1.2600	1.2600	1.2193	1.2600	1.2193	1.2600
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.1057	0.0955	0.1057	0.1023	0.1057	0.1023
	0.1057	0.1057	0.1023	0.1057	0.1023	0.1057

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 4	2.690	2.690	2.690	2.690	2.690	2.690
	2.690	2.690	2.690	2.690	2.690	2.690
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 4	0.001	0.002	0.001	0.002	0.001	0.002
	0.001	0.001	0.002	0.001	0.002	0.001

ANNUAL TOTALS FOR YEAR 7

	INCHES	CU. FEET	PERCENT
PRECIPITATION	28.81	104580.328	100.00
RUNOFF	3.918	14223.780	13.60
EVAPOTRANSPIRATION	21.308	77347.867	73.96
SUBSURFACE INFLOW INTO LAYER 3	8.040000	29185.201	27.91
DRAINAGE COLLECTED FROM LAYER 3	14.8352	53851.801	51.49
PERC./LEAKAGE THROUGH LAYER 4	1.244860	4518.841	4.32
AVG. HEAD ON TOP OF LAYER 4	2.6896		
CHANGE IN WATER STORAGE	3.584	13008.689	12.44
SOIL WATER AT START OF YEAR	778.571	2826211.750	
SOIL WATER AT END OF YEAR	783.006	2842310.500	
SNOW WATER AT START OF YEAR	0.851	3090.129	2.95
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	-8.0401	-29185.455	-27.91

AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)

DAILY AVERAGE HEAD ON TOP OF LAYER 4

AVERAGES	3.3815	2.8791	2.7469	2.7060	2.6943	2.6909
	2.6900	2.6897	2.6896	2.6896	2.6896	2.6896
STD. DEVIATIONS	1.8308	0.5014	0.1518	0.0435	0.0125	0.0035
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1 THROUGH 7

	INCHES		CU. FEET	PERCENT
PRECIPITATION	43.69	(12.369)	158579.1	100.00
RUNOFF	12.407	(8.9053)	45037.77	28.401
EVAPOTRANSPIRATION	24.752	(3.3069)	89850.22	56.660
SUBSURFACE INFLOW INTO LAYER 3	8.04000		29185.199	18.40419
LATERAL DRAINAGE COLLECTED FROM LAYER 3	15.33568	(1.30630)	55668.531	35.10458
PERCOLATION/LEAKAGE THROUGH LAYER 4	1.24545	(0.00121)	4520.966	2.85092
AVERAGE HEAD ON TOP OF LAYER 4	2.770	(0.212)		
CHANGE IN WATER STORAGE	6.032	(2.9026)	21895.08	13.807

AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1 THROUGH 7

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	2.96	2.29	4.79	3.31	3.01	4.30
	4.82	3.94	3.23	3.54	3.15	4.35
STD. DEVIATIONS	2.55	1.35	1.87	1.98	1.66	2.38
	2.95	4.14	1.70	1.97	1.46	2.79
RUNOFF						
TOTALS	0.798	1.535	1.630	0.543	0.489	0.942
	1.478	1.316	0.668	1.010	0.650	1.349
STD. DEVIATIONS	0.650	1.971	2.768	0.855	0.679	0.991
	1.559	2.573	0.712	1.262	0.677	1.439
EVAPOTRANSPIRATION						
TOTALS	0.733	0.992	2.395	2.935	2.247	3.200
	2.991	2.731	1.873	2.079	1.640	0.938
STD. DEVIATIONS	0.273	0.498	0.389	1.097	0.996	1.277
	1.242	1.668	0.978	0.492	0.142	0.151
SUBSURFACE INFLOW INTO LAYER 3						
TOTALS	0.6828	0.6168	0.6828	0.6608	0.6828	0.6608
	0.6828	0.6828	0.6608	0.6828	0.6608	0.6828
LATERAL DRAINAGE COLLECTED FROM LAYER 3						
TOTALS	1.6362	1.2248	1.2868	1.2268	1.2622	1.2199
	1.2602	1.2600	1.2193	1.2600	1.2193	1.2600
STD. DEVIATIONS	0.9955	0.2123	0.0711	0.0197	0.0059	0.0018
	0.0000	0.0003	0.0004	0.0000	0.0005	0.0000
PERCOLATION/LEAKAGE THROUGH LAYER 4						
TOTALS	0.1058	0.0960	0.1057	0.1023	0.1057	0.1023
	0.1057	0.1057	0.1023	0.1057	0.1023	0.1057
STD. DEVIATIONS	0.0002	0.0013	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

PEAK DAILY VALUES FOR YEARS 1 THROUGH 7

	(INCHES)	(CU. FT.)
PRECIPITATION	4.70	17061.000
RUNOFF	3.452	12532.0176
DRAINAGE COLLECTED FROM LAYER 3	0.22009	798.93414
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.003441	12.49175
AVERAGE HEAD ON TOP OF LAYER 4	11.816	
MAXIMUM HEAD ON TOP OF LAYER 4	13.910	
LOCATION OF MAXIMUM HEAD IN LAYER 3 (DISTANCE FROM DRAIN)	39.2 FEET	
SNOW WATER	6.37	23137.2070
MAXIMUM VEG. SOIL WATER (VOL/VOL)	0.4079	
MINIMUM VEG. SOIL WATER (VOL/VOL)	0.1800	

*** Maximum heads are computed using McEnroe's equations. ***

Reference: Maximum Saturated Depth over Landfill Liner
by Bruce M. McEnroe, University of Kansas
ASCE Journal of Environmental Engineering
Vol. 119, No. 2, March 1993, pp. 262-270.

FINAL WATER STORAGE AT END OF YEAR 7

LAYER	(INCHES)	(VOL/VOL)
1	3.5714	0.2976
2	72.8085	0.2128
3	1.5405	0.1284
4	705.0852	0.6970
SNOW WATER	0.000	

ATTACHMENT E

ATTACHMENT E

SUMMARY OF HELP OUTPUT DATA FROM RUN B

Month	Phase I Leachate (inches)	Phase II Leachate (inches)	Phase III Leachate (inches)	Phase IV Leachate (inches)	Phase V Leachate (inches)	Phase I Leachate (gallons)	Phase II Leachate (gallons)	Phase III Leachate (gallons)	Phase IV Leachate (gallons)	Phase V Leachate (gallons)	TOTAL (gallons)
Jan-92	0.6108	0.1615	1.2953			530,710	140,324	1,125,456	0	0	1,796,490
Feb-92	0.7008	0.1459	1.0253			608,909	126,769	890,859	0	0	1,626,537
Mar-92	0.8150	0.1615	1.0223			708,135	140,324	888,253	0	0	1,736,711
Apr-92	0.8530	0.1563	0.9080			741,152	135,805	788,940	0	0	1,665,897
May-92	0.9736	0.1615	0.8769			845,938	140,324	761,918	0	0	1,748,180
Jun-92	0.9747	0.1563	0.8048			846,894	135,805	699,272	0	0	1,681,972
Jul-92	1.0386	0.1615	0.7982			902,415	140,324	693,537	0	0	1,736,277
Aug-92	1.0683	0.1615	0.7732			928,221	140,324	671,816	0	0	1,740,360
Sep-92	1.0601	0.1563	0.7307			921,096	135,805	634,888	0	0	1,691,790
Oct-92	1.1527	0.1615	0.7417			1,001,554	140,324	644,446	0	0	1,786,324
Nov-92	1.1669	0.1563	0.7083			1,013,892	135,805	615,425	0	0	1,765,123
Dec-92	1.2836	0.1615	0.7246			1,115,290	140,324	629,588	0	0	1,885,202
Jan-93	1.3731	0.1615	0.7191	4.1664		1,193,055	140,324	624,809	3,620,088	0	5,578,276
Feb-93	1.2614	0.1459	0.6461	1.3509		1,096,001	126,769	561,381	1,173,766	0	2,957,917
Mar-93	1.4168	0.1615	0.7125	1.0750		1,231,025	140,324	619,075	934,043	0	2,924,466
Apr-93	1.4878	0.1563	0.6873	0.9466		1,292,715	135,805	597,179	822,479	0	2,848,178
May-93	1.5667	0.1615	0.7086	0.9580		1,361,269	140,324	615,686	832,384	0	2,949,663
Jun-93	1.5024	0.1563	0.6846	0.9230		1,305,401	135,805	594,833	801,973	0	2,838,012
Jul-93	1.6155	0.1615	0.7066	0.9529		1,403,670	140,324	613,948	827,953	0	2,985,895
Aug-93	1.6279	0.1615	0.7059	0.9527		1,414,445	140,324	613,340	827,779	0	2,995,887
Sep-93	1.7441	0.2148	0.6827	0.9219		1,515,408	186,635	593,182	801,018	0	3,096,242
Oct-93	1.8904	0.3131	0.7051	0.9526		1,642,525	272,045	612,645	827,692	0	3,354,907
Nov-93	1.7770	0.3629	0.6821	0.9219		1,543,994	315,315	592,661	801,018	0	3,252,988
Dec-93	1.9901	0.5608	0.7046	0.9526		1,729,152	487,266	612,211	827,692	0	3,656,320
Jan-94	2.0486	0.7433	0.7045	0.9526		1,779,981	645,836	612,124	827,692	0	3,865,633
Feb-94	1.7843	0.8311	0.6362	0.8604		1,550,337	722,124	552,779	747,582	0	3,572,821
Mar-94	2.0125	1.0160	0.7043	0.9526		1,748,615	882,779	611,950	827,692	0	4,071,035
Apr-94	1.9978	1.1421	0.6815	0.9219		1,735,842	992,344	592,140	801,018	0	4,121,343
May-94	2.0045	1.2238	0.7042	0.9526		1,741,664	1,063,331	611,863	827,692	0	4,244,550

ATTACHMENT E

SUMMARY OF HELP OUTPUT DATA FROM RUN B

Month	Phase I Leachate (inches)	Phase II Leachate (inches)	Phase III Leachate (inches)	Phase IV Leachate (inches)	Phase V Leachate (inches)	Phase I Leachate (gallons)	Phase II Leachate (gallons)	Phase III Leachate (gallons)	Phase IV Leachate (gallons)	Phase V Leachate (gallons)	TOTAL (gallons)
Jun-94	1.8737	1.2118	0.6815	0.9219		1,628,014	1,052,905	592,140	801,018	0	4,074,076
Jul-94	1.8877	1.2872	0.7041	0.9526		1,640,179	1,118,418	611,776	827,692	0	4,198,065
Aug-94	1.8530	1.3216	0.7041	0.9526		1,610,029	1,148,308	611,776	827,692	0	4,197,804
Sep-94	1.7398	1.2961	0.6814	0.9219		1,511,672	1,126,151	592,053	801,018	0	4,030,893
Oct-94	2.1276	1.7349	0.7041	0.9526		1,848,622	1,507,414	611,776	827,692	0	4,795,505
Nov-94	2.1344	1.7840	0.6814	0.9219		1,854,531	1,550,076	592,053	801,018	0	4,797,677
Dec-94	2.1755	1.8702	0.7041	0.9526		1,890,241	1,624,973	611,776	827,692	0	4,954,683
Jan-95	2.1588	1.9140	0.7041	0.9526	3.8939	1,875,731	1,663,030	611,776	827,692	3,383,319	8,361,549
Feb-95	1.9464	1.7031	0.6587	0.8604	1.7050	1,691,182	1,479,784	572,329	747,582	1,481,435	5,972,312
Mar-95	2.1476	1.8758	0.7041	0.9526	1.4481	1,866,000	1,629,839	611,776	827,692	1,258,220	6,193,528
Apr-95	2.0342	1.8684	0.6814	0.9219	1.2715	1,767,469	1,623,409	592,053	801,018	1,104,777	5,888,726
May-95	2.0238	1.8795	0.7041	0.9526	1.2755	1,758,433	1,633,054	611,776	827,692	1,108,252	5,939,207
Jun-95	1.8957	1.7857	0.6814	0.9219	1.2236	1,647,130	1,551,553	592,053	801,018	1,063,158	5,654,911
Jul-95	1.9374	1.8568	0.7041	0.9526	1.2613	1,683,362	1,613,330	611,776	827,692	1,095,914	5,832,075
Aug-95	1.9132	1.8513	0.7041	0.9526	1.2603	1,662,335	1,608,552	611,776	827,692	1,095,045	5,805,400
Sep-95	1.8028	1.7585	0.6814	0.9219	1.2194	1,566,411	1,527,920	592,053	801,018	1,059,508	5,546,909
Oct-95	1.8213	1.7926	0.7041	0.9526	1.2600	1,582,485	1,557,549	611,776	827,692	1,094,785	5,674,287
Nov-95	1.7537	1.7479	0.6814	0.9219	1.2193	1,523,749	1,518,710	592,053	801,018	1,059,421	5,494,951
Dec-95	1.8126	1.8257	0.7041	0.9526	1.2600	1,574,926	1,586,308	611,776	827,692	1,094,785	5,695,487
Jan-96	1.8032	1.8342	0.7041	0.9526	1.2600	1,566,759	1,593,694	611,776	827,692	1,094,785	5,694,705
Feb-96	1.6455	1.6949	0.6359	0.8912	1.1380	1,429,737	1,472,659	552,519	774,343	988,782	5,218,040
Mar-96	1.8010	2.0728	0.7041	0.9526	1.2600	1,564,847	1,801,008	611,776	827,692	1,094,785	5,900,108
Apr-96	1.9137	2.1855	0.6814	0.9219	1.2193	1,662,770	1,898,930	592,053	801,018	1,059,421	6,014,191
May-96	2.0277	2.2923	0.7041	0.9526	1.2600	1,761,821	1,991,726	611,776	827,692	1,094,785	6,287,801
Jun-96	1.9682	2.1887	0.6814	0.9219	1.2193	1,710,123	1,901,711	592,053	801,018	1,059,421	6,064,326
Jul-96	2.0193	2.2254	0.7041	0.9526	1.2600	1,754,523	1,933,598	611,776	827,692	1,094,785	6,222,374
Aug-96	1.9479	2.1285	0.7041	0.9526	1.2600	1,692,485	1,849,404	611,776	827,692	1,094,785	6,076,142
Sep-96	1.8304	1.9838	0.6814	0.9219	1.2193	1,590,392	1,723,678	592,053	801,018	1,059,421	5,766,562
Oct-96	1.8971	2.0323	0.7041	0.9526	1.2600	1,648,346	1,765,818	611,776	827,692	1,094,785	5,948,417

ATTACHMENT E

SUMMARY OF HELP OUTPUT DATA FROM RUN B

Month	Phase I Leachate (inches)	Phase II Leachate (inches)	Phase III Leachate (inches)	Phase IV Leachate (inches)	Phase V Leachate (inches)	Phase I Leachate (gallons)	Phase II Leachate (gallons)	Phase III Leachate (gallons)	Phase IV Leachate (gallons)	Phase V Leachate (gallons)	TOTAL (gallons)
Nov-96	1.9156	2.0429	0.6814	0.9219	1.2193	1,664,420	1,775,028	592,053	801,018	1,059,421	5,891,940
Dec-96	2.1159	2.3174	0.7041	0.9526	1.2600	1,838,456	2,013,535	611,776	827,692	1,094,785	6,386,244
Jan-97	2.2249	2.3067	0.7041	0.9526	1.2600	1,933,164	2,004,238	611,776	827,692	1,094,785	6,471,655
Feb-97	2.0330	2.0626	0.6359	0.8604	1.1380	1,766,427	1,792,145	552,519	747,582	988,782	5,847,454
Mar-97	2.2639	2.2944	0.7041	0.9526	1.2600	1,967,050	1,993,551	611,776	827,692	1,094,785	6,494,854
Apr-97	2.2518	2.3179	0.6814	0.9219	1.2193	1,956,537	2,013,970	592,053	801,018	1,059,421	6,422,998
May-97	2.2235	2.2868	0.7041	0.9526	1.2600	1,931,948	1,986,947	611,776	827,692	1,094,785	6,453,148
Jun-97	2.0565	2.1114	0.6814	0.9219	1.2193	1,786,845	1,834,546	592,053	801,018	1,059,421	6,073,883
Jul-97	2.0712	2.1270	0.7041	0.9526	1.2600	1,799,618	1,848,101	611,776	827,692	1,094,785	6,181,972
Aug-97	2.0297	2.0855	0.7041	0.9526	1.2600	1,763,559	1,812,043	611,776	827,692	1,094,785	6,109,855
Sep-97	1.8987	1.9527	0.6814	0.9219	1.2193	1,649,736	1,696,656	592,053	801,018	1,059,421	5,798,884
Oct-97	2.0345	2.1371	0.7041	0.9526	1.2600	1,767,730	1,856,877	611,776	827,692	1,094,785	6,158,859
Nov-97	1.9844	2.0829	0.6814	0.9219	1.2193	1,724,199	1,809,783	592,053	801,018	1,059,421	5,986,474
Dec-97	1.9752	2.0674	0.7041	0.9526	1.2600	1,716,205	1,796,316	611,776	827,692	1,094,785	6,046,774
Jan-98	2.0575	1.9962	0.7041	0.9526	1.2600	1,787,714	1,734,452	611,776	827,692	1,094,785	6,056,419
Feb-98	1.8302	1.7474	0.6587	0.8604	1.1787	1,590,218	1,518,275	572,329	747,582	1,024,145	5,452,549
Mar-98	2.0410	1.9868	0.7041	0.9526	1.2600	1,773,378	1,726,284	611,776	827,692	1,094,785	6,033,915
Apr-98	1.9949	2.0049	0.6814	0.9219	1.2193	1,733,322	1,742,011	592,053	801,018	1,059,421	5,927,825
May-98	2.0302	2.0404	0.7041	0.9526	1.2600	1,763,994	1,772,856	611,776	827,692	1,094,785	6,071,103
Jun-98	1.8943	1.9083	0.6814	0.9219	1.2193	1,645,913	1,658,078	592,053	801,018	1,059,421	5,756,483
Jul-98	1.9079	1.9400	0.7041	0.9526	1.2600	1,657,730	1,685,621	611,776	827,692	1,094,785	5,877,604
Aug-98	1.8507	1.8841	0.7041	0.9526	1.2600	1,608,030	1,637,051	611,776	827,692	1,094,785	5,779,334
Sep-98	1.7424	1.7765	0.6814	0.9219	1.2193	1,513,931	1,543,560	592,053	801,018	1,059,421	5,509,982
Oct-98	1.7653	1.8083	0.7041	0.9526	1.2600	1,533,828	1,571,190	611,776	827,692	1,094,785	5,639,271
Nov-98	1.7004	1.7574	0.6814	0.9219	1.2193	1,477,438	1,526,964	592,053	801,018	1,059,421	5,456,894
Dec-98	1.6923	1.7936	0.7041	0.9526	1.2600	1,470,400	1,558,417	611,776	827,692	1,094,785	5,563,071
Jan-99	1.8889	2.0804	0.7041	0.9526	1.2600	1,641,221	1,807,611	611,776	827,692	1,094,785	5,983,086
Feb-99	1.6663	1.9150	0.6587	0.8604	1.1380	1,447,809	1,663,899	572,329	747,582	988,782	5,420,401
Mar-99	1.9287	2.1074	0.7041	0.9526	1.2600	1,675,803	1,831,071	611,776	827,692	1,094,785	6,041,127

ATTACHMENT E

SUMMARY OF HELP OUTPUT DATA FROM RUN B

Month	Phase I Leachate (inches)	Phase II Leachate (inches)	Phase III Leachate (inches)	Phase IV Leachate (inches)	Phase V Leachate (inches)	Phase I Leachate (gallons)	Phase II Leachate (gallons)	Phase III Leachate (gallons)	Phase IV Leachate (gallons)	Phase V Leachate (gallons)	TOTAL (gallons)
Apr-99	1.8862	2.0039	0.6814	0.9219	1.2193	1,638,875	1,741,142	592,053	801,018	1,059,421	5,832,509
May-99	1.8952	2.0059	0.7041	0.9526	1.2600	1,646,695	1,742,880	611,776	827,692	1,094,785	5,923,828
Jun-99	1.8468	1.9585	0.6814	0.9219	1.2193	1,604,642	1,701,695	592,053	801,018	1,059,421	5,758,829
Jul-99	1.8531	1.9606	0.7041	0.9526	1.2600	1,610,116	1,703,520	611,776	827,692	1,094,785	5,847,888
Aug-99	1.8313	1.9371	0.7041	0.9526	1.2600	1,591,174	1,683,101	611,776	827,692	1,094,785	5,808,528
Sep-99	1.7481	1.8381	0.6814	0.9219	1.2193	1,518,884	1,597,082	592,053	801,018	1,059,421	5,568,458
Oct-99	1.7614	1.8488	0.7041	0.9526	1.2600	1,530,440	1,606,379	611,776	827,692	1,094,785	5,671,072
Nov-99	1.6671	1.7466	0.6814	0.9219	1.2193	1,448,505	1,517,580	592,053	801,018	1,059,421	5,418,576
Dec-99	1.7559	1.8673	0.7041	0.9526	1.2600	1,525,661	1,622,454	611,776	827,692	1,094,785	5,682,367
Jan-00	1.9753	1.9620	0.7041	0.9526	1.2600	1,716,292	1,704,736	611,776	827,692	1,094,785	5,955,282
Feb-00	1.9678	1.7491	0.6359	0.8912	1.1380	1,709,776	1,519,752	552,519	774,343	988,782	5,545,172
Mar-00	2.0876	1.9803	0.7041	0.9526	1.2600	1,813,867	1,720,637	611,776	827,692	1,094,785	6,068,757
Apr-00	2.0055	1.9266	0.6814	0.9219	1.2193	1,742,532	1,673,978	592,053	801,018	1,059,421	5,869,002
May-00	1.9969	1.9321	0.7041	0.9526	1.2600	1,735,060	1,678,757	611,776	827,692	1,094,785	5,948,070
Jun-00	1.8705	1.8199	0.6814	0.9219	1.2193	1,625,234	1,581,269	592,053	801,018	1,059,421	5,658,995
Jul-00	1.9067	1.8641	0.7041	0.9526	1.2600	1,656,687	1,619,673	611,776	827,692	1,094,785	5,810,614
Aug-00	1.9145	1.8807	0.7041	0.9526	1.2600	1,663,465	1,634,097	611,776	827,692	1,094,785	5,831,814
Sep-00	1.8007	1.7811	0.6814	0.9219	1.2193	1,564,586	1,547,556	592,053	801,018	1,059,421	5,564,635
Oct-00	1.8093	1.7975	0.7041	0.9526	1.2600	1,572,059	1,561,806	611,776	827,692	1,094,785	5,668,118
Nov-00	1.7078	1.7031	0.6814	0.9219	1.2193	1,483,868	1,479,784	592,053	801,018	1,059,421	5,416,144
Dec-00	1.7879	1.8057	0.7321	0.9526	1.2600	1,553,465	1,568,931	636,105	827,692	1,094,785	5,680,977
Jan-01	1.8931	1.8960	0.8464	0.9526	1.2600	1,644,871	1,647,390	735,417	827,692	1,094,785	5,950,155
Feb-01	1.6638	1.6703	0.8116	0.8604	1.1380	1,445,637	1,451,285	705,180	747,582	988,782	5,338,466
Mar-01	1.8502	1.8881	1.1226	0.9526	1.2600	1,607,596	1,640,526	975,401	827,692	1,094,785	6,146,000
Apr-01	1.8079	1.8491	1.1213	0.9219	1.2193	1,570,842	1,606,640	974,272	801,018	1,059,421	6,012,193
May-01	1.8157	1.8588	1.0356	0.9526	1.2600	1,577,620	1,615,068	899,809	827,692	1,094,785	6,014,973
Jun-01	1.7127	1.7550	0.9189	0.9219	1.2193	1,488,125	1,524,879	798,411	801,018	1,059,421	5,671,854
Jul-01	1.7305	1.7740	0.8875	0.9526	1.2600	1,503,591	1,541,387	771,128	827,692	1,094,785	5,738,584
Aug-01	1.6946	1.7388	0.8389	0.9526	1.2600	1,472,399	1,510,803	728,901	827,692	1,094,785	5,634,579

ATTACHMENT E

SUMMARY OF HELP OUTPUT DATA FROM RUN B

Month	Phase I Leachate (inches)	Phase II Leachate (inches)	Phase III Leachate (inches)	Phase IV Leachate (inches)	Phase V Leachate (inches)	Phase I Leachate (gallons)	Phase II Leachate (gallons)	Phase III Leachate (gallons)	Phase IV Leachate (gallons)	Phase V Leachate (gallons)	TOTAL (gallons)
Sep-01	1.6087	1.6533	0.7861	0.9219	1.2193	1,397,762	1,436,514	683,024	801,018	1,059,421	5,377,739
Oct-01	1.6337	1.6817	0.7968	0.9526	1.2600	1,419,484	1,461,190	692,321	827,692	1,094,785	5,495,472
Nov-01	1.6554	1.6830	0.9979	1.8789	1.2193	1,438,339	1,462,320	867,052	1,632,533	1,059,421	6,459,665
Dec-01	1.8136	1.9392	1.3077	1.9596	1.2600	1,575,795	1,684,926	1,136,230	1,702,651	1,094,785	7,194,387

ATTACHMENT F

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**                                                                          **
**                                                                          **
**              HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE               **
**                HELP MODEL VERSION 3.07  (1 NOVEMBER 1997)                **
**                  DEVELOPED BY ENVIRONMENTAL LABORATORY                   **
**                     USAE WATERWAYS EXPERIMENT STATION                    **
**              FOR USEPA RISK REDUCTION ENGINEERING LABORATORY             **
**                                                                          **
**                                                                          **
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PRECIPITATION DATA FILE:      P:\PRJ1\MDENG\HELP3\ME0250\40YEARS.D4
TEMPERATURE DATA FILE:        P:\PRJ1\MDENG\HELP3\ME0250\40YEARS.D7
SOLAR RADIATION DATA FILE:    P:\PRJ1\MDENG\HELP3\ME0250\40YEARS.D13
EVAPOTRANSPIRATION DATA:      P:\PRJ1\MDENG\HELP3\ME0250\40YEARS.D11
SOIL AND DESIGN DATA FILE:    P:\PRJ1\MDENG\HELP3\ME0250\CIL3B2CP.D10
OUTPUT DATA FILE:             P:\PRJ1\MDENG\HELP3\ME0250\CIL3B2CP.OUT


TIME:  15:57      DATE:   2/26/2003


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     TITLE:  CHERRY ISLAND LANDFILL PHASE III - RUN B2

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     NOTE:  INITIAL MOISTURE CONTENT OF THE LAYERS AND SNOW WATER
            WERE SPECIFIED BY THE USER.


                                   LAYER  1
                                   --------

                     TYPE 1 - VERTICAL PERCOLATION LAYER
                         MATERIAL TEXTURE NUMBER  22
       THICKNESS                    =      12.00   INCHES
       POROSITY                     =       0.4190 VOL/VOL
       FIELD CAPACITY               =       0.3070 VOL/VOL
       WILTING POINT                =       0.1800 VOL/VOL
       INITIAL SOIL WATER CONTENT   =       0.3621 VOL/VOL
       EFFECTIVE SAT. HYD. COND.    =  0.189999992000E-04 CM/SEC
     NOTE:  SATURATED HYDRAULIC CONDUCTIVITY IS MULTIPLIED BY  4.63
            FOR ROOT CHANNELS IN TOP HALF OF EVAPORATIVE ZONE.


                                   LAYER  2
                                   --------

                     TYPE 1 - VERTICAL PERCOLATION LAYER
                         MATERIAL TEXTURE NUMBER   0
       THICKNESS                    =    3000.00   INCHES
       POROSITY                     =       0.6100 VOL/VOL
       FIELD CAPACITY               =       0.2920 VOL/VOL
       WILTING POINT                =       0.0770 VOL/VOL
       INITIAL SOIL WATER CONTENT   =       0.0770 VOL/VOL
       EFFECTIVE SAT. HYD. COND.    =  0.100000005000E-02 CM/SEC


                                   LAYER  3
                                   --------

                     TYPE 2 - LATERAL DRAINAGE LAYER
                         MATERIAL TEXTURE NUMBER   1
       THICKNESS                    =      12.00   INCHES
       POROSITY                     =       0.4170 VOL/VOL
       FIELD CAPACITY               =       0.0450 VOL/VOL
       WILTING POINT                =       0.0180 VOL/VOL
       INITIAL SOIL WATER CONTENT   =       0.4170 VOL/VOL
       EFFECTIVE SAT. HYD. COND.    =  0.999999978000E-02 CM/SEC
       SLOPE                        =       1.50   PERCENT
       DRAINAGE LENGTH              =     230.0    FEET
       SUBSURFACE INFLOW            =       4.56   INCHES/YR


                                   LAYER  4
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                     TYPE 3 - BARRIER SOIL LINER
                         MATERIAL TEXTURE NUMBER  16
       THICKNESS                    =     904.90   INCHES
       POROSITY                     =       0.4270 VOL/VOL
       FIELD CAPACITY               =       0.4180 VOL/VOL
       WILTING POINT                =       0.3670 VOL/VOL
       INITIAL SOIL WATER CONTENT   =       0.4270 VOL/VOL
       EFFECTIVE SAT. HYD. COND.    =  0.100000001000E-06 CM/SEC


                 GENERAL DESIGN AND EVAPORATIVE ZONE DATA
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     NOTE:  SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT
            SOIL DATA BASE USING SOIL TEXTURE #22 WITH A
            POOR STAND OF GRASS, A SURFACE SLOPE OF  2.%
            AND A SLOPE LENGTH OF 1200. FEET.

       SCS RUNOFF CURVE NUMBER              =     93.10
       FRACTION OF AREA ALLOWING RUNOFF     =     100.0    PERCENT
       AREA PROJECTED ON HORIZONTAL PLANE   =     1.000    ACRES
       EVAPORATIVE ZONE DEPTH               =     24.0     INCHES
       INITIAL WATER IN EVAPORATIVE ZONE    =     5.269    INCHES
       UPPER LIMIT OF EVAPORATIVE STORAGE   =    12.348    INCHES
       LOWER LIMIT OF EVAPORATIVE STORAGE   =     3.084    INCHES
       INITIAL SNOW WATER                   =     0.000    INCHES
       INITIAL WATER IN LAYER MATERIALS     =   626.742    INCHES
       TOTAL INITIAL WATER                  =   626.742    INCHES
       TOTAL SUBSURFACE INFLOW              =     4.56     INCHES/YEAR

                 EVAPOTRANSPIRATION AND WEATHER DATA
                 -----------------------------------

     NOTE:  EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
              ALBANY                  NEW YORK

       STATION LATITUDE                     =  42.45 DEGREES
       MAXIMUM LEAF AREA INDEX              =   3.50
       START OF GROWING SEASON (JULIAN DATE)=    123
       END OF GROWING SEASON (JULIAN DATE)  =    282
       EVAPORATIVE ZONE DEPTH               =  24.0  INCHES
       AVERAGE ANNUAL WIND SPEED            =   8.90 MPH
       AVERAGE 1ST QUARTER RELATIVE HUMIDITY =  68.00 %
       AVERAGE 2ND QUARTER RELATIVE HUMIDITY =  66.00 %
       AVERAGE 3RD QUARTER RELATIVE HUMIDITY =  74.00 %
       AVERAGE 4TH QUARTER RELATIVE HUMIDITY =  74.00 %

     NOTE:  PRECIPITATION DATA FOR      CHERRY ISLAND LF
            WAS ENTERED BY THE USER.

     NOTE:  TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING
              COEFFICIENTS FOR     WILMINGTON          DELAWARE

            NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

       JAN/JUL    FEB/AUG    MAR/SEP    APR/OCT    MAY/NOV    JUN/DEC
       -------    -------    -------    -------    -------    -------
        31.20      33.20      41.80      52.40      62.20      71.20
        76.00      74.80      67.80      56.30      45.60      35.50

     NOTE:  SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
              COEFFICIENTS FOR     WILMINGTON          DELAWARE
            AND STATION LATITUDE  =  39.80 DEGREES


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                   MONTHLY TOTALS (IN INCHES) FOR YEAR    1
------------------------------------------------------------------------------
                              JAN/JUL  FEB/AUG  MAR/SEP  APR/OCT  MAY/NOV  JUN/DEC
                              -------  -------  -------  -------  -------  -------
PRECIPITATION                  1.87     1.39     4.15     2.02     1.86     5.95
                               2.42     5.10     3.84     3.78     1.81     7.26

RUNOFF                         0.095    0.001    0.577    0.031    0.038    0.439
                               0.088    0.761    1.492    0.644    0.157    1.816

EVAPOTRANSPIRATION             1.092    1.466    2.155    2.935    1.981    6.301
                               3.152    3.498    1.588    1.479    1.192    0.865

SUBSURFACE INFLOW INTO         0.3873   0.3498   0.3873   0.3748   0.3873   0.3748
  LAYER  3                     0.3873   0.3873   0.3748   0.3873   0.3748   0.3873

LATERAL DRAINAGE COLLECTED     1.2900   1.0134   1.0037   0.8858   0.8507   0.7770
  FROM LAYER  3                0.7677   0.7414   0.6990   0.7082   0.6752   0.6901

PERCOLATION/LEAKAGE THROUGH    0.1067   0.0963   0.1065   0.1029   0.1063   0.1028
  LAYER  4                     0.1062   0.1062   0.1028   0.1062   0.1027   0.1061

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                 MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)
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AVERAGE DAILY HEAD ON         11.123    9.754    8.754    7.988    7.424    7.007
  TOP OF LAYER  4              6.700    6.470    6.303    6.180    6.089    6.022

STD. DEVIATION OF DAILY        0.490    0.324    0.265    0.189    0.144    0.103
  HEAD ON TOP OF LAYER  4      0.078    0.057    0.041    0.031    0.023    0.017
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                       ANNUAL TOTALS FOR YEAR    1
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                                  INCHES        CU. FEET      PERCENT
                                  --------     ----------     -------
  PRECIPITATION                    41.45       150463.469     100.00
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RUNOFF	6.139	22283.998	14.81
EVAPOTRANSPIRATION	27.705	100567.484	66.84
SUBSURFACE INFLOW INTO LAYER 3	4.560000	16552.799	11.00
DRAINAGE COLLECTED FROM LAYER 3	10.1023	36671.395	24.37
PERC./LEAKAGE THROUGH LAYER 4	1.251808	4544.062	3.02
AVG. HEAD ON TOP OF LAYER 4	7.4846		
CHANGE IN WATER STORAGE	5.373	19502.387	12.96
SOIL WATER AT START OF YEAR	626.741	2275071.500	
SOIL WATER AT END OF YEAR	632.114	2294573.750	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	-4.5601	-16553.047	-11.00

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MONTHLY TOTALS (IN INCHES) FOR YEAR 2

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	2.12	4.54	4.19	4.19	7.87	5.80
	2.92	0.75	7.04	2.82	1.75	0.61
RUNOFF	0.337	1.022	3.785	0.176	1.729	1.012
	0.383	0.005	2.549	0.665	0.023	0.000
EVAPOTRANSPIRATION	0.723	0.498	1.731	3.957	4.502	6.707
	3.485	0.390	1.435	1.916	1.297	0.587
SUBSURFACE INFLOW INTO LAYER 3	0.3873	0.3498	0.3873	0.3748	0.3873	0.3748
	0.3873	0.3873	0.3748	0.3873	0.3748	0.3873
LATERAL DRAINAGE COLLECTED FROM LAYER 3	0.6843	0.6144	0.6773	0.6532	0.6733	0.6503
	0.6711	0.6704	0.6483	0.6695	0.6476	0.6690
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.1061	0.0959	0.1061	0.1027	0.1061	0.1027
	0.1061	0.1061	0.1027	0.1061	0.1027	0.1061

MONTHLY TOTALS (IN INCHES) FOR YEAR 3

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	7.06	1.11	2.48	2.14	2.69	7.65
	6.60	4.24	3.95	1.63	1.57	1.38
RUNOFF	2.786	0.003	0.009	0.057	0.477	1.445
	3.181	0.979	0.920	0.053	0.088	0.106
EVAPOTRANSPIRATION	0.690	1.503	2.295	2.863	2.854	6.305
	4.128	3.663	1.846	1.435	0.689	0.427
SUBSURFACE INFLOW INTO LAYER 3	0.3873	0.3498	0.3873	0.3748	0.3873	0.3748
	0.3873	0.3873	0.3748	0.3873	0.3748	0.3873
LATERAL DRAINAGE COLLECTED FROM LAYER 3	0.6689	0.6040	0.6687	0.6471	0.6686	0.6470
	0.6685	0.6685	0.6469	0.6685	0.6469	0.6685
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.1061	0.0959	0.1061	0.1027	0.1061	0.1027
	0.1061	0.1061	0.1027	0.1061	0.1027	0.1061

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 4	5.837	5.836	5.835	5.835	5.834	5.834
	5.834	5.834	5.834	5.834	5.834	5.833
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 4	0.000	0.000	0.001	0.002	0.003	0.000
	0.000	0.002	0.001	0.000	0.003	0.000

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ANNUAL TOTALS FOR YEAR 3

	INCHES	CU. FEET	PERCENT
PRECIPITATION	42.50	154274.984	100.00
RUNOFF	10.104	36679.020	23.78
EVAPOTRANSPIRATION	28.697	104170.680	67.52
SUBSURFACE INFLOW INTO LAYER 3	4.560000	16552.799	10.73
DRAINAGE COLLECTED FROM LAYER 3	7.8720	28575.287	18.52
PERC./LEAKAGE THROUGH LAYER 4	1.249560	4535.904	2.94

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 4	5.972	5.937	5.910	5.890	5.875	5.864
	5.856	5.850	5.846	5.843	5.840	5.838
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 4	0.012	0.008	0.007	0.005	0.001	0.004
	0.000	0.002	0.000	0.000	0.002	0.002

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ANNUAL TOTALS FOR YEAR 2

	INCHES	CU. FEET	PERCENT
PRECIPITATION	44.60	161897.969	100.00
RUNOFF	11.685	42417.039	26.20
EVAPOTRANSPIRATION	27.228	98839.391	61.05
SUBSURFACE INFLOW INTO LAYER 3	4.560000	16552.799	10.22
DRAINAGE COLLECTED FROM LAYER 3	7.9287	28781.104	17.78
PERC./LEAKAGE THROUGH LAYER 4	1.249617	4536.110	2.80
AVG. HEAD ON TOP OF LAYER 4	5.8768		
CHANGE IN WATER STORAGE	5.628	20429.828	12.62
SOIL WATER AT START OF YEAR	632.114	2294573.750	
SOIL WATER AT END OF YEAR	637.742	2315003.750	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	-4.5600	-16552.701	-10.22

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AVG. HEAD ON TOP OF LAYER 4	5.8345		
CHANGE IN WATER STORAGE	3.697	13419.858	8.70
SOIL WATER AT START OF YEAR	637.742	2315003.750	
SOIL WATER AT END OF YEAR	641.425	2328372.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.014	51.515	0.03
ANNUAL WATER BUDGET BALANCE	-4.5600	-16552.961	-10.73

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MONTHLY TOTALS (IN INCHES) FOR YEAR 4

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	4.44	2.19	3.41	4.62	2.81	4.90
	3.62	4.51	2.34	4.37	3.12	1.74
RUNOFF	2.726	1.113	0.788	0.220	0.263	0.505
	0.094	0.882	0.138	1.072	0.380	0.039
EVAPOTRANSPIRATION	0.369	0.669	1.921	3.518	4.263	5.143
	3.467	4.122	1.283	1.332	0.841	0.712
SUBSURFACE INFLOW INTO LAYER 3	0.3873	0.3623	0.3873	0.3748	0.3873	0.3748
	0.3873	0.3873	0.3748	0.3873	0.3748	0.3873
LATERAL DRAINAGE COLLECTED FROM LAYER 3	0.6685	0.6253	0.6685	0.6469	0.6685	0.6469
	0.6685	0.6684	0.6469	0.6684	0.6469	0.6684
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.1061	0.0993	0.1061	0.1027	0.1061	0.1027
	0.1061	0.1061	0.1027	0.1061	0.1027	0.1061

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 4	5.833	5.833	5.833	5.833	5.833	5.833
	5.833	5.833	5.833	5.833	5.833	5.833

STD. DEVIATION OF DAILY	0.000	0.003	0.003	0.005	0.000	0.004
HEAD ON TOP OF LAYER 4	0.001	0.000	0.000	0.003	0.003	0.004

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ANNUAL TOTALS FOR YEAR 4

	INCHES	CU. FEET	PERCENT
PRECIPITATION	42.07	152714.141	100.00
RUNOFF	8.221	29843.949	19.54
EVAPOTRANSPIRATION	27.640	100332.555	65.70
SUBSURFACE INFLOW INTO LAYER 3	4.572493	16598.150	10.87
DRAINAGE COLLECTED FROM LAYER 3	7.8921	28648.244	18.76
PERC./LEAKAGE THROUGH LAYER 4	1.252983	4548.330	2.98
AVG. HEAD ON TOP OF LAYER 4	5.8334		
CHANGE IN WATER STORAGE	6.209	22537.615	14.76
SOIL WATER AT START OF YEAR	641.425	2328372.000	
SOIL WATER AT END OF YEAR	647.648	2350961.250	
SNOW WATER AT START OF YEAR	0.014	51.515	0.03
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	-4.5726	-16598.400	-10.87

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MONTHLY TOTALS (IN INCHES) FOR YEAR 5

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	0.98	4.73	8.53	3.09	5.72	3.65
	5.57	8.02	7.27	4.94	3.35	3.28
RUNOFF	0.133	2.760	2.590	0.131	1.365	0.799
	0.850	1.906	2.660	2.396	0.334	0.216
EVAPOTRANSPIRATION	0.596	0.573	2.376	3.493	4.680	3.663
	5.703	4.535	3.263	1.387	1.287	0.835
SUBSURFACE INFLOW INTO LAYER 3	0.3873	0.3498	0.3873	0.3748	0.3873	0.3748
	0.3873	0.3873	0.3748	0.3873	0.3748	0.3873
LATERAL DRAINAGE COLLECTED FROM LAYER 3	0.6684	0.6038	0.6684	0.6469	0.6684	0.6469
	0.6684	0.6684	0.6469	0.6684	0.6469	0.6684
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.1061	0.0959	0.1061	0.1027	0.1061	0.1027
	0.1061	0.1061	0.1027	0.1061	0.1027	0.1061

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 4	5.833	5.833	5.833	5.833	5.833	5.833
	5.833	5.833	5.833	5.833	5.833	5.833
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 4	0.005	0.002	0.001	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000

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ANNUAL TOTALS FOR YEAR 5

	INCHES	CU. FEET	PERCENT
PRECIPITATION	59.13	214641.937	100.00
RUNOFF	16.140	58589.238	27.30
EVAPOTRANSPIRATION	32.391	117580.430	54.78
SUBSURFACE INFLOW INTO LAYER 3	4.560000	16552.799	7.71
DRAINAGE COLLECTED FROM LAYER 3	7.8705	28569.816	13.31
PERC./LEAKAGE THROUGH LAYER 4	1.249560	4535.902	2.11
AVG. HEAD ON TOP OF LAYER 4	5.8334		
CHANGE IN WATER STORAGE	10.598	38471.930	17.92
SOIL WATER AT START OF YEAR	647.648	2350961.250	
SOIL WATER AT END OF YEAR	658.246	2389433.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	-4.5599	-16552.586	-7.71

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MONTHLY TOTALS (IN INCHES) FOR YEAR 6

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	3.86	2.45	4.12	3.55	4.92	5.49
	5.26	7.83	3.95	2.25	4.13	1.23
RUNOFF	0.327	2.079	0.743	0.340	0.839	0.945
	1.177	2.261	0.880	0.252	1.202	0.108
EVAPOTRANSPIRATION	0.695	0.997	2.723	3.955	3.285	6.703
	4.321	4.933	2.883	1.023	0.824	0.511
SUBSURFACE INFLOW INTO LAYER 3	0.3873	0.3498	0.3873	0.3748	0.3873	0.3748
	0.3873	0.3873	0.3748	0.3873	0.3748	0.3873
LATERAL DRAINAGE COLLECTED FROM LAYER 3	0.6684	0.6038	0.6684	0.6469	0.6684	0.6469
	0.6684	0.6684	0.6469	0.6684	0.6469	0.6684
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.1061	0.0959	0.1061	0.1027	0.1061	0.1027
	0.1061	0.1061	0.1027	0.1061	0.1027	0.1061

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 4	5.833	5.833	5.833	5.833	5.833	5.833
	5.833	5.833	5.833	5.833	5.833	5.833
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 4	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000

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ANNUAL TOTALS FOR YEAR 6

	INCHES	CU. FEET	PERCENT
PRECIPITATION	49.04	178015.187	100.00
RUNOFF	11.153	40483.594	22.74
EVAPOTRANSPIRATION	32.855	119262.039	67.00
SUBSURFACE INFLOW INTO LAYER 3	4.560000	16552.799	9.30
DRAINAGE COLLECTED FROM LAYER 3	7.8705	28569.814	16.05
PERC./LEAKAGE THROUGH LAYER 4	1.249560	4535.902	2.55
AVG. HEAD ON TOP OF LAYER 4	5.8334		
CHANGE IN WATER STORAGE	5.033	18269.420	10.26
SOIL WATER AT START OF YEAR	658.246	2389433.000	
SOIL WATER AT END OF YEAR	663.279	2407702.500	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	-4.5600	-16552.783	-9.30

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MONTHLY TOTALS (IN INCHES) FOR YEAR 7

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	4.59	1.40	5.75	4.02	1.74	2.86
	1.55	5.61	5.53	1.83	7.03	4.38
RUNOFF	1.944	0.802	1.245	0.269	0.031	0.610
	0.009	1.265	1.701	0.438	2.049	1.403
EVAPOTRANSPIRATION	0.766	0.316	1.594	3.708	3.106	3.802
	1.548	4.181	1.916	1.522	1.198	0.814
SUBSURFACE INFLOW INTO LAYER 3	0.3873	0.3498	0.3873	0.3748	0.3873	0.3748
	0.3873	0.3873	0.3748	0.3873	0.3748	0.3873

LATERAL DRAINAGE COLLECTED FROM LAYER 3	0.6684	0.6038	0.6684	0.6469	0.6684	0.6469
	0.6684	0.6684	0.6469	0.6684	0.6469	0.6684
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.1061	0.0959	0.1061	0.1027	0.1061	0.1027
	0.1061	0.1061	0.1027	0.1061	0.1027	0.1061

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 4	5.833	5.833	5.833	5.833	5.833	5.833
	5.833	5.833	5.833	5.833	5.833	5.833
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 4	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000

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ANNUAL TOTALS FOR YEAR 7

	INCHES	CU. FEET	PERCENT
PRECIPITATION	46.29	168032.703	100.00
RUNOFF	11.764	42704.168	25.41
EVAPOTRANSPIRATION	24.471	88829.359	52.86
SUBSURFACE INFLOW INTO LAYER 3	4.560000	16552.799	9.85
DRAINAGE COLLECTED FROM LAYER 3	7.8705	28569.814	17.00
PERC./LEAKAGE THROUGH LAYER 4	1.249560	4535.902	2.70
AVG. HEAD ON TOP OF LAYER 4	5.8334		
CHANGE IN WATER STORAGE	10.055	36499.402	21.72
SOIL WATER AT START OF YEAR	663.279	2407702.500	
SOIL WATER AT END OF YEAR	673.334	2444202.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	-4.5601	-16553.143	-9.85

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SUBSURFACE INFLOW INTO LAYER 3	4.572493	16598.150	11.09			
DRAINAGE COLLECTED FROM LAYER 3	7.8920	28648.088	19.14			
PERC./LEAKAGE THROUGH LAYER 4	1.252983	4548.330	3.04			
AVG. HEAD ON TOP OF LAYER 4	5.8334					
CHANGE IN WATER STORAGE	5.910	21451.873	14.33			
SOIL WATER AT START OF YEAR	673.334	2444202.000				
SOIL WATER AT END OF YEAR	679.243	2465653.750				
SNOW WATER AT START OF YEAR	0.000	0.000	0.00			
SNOW WATER AT END OF YEAR	0.000	0.000	0.00			
ANNUAL WATER BUDGET BALANCE	-4.5725	-16598.279	-11.09			

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MONTHLY TOTALS (IN INCHES) FOR YEAR 9

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	4.63	2.81	2.61	4.64	3.92	5.10
	5.22	6.98	10.80	0.60	4.39	3.09
RUNOFF	2.828	2.240	0.612	0.613	0.132	0.846
	1.666	2.141	4.366	0.018	0.420	0.651
EVAPOTRANSPIRATION	0.399	0.192	1.613	3.944	4.339	5.133
	3.647	4.345	3.169	1.601	1.170	0.623
SUBSURFACE INFLOW INTO LAYER 3	0.3873	0.3498	0.3873	0.3748	0.3873	0.3748
	0.3873	0.3873	0.3748	0.3873	0.3748	0.3873
LATERAL DRAINAGE COLLECTED FROM LAYER 3	0.6684	0.6038	0.6684	0.6469	0.6684	0.6469
	0.6684	0.6684	0.6469	0.6684	0.6469	0.6684
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.1061	0.0959	0.1061	0.1027	0.1061	0.1027
	0.1061	0.1061	0.1027	0.1061	0.1027	0.1061

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

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MONTHLY TOTALS (IN INCHES) FOR YEAR 8

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	5.72	2.50	3.55	6.62	2.47	3.30
	1.89	4.41	1.64	3.14	2.70	3.30
RUNOFF	1.759	0.688	0.446	1.820	0.029	0.442
	0.179	0.857	0.138	0.599	0.654	0.559
EVAPOTRANSPIRATION	1.216	1.661	2.692	4.385	3.188	4.667
	1.539	3.809	1.536	1.138	0.871	0.460
SUBSURFACE INFLOW INTO LAYER 3	0.3873	0.3623	0.3873	0.3748	0.3873	0.3748
	0.3873	0.3873	0.3748	0.3873	0.3748	0.3873
LATERAL DRAINAGE COLLECTED FROM LAYER 3	0.6684	0.6253	0.6684	0.6469	0.6684	0.6469
	0.6684	0.6684	0.6469	0.6684	0.6469	0.6684
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.1061	0.0993	0.1061	0.1027	0.1061	0.1027
	0.1061	0.1061	0.1027	0.1061	0.1027	0.1061

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 4	5.833	5.833	5.833	5.833	5.833	5.833
	5.833	5.833	5.833	5.833	5.833	5.833
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 4	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000

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ANNUAL TOTALS FOR YEAR 8

	INCHES	CU. FEET	PERCENT
PRECIPITATION	41.24	149701.187	100.00
RUNOFF	8.169	29654.473	19.81
EVAPOTRANSPIRATION	27.161	98594.859	65.86

AVERAGE DAILY HEAD ON TOP OF LAYER 4	5.833	5.833	5.833	5.833	5.833	5.833
	5.833	5.833	5.833	5.833	5.833	5.833
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 4	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000

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ANNUAL TOTALS FOR YEAR 9

	INCHES	CU. FEET	PERCENT
PRECIPITATION	54.79	198887.719	100.00
RUNOFF	16.532	60010.840	30.17
EVAPOTRANSPIRATION	30.175	109536.453	55.07
SUBSURFACE INFLOW INTO LAYER 3	4.560000	16552.799	8.32
DRAINAGE COLLECTED FROM LAYER 3	7.8705	28569.814	14.36
PERC./LEAKAGE THROUGH LAYER 4	1.249560	4535.902	2.28
AVG. HEAD ON TOP OF LAYER 4	5.8334		
CHANGE IN WATER STORAGE	8.083	29340.520	14.75
SOIL WATER AT START OF YEAR	679.243	2465653.750	
SOIL WATER AT END OF YEAR	687.030	2493918.500	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.296	1075.748	0.54
ANNUAL WATER BUDGET BALANCE	-4.5601	-16553.010	-8.32

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MONTHLY TOTALS (IN INCHES) FOR YEAR 10

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	3.98	2.12	4.68	3.52	3.38	4.46
	6.20	5.67	11.97	7.03	2.02	2.41
RUNOFF	2.512	1.409	1.382	0.471	0.110	0.557
	2.408	1.455	6.389	2.106	0.061	0.167
EVAPOTRANSPIRATION	0.475	0.417	2.738	3.000	3.158	6.169
	3.085	3.928	2.535	1.719	1.062	0.583
SUBSURFACE INFLOW INTO LAYER 3	0.3873	0.3498	0.3873	0.3748	0.3873	0.3748
	0.3873	0.3873	0.3748	0.3873	0.3748	0.3873
LATERAL DRAINAGE COLLECTED FROM LAYER 3	0.6684	0.6038	0.6684	0.6469	0.6684	0.6469
	0.6684	0.6684	0.6469	0.6684	0.6469	0.6684
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.1061	0.0959	0.1061	0.1027	0.1061	0.1027
	0.1061	0.1061	0.1027	0.1061	0.1027	0.1061

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 4	5.833	5.833	5.833	5.833	5.833	5.833
	5.833	5.833	5.833	5.833	5.833	5.833
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 4	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000

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ANNUAL TOTALS FOR YEAR 10

	INCHES	CU. FEET	PERCENT
PRECIPITATION	57.44	208507.234	100.00
RUNOFF	19.027	69066.852	33.12
EVAPOTRANSPIRATION	28.870	104798.945	50.26
SUBSURFACE INFLOW INTO LAYER 3	4.560000	16552.799	7.94
DRAINAGE COLLECTED FROM LAYER 3	7.8705	28569.814	13.70
PERC./LEAKAGE THROUGH LAYER 4	1.249560	4535.902	2.18
AVG. HEAD ON TOP OF LAYER 4	5.8334		
CHANGE IN WATER STORAGE	9.543	34641.332	16.61
SOIL WATER AT START OF YEAR	687.030	2493918.500	
SOIL WATER AT END OF YEAR	696.869	2529635.750	
SNOW WATER AT START OF YEAR	0.296	1075.748	0.52
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	-4.5600	-16552.812	-7.94

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MONTHLY TOTALS (IN INCHES) FOR YEAR 11

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	3.93	3.22	3.86	2.79	1.90	6.67
	10.86	3.62	1.46	1.67	2.93	2.27
RUNOFF	2.682	1.434	0.499	0.307	0.093	0.986
	3.871	0.526	0.217	0.159	0.498	0.353
EVAPOTRANSPIRATION	0.152	0.758	2.953	3.862	2.045	6.084
	6.811	4.078	0.705	1.234	0.764	0.503
SUBSURFACE INFLOW INTO LAYER 3	0.3873	0.3498	0.3873	0.3748	0.3873	0.3748
	0.3873	0.3873	0.3748	0.3873	0.3748	0.3873
LATERAL DRAINAGE COLLECTED FROM LAYER 3	0.6684	0.6038	0.6684	0.6469	0.6684	0.6469
	0.6684	0.6684	0.6469	0.6684	0.6469	0.6684
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.1061	0.0959	0.1061	0.1027	0.1061	0.1027
	0.1061	0.1061	0.1027	0.1061	0.1027	0.1061

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 4	5.833	5.833	5.833	5.833	5.833	5.833
	5.833	5.833	5.833	5.833	5.833	5.833
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 4	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000

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ANNUAL TOTALS FOR YEAR 11

	INCHES	CU. FEET	PERCENT
PRECIPITATION	45.18	164003.359	100.00
RUNOFF	11.625	42199.598	25.73
EVAPOTRANSPIRATION	29.950	108717.641	66.29
SUBSURFACE INFLOW INTO LAYER 3	4.560000	16552.799	10.09
DRAINAGE COLLECTED FROM LAYER 3	7.8705	28569.814	17.42
PERC./LEAKAGE THROUGH LAYER 4	1.249560	4535.902	2.77
AVG. HEAD ON TOP OF LAYER 4	5.8334		
CHANGE IN WATER STORAGE	3.605	13085.857	7.98
SOIL WATER AT START OF YEAR	696.869	2529635.750	
SOIL WATER AT END OF YEAR	700.474	2542721.500	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	-4.5600	-16552.658	-10.09

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MONTHLY TOTALS (IN INCHES) FOR YEAR 12

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	8.05	2.10	8.59	9.03	4.39	8.03
	5.35	3.72	2.36	6.26	5.12	5.83
RUNOFF	0.436	3.049	8.575	3.208	0.547	2.506
	1.712	0.574	0.455	2.480	1.866	1.370
EVAPOTRANSPIRATION	0.693	0.450	1.951	4.034	5.292	7.422
	3.646	3.146	0.754	1.114	1.104	0.809
SUBSURFACE INFLOW INTO LAYER 3	0.3873	0.3623	0.3873	0.3748	0.3873	0.3748
	0.3873	0.3873	0.3748	0.3873	0.3748	0.3873
LATERAL DRAINAGE COLLECTED FROM LAYER 3	0.6684	0.6253	0.6684	0.6469	0.6684	0.6469
	0.6684	0.6684	0.6469	0.6684	0.6469	0.6684
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.1061	0.0993	0.1061	0.1027	0.1061	0.1027
	0.1061	0.1061	0.1027	0.1061	0.1027	0.1061

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 4	5.833	5.833	5.833	5.833	5.833	5.833
	5.833	5.833	5.833	5.833	5.833	5.833
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 4	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000

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ANNUAL TOTALS FOR YEAR 12

	INCHES	CU. FEET	PERCENT
PRECIPITATION	68.83	249852.844	100.00
RUNOFF	26.778	97205.555	38.91
EVAPOTRANSPIRATION	30.414	110404.172	44.19
SUBSURFACE INFLOW INTO LAYER 3	4.572493	16598.150	6.64
DRAINAGE COLLECTED FROM LAYER 3	7.8920	28648.088	11.47
PERC./LEAKAGE THROUGH LAYER 4	1.252983	4548.330	1.82
AVG. HEAD ON TOP OF LAYER 4	5.8334		
CHANGE IN WATER STORAGE	11.637	42243.359	16.91
SOIL WATER AT START OF YEAR	700.474	2542721.500	
SOIL WATER AT END OF YEAR	710.070	2577553.500	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	2.042	7411.400	2.97

ANNUAL WATER BUDGET BALANCE	-4.5726	-16598.498	-6.64

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MONTHLY TOTALS (IN INCHES) FOR YEAR 13

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	2.02	1.24	5.86	2.65	2.08	1.82
	3.99	0.38	6.34	6.41	1.89	4.28
RUNOFF	0.692	0.523	1.699	0.262	0.019	0.193
	1.401	0.000	1.821	3.027	0.095	0.857
EVAPOTRANSPIRATION	0.550	0.240	2.354	3.218	2.230	3.507
	2.589	0.380	2.126	1.840	1.181	0.768
SUBSURFACE INFLOW INTO LAYER 3	0.3873	0.3498	0.3873	0.3748	0.3873	0.3748
	0.3873	0.3873	0.3748	0.3873	0.3748	0.3873
LATERAL DRAINAGE COLLECTED FROM LAYER 3	0.6684	0.6038	0.6684	0.6469	0.6684	0.6469
	0.6684	0.6684	0.6469	0.6684	0.6469	0.6684
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.1061	0.0959	0.1061	0.1027	0.1061	0.1027
	0.1061	0.1061	0.1027	0.1061	0.1027	0.1061

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 4	5.833	5.833	5.833	5.833	5.833	5.833
	5.833	5.833	5.833	5.833	5.833	5.833
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 4	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000

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ANNUAL TOTALS FOR YEAR 13

	INCHES	CU. FEET	PERCENT
PRECIPITATION	38.96	141424.828	100.00
RUNOFF	10.589	38439.430	27.18
EVAPOTRANSPIRATION	20.982	76165.945	53.86
SUBSURFACE INFLOW INTO LAYER 3	4.560000	16552.799	11.70
DRAINAGE COLLECTED FROM LAYER 3	7.8705	28569.814	20.20
PERC./LEAKAGE THROUGH LAYER 4	1.249560	4535.902	3.21
AVG. HEAD ON TOP OF LAYER 4	5.8334		
CHANGE IN WATER STORAGE	7.388	26819.229	18.96
SOIL WATER AT START OF YEAR	710.070	2577553.500	
SOIL WATER AT END OF YEAR	718.781	2609175.500	
SNOW WATER AT START OF YEAR	2.042	7411.400	5.24
SNOW WATER AT END OF YEAR	0.719	2608.595	1.84
ANNUAL WATER BUDGET BALANCE	-4.5600	-16552.699	-11.70

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MONTHLY TOTALS (IN INCHES) FOR YEAR 14

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	1.68	0.64	4.01	4.21	3.90	3.86
	2.56	1.74	2.98	2.88	1.21	8.76
RUNOFF	0.046	0.630	0.512	0.384	0.213	0.364
	0.344	0.150	0.205	0.143	0.076	3.412
EVAPOTRANSPIRATION	0.658	0.321	2.773	4.338	3.226	5.094
	2.987	1.493	2.264	1.616	0.762	0.617
SUBSURFACE INFLOW INTO LAYER 3	0.3873	0.3498	0.3873	0.3748	0.3873	0.3748
	0.3873	0.3873	0.3748	0.3873	0.3748	0.3873
LATERAL DRAINAGE COLLECTED FROM LAYER 3	0.6684	0.6038	0.6684	0.6469	0.6684	0.6469
	0.6684	0.6684	0.6469	0.6684	0.6469	0.6684
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.1061	0.0959	0.1061	0.1027	0.1061	0.1027
	0.1061	0.1061	0.1027	0.1061	0.1027	0.1061

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 4	5.833	5.833	5.833	5.833	5.833	5.833
	5.833	5.833	5.833	5.833	5.833	5.833
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 4	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000

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ANNUAL TOTALS FOR YEAR 14

	INCHES	CU. FEET	PERCENT
PRECIPITATION	38.43	139500.906	100.00
RUNOFF	6.480	23520.609	16.86
EVAPOTRANSPIRATION	26.150	94923.398	68.05
SUBSURFACE INFLOW INTO LAYER 3	4.560000	16552.799	11.87
DRAINAGE COLLECTED FROM LAYER 3	7.8705	28569.814	20.48
PERC./LEAKAGE THROUGH LAYER 4	1.249560	4535.902	3.25
AVG. HEAD ON TOP OF LAYER 4	5.8334		
CHANGE IN WATER STORAGE	5.801	21057.088	15.09
SOIL WATER AT START OF YEAR	718.781	2609175.500	
SOIL WATER AT END OF YEAR	723.758	2627242.500	
SNOW WATER AT START OF YEAR	0.719	2608.595	1.87
SNOW WATER AT END OF YEAR	1.542	5598.767	4.01
ANNUAL WATER BUDGET BALANCE	-4.5601	-16553.113	-11.87

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MONTHLY TOTALS (IN INCHES) FOR YEAR 15

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	0.95	4.60	4.04	0.69	3.91	2.40
	2.68	12.91	4.59	3.00	3.10	4.24
RUNOFF	0.756	3.549	1.093	0.000	1.501	0.364
	0.227	6.362	1.216	0.451	0.612	0.196
EVAPOTRANSPIRATION	0.627	0.524	2.292	1.757	1.861	4.181
	2.454	5.616	2.975	1.405	0.777	0.460
SUBSURFACE INFLOW INTO LAYER 3	0.3873	0.3498	0.3873	0.3748	0.3873	0.3748
	0.3873	0.3873	0.3748	0.3873	0.3748	0.3873
LATERAL DRAINAGE COLLECTED FROM LAYER 3	0.6684	0.6038	0.6684	0.6469	0.6684	0.6469
	0.6684	0.6684	0.6469	0.6684	0.6469	0.6684
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.1061	0.0959	0.1061	0.1027	0.1061	0.1027
	0.1061	0.1061	0.1027	0.1061	0.1027	0.1061

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 4	5.833	5.833	5.833	5.833	5.833	5.833
	5.833	5.833	5.833	5.833	5.833	5.833
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 4	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000

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ANNUAL TOTALS FOR YEAR 15

	INCHES	CU. FEET	PERCENT
PRECIPITATION	47.11	171009.375	100.00
RUNOFF	16.327	59265.539	34.66
EVAPOTRANSPIRATION	24.929	90491.781	52.92
SUBSURFACE INFLOW INTO LAYER 3	4.560000	16552.799	9.68

DRAINAGE COLLECTED FROM LAYER 3	7.8705	28569.814	16.71
PERC./LEAKAGE THROUGH LAYER 4	1.249560	4535.902	2.65
AVG. HEAD ON TOP OF LAYER 4	5.8334		
CHANGE IN WATER STORAGE	5.855	21251.996	12.43
SOIL WATER AT START OF YEAR	723.758	2627242.500	
SOIL WATER AT END OF YEAR	729.003	2646282.500	
SNOW WATER AT START OF YEAR	1.542	5598.767	3.27
SNOW WATER AT END OF YEAR	2.152	7810.766	4.57
ANNUAL WATER BUDGET BALANCE	-4.5600	-16552.863	-9.68

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MONTHLY TOTALS (IN INCHES) FOR YEAR 16

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	3.42	2.71	4.10	3.22	1.44	4.36
	5.56	3.22	3.06	0.90	2.77	3.04
RUNOFF	1.533	1.711	0.993	0.297	0.037	0.750
	0.959	0.399	0.334	0.132	0.283	0.231
EVAPOTRANSPIRATION	0.649	0.356	2.176	4.061	2.249	4.714
	3.578	4.229	1.231	1.112	0.715	0.488
SUBSURFACE INFLOW INTO LAYER 3	0.3873	0.3623	0.3873	0.3748	0.3873	0.3748
	0.3873	0.3873	0.3748	0.3873	0.3748	0.3873
LATERAL DRAINAGE COLLECTED FROM LAYER 3	0.6684	0.6253	0.6684	0.6469	0.6684	0.6469
	0.6684	0.6684	0.6469	0.6684	0.6469	0.6684
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.1061	0.0993	0.1061	0.1027	0.1061	0.1027
	0.1061	0.1061	0.1027	0.1061	0.1027	0.1061

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

PRECIPITATION	0.66	1.49	3.09	2.64	1.65	2.73
	2.67	1.56	3.30	2.64	5.00	1.38
RUNOFF	0.000	0.472	0.473	0.018	0.022	0.232
	0.235	0.004	0.189	0.380	1.105	0.018
EVAPOTRANSPIRATION	0.680	0.382	2.418	2.419	2.109	4.551
	2.301	1.426	2.747	1.613	0.920	0.645
SUBSURFACE INFLOW INTO LAYER 3	0.3873	0.3498	0.3873	0.3748	0.3873	0.3748
	0.3873	0.3873	0.3748	0.3873	0.3748	0.3873
LATERAL DRAINAGE COLLECTED FROM LAYER 3	0.6684	0.6038	0.6684	0.6469	0.6684	0.6469
	0.6684	0.6684	0.6469	0.6684	0.6469	0.6684
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.1061	0.0959	0.1061	0.1027	0.1061	0.1027
	0.1061	0.1061	0.1027	0.1061	0.1027	0.1061

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 4	5.833	5.833	5.833	5.833	5.833	5.833
	5.833	5.833	5.833	5.833	5.833	5.833
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 4	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000

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ANNUAL TOTALS FOR YEAR 17

	INCHES	CU. FEET	PERCENT
PRECIPITATION	28.81	104580.328	100.00
RUNOFF	3.148	11425.474	10.93
EVAPOTRANSPIRATION	22.210	80621.289	77.09
SUBSURFACE INFLOW INTO LAYER 3	4.560000	16552.799	15.83
DRAINAGE COLLECTED FROM LAYER 3	7.8705	28569.814	27.32
PERC./LEAKAGE THROUGH LAYER 4	1.249560	4535.902	4.34
AVG. HEAD ON TOP OF LAYER 4	5.8334		
CHANGE IN WATER STORAGE	3.453	12533.515	11.98
SOIL WATER AT START OF YEAR	735.739	2670730.750	

AVERAGE DAILY HEAD ON TOP OF LAYER 4	5.833	5.833	5.833	5.833	5.833	5.833
	5.833	5.833	5.833	5.833	5.833	5.833
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 4	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000

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ANNUAL TOTALS FOR YEAR 16

	INCHES	CU. FEET	PERCENT
PRECIPITATION	37.80	137213.984	100.00
RUNOFF	7.659	27802.449	20.26
EVAPOTRANSPIRATION	25.558	92773.930	67.61
SUBSURFACE INFLOW INTO LAYER 3	4.572493	16598.150	12.10
DRAINAGE COLLECTED FROM LAYER 3	7.8920	28648.088	20.88
PERC./LEAKAGE THROUGH LAYER 4	1.252983	4548.330	3.31
AVG. HEAD ON TOP OF LAYER 4	5.8334		
CHANGE IN WATER STORAGE	4.583	16637.676	12.13
SOIL WATER AT START OF YEAR	729.003	2646282.500	
SOIL WATER AT END OF YEAR	735.739	2670730.750	
SNOW WATER AT START OF YEAR	2.152	7810.766	5.69
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	-4.5725	-16598.338	-12.10

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MONTHLY TOTALS (IN INCHES) FOR YEAR 17

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC

SOIL WATER AT END OF YEAR	739.191	2683264.250	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	-4.5600	-16552.865	-15.83

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MONTHLY TOTALS (IN INCHES) FOR YEAR 18

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	1.87	1.39	4.15	2.02	1.86	5.95
	2.42	5.10	3.84	3.78	1.81	7.26
RUNOFF	0.106	0.139	2.006	0.028	0.034	0.471
	0.088	0.738	1.507	0.657	0.164	2.034
EVAPOTRANSPIRATION	0.967	0.595	1.893	2.788	1.925	6.364
	3.337	3.493	1.579	1.463	1.101	0.655
SUBSURFACE INFLOW INTO LAYER 3	0.3873	0.3498	0.3873	0.3748	0.3873	0.3748
	0.3873	0.3873	0.3748	0.3873	0.3748	0.3873
LATERAL DRAINAGE COLLECTED FROM LAYER 3	0.6684	0.6038	0.6684	0.6469	0.6684	0.6469
	0.6684	0.6684	0.6469	0.6684	0.6469	0.6684
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.1061	0.0959	0.1061	0.1027	0.1061	0.1027
	0.1061	0.1061	0.1027	0.1061	0.1027	0.1061

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 4	5.833	5.833	5.833	5.833	5.833	5.833
	5.833	5.833	5.833	5.833	5.833	5.833
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 4	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000

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ANNUAL TOTALS FOR YEAR 18

	INCHES	CU. FEET	PERCENT
PRECIPITATION	41.45	150463.469	100.00
RUNOFF	7.971	28933.273	19.23
EVAPOTRANSPIRATION	26.160	94962.250	63.11
SUBSURFACE INFLOW INTO LAYER 3	4.560000	16552.799	11.00
DRAINAGE COLLECTED FROM LAYER 3	7.8705	28569.814	18.99
PERC./LEAKAGE THROUGH LAYER 4	1.249560	4535.902	3.01
AVG. HEAD ON TOP OF LAYER 4	5.8334		
CHANGE IN WATER STORAGE	7.319	26567.859	17.66
SOIL WATER AT START OF YEAR	739.191	2683264.250	
SOIL WATER AT END OF YEAR	746.510	2709832.250	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	-4.5600	-16552.830	-11.00

MONTHLY TOTALS (IN INCHES) FOR YEAR 19

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	2.12	4.54	4.19	4.19	7.87	5.80
	2.92	0.75	7.04	2.82	1.75	0.61
RUNOFF	0.403	1.156	2.459	0.190	1.733	1.001
	0.388	0.005	2.515	0.661	0.030	0.000
EVAPOTRANSPIRATION	0.807	0.664	1.740	4.066	4.564	6.615
	3.334	0.357	1.542	1.781	1.228	0.749
SUBSURFACE INFLOW INTO LAYER 3	0.3873	0.3498	0.3873	0.3748	0.3873	0.3748
	0.3873	0.3873	0.3748	0.3873	0.3748	0.3873
LATERAL DRAINAGE COLLECTED FROM LAYER 3	0.6684	0.6038	0.6684	0.6469	0.6684	0.6469
	0.6684	0.6684	0.6469	0.6684	0.6469	0.6684
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.1061	0.0959	0.1061	0.1027	0.1061	0.1027
	0.1061	0.1061	0.1027	0.1061	0.1027	0.1061

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 4	5.833	5.833	5.833	5.833	5.833	5.833
	5.833	5.833	5.833	5.833	5.833	5.833
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 4	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000

ANNUAL TOTALS FOR YEAR 19

	INCHES	CU. FEET	PERCENT
PRECIPITATION	44.60	161897.969	100.00
RUNOFF	10.540	38260.137	23.63
EVAPOTRANSPIRATION	27.447	99633.500	61.54
SUBSURFACE INFLOW INTO LAYER 3	4.560000	16552.799	10.22
DRAINAGE COLLECTED FROM LAYER 3	7.8705	28569.814	17.65
PERC./LEAKAGE THROUGH LAYER 4	1.249560	4535.902	2.80
AVG. HEAD ON TOP OF LAYER 4	5.8334		
CHANGE IN WATER STORAGE	6.613	24004.437	14.83
SOIL WATER AT START OF YEAR	746.510	2709832.250	
SOIL WATER AT END OF YEAR	753.123	2733836.750	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	-4.5601	-16553.025	-10.22

MONTHLY TOTALS (IN INCHES) FOR YEAR 20

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	7.06	1.11	2.48	2.14	2.69	7.65
	6.60	4.40	3.85	1.57	1.57	1.38
RUNOFF	4.385	0.002	0.491	0.062	0.448	1.478
	3.148	0.977	0.921	0.061	0.100	0.064
EVAPOTRANSPIRATION	0.546	1.403	0.939	2.937	2.861	6.820
	4.041	3.489	1.649	1.429	0.595	0.578
SUBSURFACE INFLOW INTO LAYER 3	0.3873	0.3623	0.3873	0.3748	0.3873	0.3748
	0.3873	0.3873	0.3748	0.3873	0.3748	0.3873
LATERAL DRAINAGE COLLECTED FROM LAYER 3	0.6684	0.6253	0.6684	0.6469	0.6684	0.6469
	0.6684	0.6684	0.6469	0.6684	0.6469	0.6684
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.1061	0.0993	0.1061	0.1027	0.1061	0.1027
	0.1061	0.1061	0.1027	0.1061	0.1027	0.1061

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 4	5.833	5.833	5.833	5.833	5.833	5.833
	5.833	5.833	5.833	5.833	5.833	5.833
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 4	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000

ANNUAL TOTALS FOR YEAR 20

	INCHES	CU. FEET	PERCENT
PRECIPITATION	42.50	154274.984	100.00
RUNOFF	12.138	44061.629	28.56
EVAPOTRANSPIRATION	27.290	99064.391	64.21
SUBSURFACE INFLOW INTO LAYER 3	4.572493	16598.150	10.76
DRAINAGE COLLECTED FROM LAYER 3	7.8920	28648.088	18.57
PERC./LEAKAGE THROUGH LAYER 4	1.252983	4548.330	2.95
AVG. HEAD ON TOP OF LAYER 4	5.8334		
CHANGE IN WATER STORAGE	3.071	11148.779	7.23
SOIL WATER AT START OF YEAR	753.123	2733836.750	
SOIL WATER AT END OF YEAR	756.194	2744985.500	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	-4.5725	-16598.086	-10.76

MONTHLY TOTALS (IN INCHES) FOR YEAR 21

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	4.44	2.19	3.41	4.62	2.81	4.90
	3.62	4.51	2.28	4.43	3.12	1.74
RUNOFF	0.717	1.766	1.049	0.201	0.233	0.500
	0.094	0.881	0.139	1.064	0.378	0.036
EVAPOTRANSPIRATION	0.946	0.399	2.172	3.447	4.393	4.896
	3.593	4.305	1.252	1.438	0.903	0.740
SUBSURFACE INFLOW INTO LAYER 3	0.3873	0.3498	0.3873	0.3748	0.3873	0.3748
	0.3873	0.3873	0.3748	0.3873	0.3748	0.3873
LATERAL DRAINAGE COLLECTED FROM LAYER 3	0.6684	0.6038	0.6684	0.6469	0.6684	0.6469
	0.6684	0.6684	0.6469	0.6684	0.6469	0.6684
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.1061	0.0959	0.1061	0.1027	0.1061	0.1027
	0.1061	0.1061	0.1027	0.1061	0.1027	0.1061

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON	5.833	5.833	5.833	5.833	5.833	5.833
TOP OF LAYER 4	5.833	5.833	5.833	5.833	5.833	5.833
STD. DEVIATION OF DAILY	0.000	0.000	0.000	0.000	0.000	0.000
HEAD ON TOP OF LAYER 4	0.000	0.000	0.000	0.000	0.000	0.000

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ANNUAL TOTALS FOR YEAR 21

	INCHES	CU. FEET	PERCENT
PRECIPITATION	42.07	152714.141	100.00
RUNOFF	7.059	25623.549	16.78
EVAPOTRANSPIRATION	28.485	103399.289	67.71
SUBSURFACE INFLOW INTO LAYER 3	4.560000	16552.799	10.84
DRAINAGE COLLECTED FROM LAYER 3	7.8705	28569.814	18.71
PERC./LEAKAGE THROUGH LAYER 4	1.249560	4535.902	2.97
AVG. HEAD ON TOP OF LAYER 4	5.8334		
CHANGE IN WATER STORAGE	6.527	23691.377	15.51
SOIL WATER AT START OF YEAR	756.194	2744985.500	
SOIL WATER AT END OF YEAR	762.721	2768676.750	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	-4.5601	-16552.996	-10.84

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AVG. HEAD ON TOP OF LAYER 4	5.8334					
CHANGE IN WATER STORAGE	10.035	36427.848	16.97			
SOIL WATER AT START OF YEAR	762.721	2768676.750				
SOIL WATER AT END OF YEAR	772.335	2803577.750				
SNOW WATER AT START OF YEAR	0.000	0.000	0.00			
SNOW WATER AT END OF YEAR	0.421	1526.985	0.71			
ANNUAL WATER BUDGET BALANCE	-4.5600	-16552.949	-7.71			

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MONTHLY TOTALS (IN INCHES) FOR YEAR 23

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	3.86	2.45	4.12	3.55	4.92	5.49
	5.26	7.83	3.95	2.25	4.13	1.23
RUNOFF	2.816	0.321	0.736	0.361	0.816	0.942
	1.198	2.258	0.875	0.247	1.193	0.108
EVAPOTRANSPIRATION	0.505	1.229	2.797	3.775	3.254	6.675
	4.306	4.987	3.249	1.196	0.788	0.525
SUBSURFACE INFLOW INTO	0.3873	0.3498	0.3873	0.3748	0.3873	0.3748
LAYER 3	0.3873	0.3873	0.3748	0.3873	0.3748	0.3873
LATERAL DRAINAGE COLLECTED	0.6684	0.6038	0.6684	0.6469	0.6684	0.6469
FROM LAYER 3	0.6684	0.6684	0.6469	0.6684	0.6469	0.6684
PERCOLATION/LEAKAGE THROUGH	0.1061	0.0959	0.1061	0.1027	0.1061	0.1027
LAYER 4	0.1061	0.1061	0.1027	0.1061	0.1027	0.1061

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON	5.833	5.833	5.833	5.833	5.833	5.833
TOP OF LAYER 4	5.833	5.833	5.833	5.833	5.833	5.833

MONTHLY TOTALS (IN INCHES) FOR YEAR 22

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	0.98	4.73	8.53	3.09	5.72	3.65
	5.57	8.02	7.27	4.94	3.35	3.28
RUNOFF	0.010	3.089	3.430	0.125	1.363	0.797
	0.872	1.915	2.550	2.397	0.335	0.067
EVAPOTRANSPIRATION	0.897	0.432	2.231	3.806	4.535	3.308
	5.705	4.526	3.523	1.450	1.151	0.582
SUBSURFACE INFLOW INTO	0.3873	0.3498	0.3873	0.3748	0.3873	0.3748
LAYER 3	0.3873	0.3873	0.3748	0.3873	0.3748	0.3873
LATERAL DRAINAGE COLLECTED	0.6684	0.6038	0.6684	0.6469	0.6684	0.6469
FROM LAYER 3	0.6684	0.6684	0.6469	0.6684	0.6469	0.6684
PERCOLATION/LEAKAGE THROUGH	0.1061	0.0959	0.1061	0.1027	0.1061	0.1027
LAYER 4	0.1061	0.1061	0.1027	0.1061	0.1027	0.1061

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON	5.833	5.833	5.833	5.833	5.833	5.833
TOP OF LAYER 4	5.833	5.833	5.833	5.833	5.833	5.833
STD. DEVIATION OF DAILY	0.000	0.000	0.000	0.000	0.000	0.000
HEAD ON TOP OF LAYER 4	0.000	0.000	0.000	0.000	0.000	0.000

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ANNUAL TOTALS FOR YEAR 22

	INCHES	CU. FEET	PERCENT
PRECIPITATION	59.13	214641.937	100.00
RUNOFF	16.949	61524.535	28.66
EVAPOTRANSPIRATION	32.146	116689.578	54.36
SUBSURFACE INFLOW INTO LAYER 3	4.560000	16552.799	7.71
DRAINAGE COLLECTED FROM LAYER 3	7.8705	28569.814	13.31
PERC./LEAKAGE THROUGH LAYER 4	1.249560	4535.902	2.11

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ANNUAL TOTALS FOR YEAR 23

	INCHES	CU. FEET	PERCENT
PRECIPITATION	49.04	178015.187	100.00
RUNOFF	11.871	43092.879	24.21
EVAPOTRANSPIRATION	33.288	120834.461	67.88
SUBSURFACE INFLOW INTO LAYER 3	4.560000	16552.799	9.30
DRAINAGE COLLECTED FROM LAYER 3	7.8705	28569.814	16.05
PERC./LEAKAGE THROUGH LAYER 4	1.249560	4535.902	2.55
AVG. HEAD ON TOP OF LAYER 4	5.8334		
CHANGE IN WATER STORAGE	3.881	14087.952	7.91
SOIL WATER AT START OF YEAR	772.335	2803577.750	
SOIL WATER AT END OF YEAR	776.637	2819192.500	
SNOW WATER AT START OF YEAR	0.421	1526.985	0.86
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	-4.5601	-16553.025	-9.30

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MONTHLY TOTALS (IN INCHES) FOR YEAR 24

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	4.59	1.40	6.05	3.72	1.78	2.82
	2.29	5.56	4.84	1.83	7.03	4.79

RUNOFF	0.202	1.845	2.226	0.225	0.031	0.610
	0.069	1.252	1.659	0.439	2.086	1.367
EVAPOTRANSPIRATION	0.678	0.437	2.229	3.449	2.855	3.817
	1.649	4.152	1.881	1.511	1.167	0.788
SUBSURFACE INFLOW INTO LAYER 3	0.3873	0.3623	0.3873	0.3748	0.3873	0.3748
	0.3873	0.3873	0.3748	0.3873	0.3748	0.3873
LATERAL DRAINAGE COLLECTED FROM LAYER 3	0.6684	0.6253	0.6684	0.6469	0.6684	0.6469
	0.6684	0.6684	0.6469	0.6684	0.6469	0.6684
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.1061	0.0993	0.1061	0.1027	0.1061	0.1027
	0.1061	0.1061	0.1027	0.1061	0.1027	0.1061

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 4	5.833	5.833	5.833	5.833	5.833	5.833
	5.833	5.833	5.833	5.833	5.833	5.833
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 4	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000

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ANNUAL TOTALS FOR YEAR 24

	INCHES	CU. FEET	PERCENT
PRECIPITATION	46.70	169521.000	100.00
RUNOFF	12.009	43591.117	25.71
EVAPOTRANSPIRATION	24.611	89338.828	52.70
SUBSURFACE INFLOW INTO LAYER 3	4.572493	16598.150	9.79
DRAINAGE COLLECTED FROM LAYER 3	7.8920	28648.088	16.90
PERC./LEAKAGE THROUGH LAYER 4	1.252983	4548.330	2.68
AVG. HEAD ON TOP OF LAYER 4	5.8334		
CHANGE IN WATER STORAGE	10.080	36590.906	21.58
SOIL WATER AT START OF YEAR	776.637	2819192.500	
SOIL WATER AT END OF YEAR	786.717	2855783.500	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	-4.5725	-16598.121	-9.79

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MONTHLY TOTALS (IN INCHES) FOR YEAR 25

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	5.72	2.50	3.55	6.62	2.37	3.40
	1.71	4.59	1.64	3.14	2.70	3.09
RUNOFF	1.819	1.641	0.505	1.880	0.032	0.443
	0.179	0.854	0.138	0.599	0.668	0.339
EVAPOTRANSPIRATION	0.865	0.283	2.307	4.292	2.959	4.702
	1.388	3.860	1.744	0.929	0.899	0.586
SUBSURFACE INFLOW INTO LAYER 3	0.3873	0.3498	0.3873	0.3748	0.3873	0.3748
	0.3873	0.3873	0.3748	0.3873	0.3748	0.3873
LATERAL DRAINAGE COLLECTED FROM LAYER 3	0.6684	0.6038	0.6684	0.6469	0.6684	0.6469
	0.6684	0.6684	0.6469	0.6684	0.6469	0.6684
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.1061	0.0959	0.1061	0.1027	0.1061	0.1027
	0.1061	0.1061	0.1027	0.1061	0.1027	0.1061

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 4	5.833	5.833	5.833	5.833	5.833	5.833
	5.833	5.833	5.833	5.833	5.833	5.833
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 4	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000

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ANNUAL TOTALS FOR YEAR 25

	INCHES	CU. FEET	PERCENT
PRECIPITATION	41.03	148938.891	100.00
RUNOFF	9.099	33030.348	22.18
EVAPOTRANSPIRATION	24.813	90072.211	60.48
SUBSURFACE INFLOW INTO LAYER 3	4.560000	16552.799	11.11
DRAINAGE COLLECTED FROM LAYER 3	7.8705	28569.814	19.18
PERC./LEAKAGE THROUGH LAYER 4	1.249560	4535.902	3.05
AVG. HEAD ON TOP OF LAYER 4	5.8334		
CHANGE IN WATER STORAGE	7.117	25836.412	17.35
SOIL WATER AT START OF YEAR	786.717	2855783.500	
SOIL WATER AT END OF YEAR	793.317	2879742.250	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.517	1877.615	1.26
ANNUAL WATER BUDGET BALANCE	-4.5601	-16552.996	-11.11

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MONTHLY TOTALS (IN INCHES) FOR YEAR 26

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	4.63	2.81	2.61	4.64	3.92	5.10
	5.22	6.98	10.80	0.60	4.39	3.09
RUNOFF	2.142	3.506	0.064	0.546	0.137	0.818
	1.759	2.133	4.406	0.018	0.733	0.221
EVAPOTRANSPIRATION	0.385	1.056	2.618	4.154	4.082	5.127
	3.486	4.363	3.039	1.499	1.276	0.807
SUBSURFACE INFLOW INTO LAYER 3	0.3873	0.3498	0.3873	0.3748	0.3873	0.3748
	0.3873	0.3873	0.3748	0.3873	0.3748	0.3873
LATERAL DRAINAGE COLLECTED FROM LAYER 3	0.6684	0.6038	0.6684	0.6469	0.6684	0.6469
	0.6684	0.6684	0.6469	0.6684	0.6469	0.6684
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.1061	0.0959	0.1061	0.1027	0.1061	0.1027
	0.1061	0.1061	0.1027	0.1061	0.1027	0.1061

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 4	5.833	5.833	5.833	5.833	5.833	5.833
	5.833	5.833	5.833	5.833	5.833	5.833
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 4	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000

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ANNUAL TOTALS FOR YEAR 26

	INCHES	CU. FEET	PERCENT
PRECIPITATION	54.79	198887.719	100.00
RUNOFF	16.484	59835.863	30.09
EVAPOTRANSPIRATION	31.894	115774.953	58.21
SUBSURFACE INFLOW INTO LAYER 3	4.560000	16552.799	8.32
DRAINAGE COLLECTED FROM LAYER 3	7.8705	28569.814	14.36
PERC./LEAKAGE THROUGH LAYER 4	1.249560	4535.902	2.28
AVG. HEAD ON TOP OF LAYER 4	5.8334		
CHANGE IN WATER STORAGE	6.412	23276.930	11.70
SOIL WATER AT START OF YEAR	793.317	2879742.250	
SOIL WATER AT END OF YEAR	800.247	2904896.750	
SNOW WATER AT START OF YEAR	0.517	1877.615	0.94
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	-4.5600	-16552.947	-8.32

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MONTHLY TOTALS (IN INCHES) FOR YEAR 27

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	3.98	2.12	4.68	3.52	3.38	4.46
	6.20	5.67	11.97	7.03	2.02	2.41
RUNOFF	0.783	1.354	1.713	0.478	0.106	0.565
	2.394	1.452	6.423	2.114	0.014	0.169
EVAPOTRANSPIRATION	1.266	0.466	1.852	3.245	3.132	6.184
	3.100	4.100	2.386	1.760	1.119	1.074
SUBSURFACE INFLOW INTO LAYER 3	0.3873	0.3498	0.3873	0.3748	0.3873	0.3748
	0.3873	0.3873	0.3748	0.3873	0.3748	0.3873
LATERAL DRAINAGE COLLECTED FROM LAYER 3	0.6684	0.6038	0.6684	0.6469	0.6684	0.6469
	0.6684	0.6684	0.6469	0.6684	0.6469	0.6684
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.1061	0.0959	0.1061	0.1027	0.1061	0.1027
	0.1061	0.1061	0.1027	0.1061	0.1027	0.1061

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 4	5.833	5.833	5.833	5.833	5.833	5.833
	5.833	5.833	5.833	5.833	5.833	5.833
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 4	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000

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ANNUAL TOTALS FOR YEAR 27

	INCHES	CU. FEET	PERCENT
PRECIPITATION	57.44	208507.234	100.00
RUNOFF	17.565	63762.047	30.58
EVAPOTRANSPIRATION	29.684	107753.109	51.68
SUBSURFACE INFLOW INTO LAYER 3	4.560000	16552.799	7.94
DRAINAGE COLLECTED FROM LAYER 3	7.8705	28569.814	13.70
PERC./LEAKAGE THROUGH LAYER 4	1.249560	4535.902	2.18
AVG. HEAD ON TOP OF LAYER 4	5.8334		
CHANGE IN WATER STORAGE	10.191	36992.145	17.74
SOIL WATER AT START OF YEAR	800.247	2904896.750	
SOIL WATER AT END OF YEAR	810.438	2941889.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	-4.5600	-16552.980	-7.94

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MONTHLY TOTALS (IN INCHES) FOR YEAR 28

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	3.93	3.22	4.40	2.25	2.75	5.82
	10.86	3.65	1.43	1.67	2.93	2.27
RUNOFF	1.362	2.257	0.895	0.353	0.183	0.891
	3.824	0.531	0.217	0.158	0.496	0.080
EVAPOTRANSPIRATION	0.716	0.607	1.475	2.857	2.071	6.234
	7.000	3.900	0.815	1.164	0.617	0.531
SUBSURFACE INFLOW INTO LAYER 3	0.3873	0.3623	0.3873	0.3748	0.3873	0.3748
	0.3873	0.3873	0.3748	0.3873	0.3748	0.3873
LATERAL DRAINAGE COLLECTED FROM LAYER 3	0.6684	0.6253	0.6684	0.6469	0.6684	0.6469
	0.6684	0.6684	0.6469	0.6684	0.6469	0.6684
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.1061	0.0993	0.1061	0.1027	0.1061	0.1027
	0.1061	0.1061	0.1027	0.1061	0.1027	0.1061

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 4	5.833	5.833	5.833	5.833	5.833	5.833
	5.833	5.833	5.833	5.833	5.833	5.833
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 4	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000

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ANNUAL TOTALS FOR YEAR 28

	INCHES	CU. FEET	PERCENT
PRECIPITATION	45.18	164003.359	100.00
RUNOFF	11.247	40827.258	24.89
EVAPOTRANSPIRATION	27.987	101594.547	61.95
SUBSURFACE INFLOW INTO LAYER 3	4.572493	16598.150	10.12
DRAINAGE COLLECTED FROM LAYER 3	7.8920	28648.088	17.47
PERC./LEAKAGE THROUGH LAYER 4	1.252983	4548.330	2.77
AVG. HEAD ON TOP OF LAYER 4	5.8334		
CHANGE IN WATER STORAGE	5.945	21581.484	13.16
SOIL WATER AT START OF YEAR	810.438	2941889.000	
SOIL WATER AT END OF YEAR	816.383	2963470.500	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	-4.5725	-16598.197	-10.12

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MONTHLY TOTALS (IN INCHES) FOR YEAR 29

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	8.05	2.10	8.59	7.13	6.01	8.31
	5.35	3.72	2.36	6.26	5.12	5.36
RUNOFF	2.880	3.263	3.073	2.395	1.400	2.509
	1.712	0.578	0.441	2.482	1.880	0.919
EVAPOTRANSPIRATION	0.661	0.567	2.436	3.642	5.227	7.298
	3.864	3.154	0.876	1.371	0.861	0.578
SUBSURFACE INFLOW INTO LAYER 3	0.3873	0.3498	0.3873	0.3748	0.3873	0.3748
	0.3873	0.3873	0.3748	0.3873	0.3748	0.3873
LATERAL DRAINAGE COLLECTED FROM LAYER 3	0.6684	0.6038	0.6684	0.6469	0.6684	0.6469
	0.6684	0.6684	0.6469	0.6684	0.6469	0.6684
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.1061	0.0959	0.1061	0.1027	0.1061	0.1027
	0.1061	0.1061	0.1027	0.1061	0.1027	0.1061

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 4	5.833	5.833	5.833	5.833	5.833	5.833
	5.833	5.833	5.833	5.833	5.833	5.833
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 4	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000

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ANNUAL TOTALS FOR YEAR 29

	INCHES	CU. FEET	PERCENT
PRECIPITATION	68.36	248146.750	100.00
RUNOFF	23.531	85415.812	34.42
EVAPOTRANSPIRATION	30.535	110840.922	44.67
SUBSURFACE INFLOW INTO LAYER 3	4.560000	16552.799	6.67
DRAINAGE COLLECTED FROM LAYER 3	7.8705	28569.814	11.51
PERC./LEAKAGE THROUGH LAYER 4	1.249560	4535.902	1.83
AVG. HEAD ON TOP OF LAYER 4	5.8334		

CHANGE IN WATER STORAGE	14.295	51890.102	20.91
SOIL WATER AT START OF YEAR	816.383	2963470.500	
SOIL WATER AT END OF YEAR	829.073	3009534.750	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	1.605	5825.835	2.35
ANNUAL WATER BUDGET BALANCE	-4.5601	-16553.006	-6.67

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MONTHLY TOTALS (IN INCHES) FOR YEAR 30

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	2.02	1.24	5.86	2.65	2.08	1.82
	3.99	0.38	6.34	6.41	1.89	4.28
RUNOFF	1.473	0.557	1.539	0.254	0.018	0.195
	1.413	0.000	1.818	3.012	0.076	0.813
EVAPOTRANSPIRATION	0.572	0.431	2.378	3.450	2.236	3.430
	2.577	0.380	2.107	1.974	1.168	1.045
SUBSURFACE INFLOW INTO LAYER 3	0.3873	0.3498	0.3873	0.3748	0.3873	0.3748
	0.3873	0.3873	0.3748	0.3873	0.3748	0.3873
LATERAL DRAINAGE COLLECTED FROM LAYER 3	0.6684	0.6038	0.6684	0.6469	0.6684	0.6469
	0.6684	0.6684	0.6469	0.6684	0.6469	0.6684
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.1061	0.0959	0.1061	0.1027	0.1061	0.1027
	0.1061	0.1061	0.1027	0.1061	0.1027	0.1061

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 4	5.833	5.833	5.833	5.833	5.833	5.833
	5.833	5.833	5.833	5.833	5.833	5.833
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 4	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000

EVAPOTRANSPIRATION	0.395	1.045	2.015	4.138	3.263	5.107
	3.000	1.572	2.158	1.551	0.887	0.774
SUBSURFACE INFLOW INTO LAYER 3	0.3873	0.3498	0.3873	0.3748	0.3873	0.3748
	0.3873	0.3873	0.3748	0.3873	0.3748	0.3873
LATERAL DRAINAGE COLLECTED FROM LAYER 3	0.6684	0.6038	0.6684	0.6469	0.6684	0.6469
	0.6684	0.6684	0.6469	0.6684	0.6469	0.6684
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.1061	0.0959	0.1061	0.1027	0.1061	0.1027
	0.1061	0.1061	0.1027	0.1061	0.1027	0.1061

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 4	5.833	5.833	5.833	5.833	5.833	5.833
	5.833	5.833	5.833	5.833	5.833	5.833
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 4	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000

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ANNUAL TOTALS FOR YEAR 31

	INCHES	CU. FEET	PERCENT
PRECIPITATION	38.43	139500.906	100.00
RUNOFF	6.751	24506.750	17.57
EVAPOTRANSPIRATION	25.905	94035.906	67.41
SUBSURFACE INFLOW INTO LAYER 3	4.560000	16552.799	11.87
DRAINAGE COLLECTED FROM LAYER 3	7.8705	28569.814	20.48
PERC./LEAKAGE THROUGH LAYER 4	1.249560	4535.902	3.25
AVG. HEAD ON TOP OF LAYER 4	5.8334		
CHANGE IN WATER STORAGE	5.774	20958.223	15.02
SOIL WATER AT START OF YEAR	836.288	3035726.250	
SOIL WATER AT END OF YEAR	842.496	3058260.750	
SNOW WATER AT START OF YEAR	0.434	1576.404	1.13
SNOW WATER AT END OF YEAR	0.000	0.000	0.00

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ANNUAL TOTALS FOR YEAR 30

	INCHES	CU. FEET	PERCENT
PRECIPITATION	38.96	141424.828	100.00
RUNOFF	11.167	40535.691	28.66
EVAPOTRANSPIRATION	21.748	78947.023	55.82
SUBSURFACE INFLOW INTO LAYER 3	4.560000	16552.799	11.70
DRAINAGE COLLECTED FROM LAYER 3	7.8705	28569.814	20.20
PERC./LEAKAGE THROUGH LAYER 4	1.249560	4535.902	3.21
AVG. HEAD ON TOP OF LAYER 4	5.8334		
CHANGE IN WATER STORAGE	6.045	21942.002	15.51
SOIL WATER AT START OF YEAR	829.073	3009534.750	
SOIL WATER AT END OF YEAR	836.288	3035726.250	
SNOW WATER AT START OF YEAR	1.605	5825.835	4.12
SNOW WATER AT END OF YEAR	0.434	1576.404	1.11
ANNUAL WATER BUDGET BALANCE	-4.5600	-16552.809	-11.70

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MONTHLY TOTALS (IN INCHES) FOR YEAR 31

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	1.68	0.64	4.01	4.21	3.90	3.86
	2.56	1.74	2.98	2.88	1.21	8.76
RUNOFF	0.957	0.000	0.269	0.406	0.213	0.363
	0.343	0.151	0.204	0.149	0.072	3.624

ANNUAL WATER BUDGET BALANCE	-4.5600	-16552.895	-11.87

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MONTHLY TOTALS (IN INCHES) FOR YEAR 32

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	0.95	4.60	4.09	0.64	3.91	2.40
	7.38	8.21	4.59	3.00	3.10	4.24
RUNOFF	0.009	2.373	1.180	0.000	1.507	0.365
	3.249	3.365	1.214	0.438	0.073	2.060
EVAPOTRANSPIRATION	0.772	0.645	2.225	1.738	1.967	4.022
	2.565	6.375	2.516	1.238	0.652	0.397
SUBSURFACE INFLOW INTO LAYER 3	0.3873	0.3623	0.3873	0.3748	0.3873	0.3748
	0.3873	0.3873	0.3748	0.3873	0.3748	0.3873
LATERAL DRAINAGE COLLECTED FROM LAYER 3	0.6684	0.6253	0.6684	0.6469	0.6684	0.6469
	0.6684	0.6684	0.6469	0.6684	0.6469	0.6684
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.1061	0.0993	0.1061	0.1027	0.1061	0.1027
	0.1061	0.1061	0.1027	0.1061	0.1027	0.1061

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 4	5.833	5.833	5.833	5.833	5.833	5.833
	5.833	5.833	5.833	5.833	5.833	5.833
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 4	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000

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ANNUAL TOTALS FOR YEAR 32

	INCHES	CU. FEET	PERCENT

PRECIPITATION	47.11	171009.375	100.00
RUNOFF	15.835	57479.812	33.61
EVAPOTRANSPIRATION	25.113	91159.437	53.31
SUBSURFACE INFLOW INTO LAYER 3	4.572493	16598.150	9.71
DRAINAGE COLLECTED FROM LAYER 3	7.8920	28648.088	16.75
PERC./LEAKAGE THROUGH LAYER 4	1.252983	4548.330	2.66
AVG. HEAD ON TOP OF LAYER 4	5.8334		
CHANGE IN WATER STORAGE	6.163	22370.127	13.08
SOIL WATER AT START OF YEAR	842.496	3058260.750	
SOIL WATER AT END OF YEAR	848.630	3080527.250	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.029	103.587	0.06
ANNUAL WATER BUDGET BALANCE	-4.5725	-16598.273	-9.71

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MONTHLY TOTALS (IN INCHES) FOR YEAR 33

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	3.42	2.71	4.10	3.03	1.63	4.32
	5.60	3.22	2.02	1.94	2.77	3.04
RUNOFF	0.841	0.309	0.619	0.310	0.037	0.748
	0.947	0.380	0.121	0.351	0.232	1.233
EVAPOTRANSPIRATION	0.870	1.309	2.163	3.657	2.656	4.487
	3.693	4.277	1.167	1.179	0.523	0.539
SUBSURFACE INFLOW INTO LAYER 3	0.3873	0.3498	0.3873	0.3748	0.3873	0.3748
	0.3873	0.3873	0.3748	0.3873	0.3748	0.3873
LATERAL DRAINAGE COLLECTED FROM LAYER 3	0.6684	0.6038	0.6684	0.6469	0.6684	0.6469
	0.6684	0.6684	0.6469	0.6684	0.6469	0.6684
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.1061	0.0959	0.1061	0.1027	0.1061	0.1027
	0.1061	0.1061	0.1027	0.1061	0.1027	0.1061

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 4	5.833	5.833	5.833	5.833	5.833	5.833
	5.833	5.833	5.833	5.833	5.833	5.833
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 4	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000

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ANNUAL TOTALS FOR YEAR 33

	INCHES	CU. FEET	PERCENT
PRECIPITATION	37.80	137213.984	100.00
RUNOFF	6.129	22248.230	16.21
EVAPOTRANSPIRATION	26.519	96265.578	70.16
SUBSURFACE INFLOW INTO LAYER 3	4.560000	16552.799	12.06
DRAINAGE COLLECTED FROM LAYER 3	7.8705	28569.814	20.82
PERC./LEAKAGE THROUGH LAYER 4	1.249560	4535.902	3.31
AVG. HEAD ON TOP OF LAYER 4	5.8334		
CHANGE IN WATER STORAGE	5.152	18700.230	13.63
SOIL WATER AT START OF YEAR	848.630	3080527.250	
SOIL WATER AT END OF YEAR	853.810	3099331.250	
SNOW WATER AT START OF YEAR	0.029	103.587	0.08
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	-4.5600	-16552.975	-12.06

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MONTHLY TOTALS (IN INCHES) FOR YEAR 34

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	0.66	1.49	3.09	2.64	1.65	2.73
	2.67	1.56	3.30	2.64	5.00	1.38
RUNOFF	0.014	0.224	0.099	0.011	0.022	0.223
	0.235	0.004	0.188	0.387	1.132	0.003
EVAPOTRANSPIRATION	0.536	0.996	2.316	2.657	2.412	4.329
	2.258	1.468	2.649	1.302	1.035	0.610
SUBSURFACE INFLOW INTO LAYER 3	0.3873	0.3498	0.3873	0.3748	0.3873	0.3748
	0.3873	0.3873	0.3748	0.3873	0.3748	0.3873
LATERAL DRAINAGE COLLECTED FROM LAYER 3	0.6684	0.6038	0.6684	0.6469	0.6684	0.6469
	0.6684	0.6684	0.6469	0.6684	0.6469	0.6684
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.1061	0.0959	0.1061	0.1027	0.1061	0.1027
	0.1061	0.1061	0.1027	0.1061	0.1027	0.1061

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 4	5.833	5.833	5.833	5.833	5.833	5.833
	5.833	5.833	5.833	5.833	5.833	5.833
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 4	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000

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ANNUAL TOTALS FOR YEAR 34

	INCHES	CU. FEET	PERCENT
PRECIPITATION	28.81	104580.328	100.00
RUNOFF	2.542	9229.107	8.82
EVAPOTRANSPIRATION	22.568	81920.195	78.33
SUBSURFACE INFLOW INTO LAYER 3	4.560000	16552.799	15.83
DRAINAGE COLLECTED FROM LAYER 3	7.8705	28569.814	27.32
PERC./LEAKAGE THROUGH LAYER 4	1.249560	4535.902	4.34
AVG. HEAD ON TOP OF LAYER 4	5.8334		
CHANGE IN WATER STORAGE	3.700	13431.044	12.84
SOIL WATER AT START OF YEAR	853.810	3099331.250	
SOIL WATER AT END OF YEAR	857.510	3112762.250	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	-4.5600	-16552.937	-15.83

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MONTHLY TOTALS (IN INCHES) FOR YEAR 35

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	1.87	1.39	4.15	2.02	1.86	5.95
	2.42	5.10	3.84	3.78	1.81	7.26
RUNOFF	0.408	0.277	0.479	0.034	0.033	0.477
	0.088	0.747	1.528	0.650	0.180	3.353
EVAPOTRANSPIRATION	0.602	0.728	2.636	2.925	1.954	6.331
	3.311	3.463	1.557	1.484	0.927	0.440
SUBSURFACE INFLOW INTO LAYER 3	0.3873	0.3498	0.3873	0.3748	0.3873	0.3748
	0.3873	0.3873	0.3748	0.3873	0.3748	0.3873
LATERAL DRAINAGE COLLECTED FROM LAYER 3	0.6684	0.6038	0.6684	0.6469	0.6684	0.6469
	0.6684	0.6684	0.6469	0.6684	0.6469	0.6684
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.1061	0.0959	0.1061	0.1027	0.1061	0.1027
	0.1061	0.1061	0.1027	0.1061	0.1027	0.1061

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 4	5.833 5.833	5.833 5.833	5.833 5.833	5.833 5.833	5.833 5.833	5.833 5.833
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 4	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000

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ANNUAL TOTALS FOR YEAR 35

	INCHES	CU. FEET	PERCENT
PRECIPITATION	41.45	150463.469	100.00
RUNOFF	8.255	29964.439	19.91
EVAPOTRANSPIRATION	26.358	95679.812	63.59
SUBSURFACE INFLOW INTO LAYER 3	4.560000	16552.799	11.00
DRAINAGE COLLECTED FROM LAYER 3	7.8705	28569.814	18.99
PERC./LEAKAGE THROUGH LAYER 4	1.249560	4535.902	3.01
AVG. HEAD ON TOP OF LAYER 4	5.8334		
CHANGE IN WATER STORAGE	6.837	24819.328	16.50
SOIL WATER AT START OF YEAR	857.510	3112762.250	
SOIL WATER AT END OF YEAR	864.348	3137581.500	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	-4.5601	-16553.025	-11.00

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MONTHLY TOTALS (IN INCHES) FOR YEAR 36

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	2.12 2.92	4.54 0.75	4.19 8.39	4.19 1.47	8.03 1.75	5.64 0.61
RUNOFF	0.626 0.394	1.582 0.005	1.161 3.150	0.193 0.038	1.721 0.025	1.022 0.000
EVAPOTRANSPIRATION	1.019 2.638	0.897 0.417	2.732 1.490	4.351 1.782	4.527 1.136	7.213 0.809
SUBSURFACE INFLOW INTO LAYER 3	0.3873 0.3873	0.3623 0.3873	0.3873 0.3748	0.3748 0.3873	0.3873 0.3748	0.3748 0.3873
LATERAL DRAINAGE COLLECTED FROM LAYER 3	0.6684 0.6684	0.6253 0.6684	0.6684 0.6469	0.6469 0.6684	0.6684 0.6469	0.6469 0.6684
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.1061 0.1061	0.0993 0.1061	0.1061 0.1027	0.1027 0.1061	0.1061 0.1027	0.1027 0.1061

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 4	5.833 5.833	5.833 5.833	5.833 5.833	5.833 5.833	5.833 5.833	5.833 5.833
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 4	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000

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ANNUAL TOTALS FOR YEAR 36

	INCHES	CU. FEET	PERCENT
PRECIPITATION	44.60	161897.969	100.00
RUNOFF	9.914	35988.570	22.23
EVAPOTRANSPIRATION	29.011	105308.687	65.05
SUBSURFACE INFLOW INTO LAYER 3	4.572493	16598.150	10.25
DRAINAGE COLLECTED FROM LAYER 3	7.8920	28648.088	17.70
PERC./LEAKAGE THROUGH LAYER 4	1.252983	4548.330	2.81
AVG. HEAD ON TOP OF LAYER 4	5.8334		
CHANGE IN WATER STORAGE	5.675	20600.428	12.72
SOIL WATER AT START OF YEAR	864.348	3137581.500	
SOIL WATER AT END OF YEAR	870.023	3158182.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	-4.5724	-16597.988	-10.25

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MONTHLY TOTALS (IN INCHES) FOR YEAR 37

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	7.06 6.60	1.11 4.24	2.48 3.95	2.14 1.63	2.69 1.57	7.65 1.38
RUNOFF	3.601 3.182	0.312 0.987	0.001 0.922	0.055 0.059	0.427 0.082	1.499 0.063
EVAPOTRANSPIRATION	0.778 3.887	0.949 3.555	2.460 1.613	2.764 1.524	2.871 0.761	6.736 0.532
SUBSURFACE INFLOW INTO LAYER 3	0.3873 0.3873	0.3498 0.3873	0.3873 0.3748	0.3748 0.3873	0.3873 0.3748	0.3748 0.3873
LATERAL DRAINAGE COLLECTED FROM LAYER 3	0.6684 0.6684	0.6038 0.6684	0.6684 0.6469	0.6469 0.6684	0.6684 0.6469	0.6469 0.6684
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.1061 0.1061	0.0959 0.1061	0.1061 0.1027	0.1027 0.1061	0.1061 0.1027	0.1027 0.1061

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 4	5.833 5.833	5.833 5.833	5.833 5.833	5.833 5.833	5.833 5.833	5.833 5.833
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 4	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000

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ANNUAL TOTALS FOR YEAR 37

	INCHES	CU. FEET	PERCENT
PRECIPITATION	42.50	154274.984	100.00
RUNOFF	11.191	40625.117	26.33
EVAPOTRANSPIRATION	28.431	103205.461	66.90
SUBSURFACE INFLOW INTO LAYER 3	4.560000	16552.799	10.73
DRAINAGE COLLECTED FROM LAYER 3	7.8705	28569.814	18.52
PERC./LEAKAGE THROUGH LAYER 4	1.249560	4535.902	2.94
AVG. HEAD ON TOP OF LAYER 4	5.8334		
CHANGE IN WATER STORAGE	2.877	10444.447	6.77
SOIL WATER AT START OF YEAR	870.023	3158182.000	
SOIL WATER AT END OF YEAR	872.900	3168626.500	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	-4.5600	-16552.959	-10.73

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MONTHLY TOTALS (IN INCHES) FOR YEAR 38

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	4.44 3.62	2.19 4.51	3.41 2.28	4.62 4.43	2.81 3.12	4.90 1.74
RUNOFF	2.724 0.094	1.260 0.885	1.778 0.140	0.185 1.075	0.230 0.366	0.49. 0.046
EVAPOTRANSPIRATION	0.511 3.328	0.460 4.411	1.911 1.171	3.765 1.326	4.311 0.915	4.977 0.762

SUBSURFACE INFLOW INTO	0.3873	0.3498	0.3873	0.3748	0.3873	0.3748
LAYER 3	0.3873	0.3873	0.3748	0.3873	0.3748	0.3873
LATERAL DRAINAGE COLLECTED	0.6684	0.6038	0.6684	0.6469	0.6684	0.6469
FROM LAYER 3	0.6684	0.6684	0.6469	0.6684	0.6469	0.6684
PERCOLATION/LEAKAGE THROUGH	0.1061	0.0959	0.1061	0.1027	0.1061	0.1027
LAYER 4	0.1061	0.1061	0.1027	0.1061	0.1027	0.1061

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON	5.833	5.833	5.833	5.833	5.833	5.833
TOP OF LAYER 4	5.833	5.833	5.833	5.833	5.833	5.833
STD. DEVIATION OF DAILY	0.000	0.000	0.000	0.000	0.000	0.000
HEAD ON TOP OF LAYER 4	0.000	0.000	0.000	0.000	0.000	0.000

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ANNUAL TOTALS FOR YEAR 38

	INCHES	CU. FEET	PERCENT
PRECIPITATION	42.07	152714.141	100.00
RUNOFF	9.274	33664.473	22.04
EVAPOTRANSPIRATION	27.849	101090.656	66.20
SUBSURFACE INFLOW INTO LAYER 3	4.560000	16552.799	10.84
DRAINAGE COLLECTED FROM LAYER 3	7.8705	28569.814	18.71
PERC./LEAKAGE THROUGH LAYER 4	1.249560	4535.902	2.97
AVG. HEAD ON TOP OF LAYER 4	5.8334		
CHANGE IN WATER STORAGE	4.947	17959.238	11.76
SOIL WATER AT START OF YEAR	872.900	3168626.500	
SOIL WATER AT END OF YEAR	877.847	3186585.750	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	-4.5601	-16553.143	-10.84

RUNOFF	18.928	68707.094	32.01
EVAPOTRANSPIRATION	30.460	110568.914	51.51
SUBSURFACE INFLOW INTO LAYER 3	4.560000	16552.799	7.71
DRAINAGE COLLECTED FROM LAYER 3	7.8705	28569.814	13.31
PERC./LEAKAGE THROUGH LAYER 4	1.249560	4535.902	2.11
AVG. HEAD ON TOP OF LAYER 4	5.8334		
CHANGE IN WATER STORAGE	9.743	35365.691	16.48
SOIL WATER AT START OF YEAR	877.847	3186585.750	
SOIL WATER AT END OF YEAR	887.590	3221951.250	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	-4.5600	-16552.682	-7.71

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MONTHLY TOTALS (IN INCHES) FOR YEAR 40

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	3.86	2.74	3.83	3.55	5.78	4.63
	5.26	7.89	3.89	2.25	4.13	1.23
RUNOFF	0.334	0.166	1.171	0.341	0.963	0.809
	1.179	2.258	0.894	0.247	1.208	0.002
EVAPOTRANSPIRATION	1.114	1.458	2.241	3.984	3.294	6.795
	4.231	4.655	2.913	1.174	0.790	0.576
SUBSURFACE INFLOW INTO	0.3873	0.3623	0.3873	0.3748	0.3873	0.3748
LAYER 3	0.3873	0.3873	0.3748	0.3873	0.3748	0.3873
LATERAL DRAINAGE COLLECTED	0.6684	0.6253	0.6684	0.6469	0.6684	0.6469
FROM LAYER 3	0.6684	0.6684	0.6469	0.6684	0.6469	0.6684
PERCOLATION/LEAKAGE THROUGH	0.1061	0.0993	0.1061	0.1027	0.1061	0.1027
LAYER 4	0.1061	0.1061	0.1027	0.1061	0.1027	0.1061

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MONTHLY TOTALS (IN INCHES) FOR YEAR 39

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	0.98	4.73	8.53	3.09	5.72	3.65
	5.57	8.02	7.27	4.94	3.35	3.28
RUNOFF	0.153	0.890	7.276	0.139	1.396	0.797
	0.875	1.887	2.629	2.380	0.277	0.228
EVAPOTRANSPIRATION	0.477	0.285	1.306	3.692	4.297	3.308
	5.808	4.530	3.603	1.374	0.931	0.849
SUBSURFACE INFLOW INTO	0.3873	0.3498	0.3873	0.3748	0.3873	0.3748
LAYER 3	0.3873	0.3873	0.3748	0.3873	0.3748	0.3873
LATERAL DRAINAGE COLLECTED	0.6684	0.6038	0.6684	0.6469	0.6684	0.6469
FROM LAYER 3	0.6684	0.6684	0.6469	0.6684	0.6469	0.6684
PERCOLATION/LEAKAGE THROUGH	0.1061	0.0959	0.1061	0.1027	0.1061	0.1027
LAYER 4	0.1061	0.1061	0.1027	0.1061	0.1027	0.1061

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON	5.833	5.833	5.833	5.833	5.833	5.833
TOP OF LAYER 4	5.833	5.833	5.833	5.833	5.833	5.833
STD. DEVIATION OF DAILY	0.000	0.000	0.000	0.000	0.000	0.000
HEAD ON TOP OF LAYER 4	0.000	0.000	0.000	0.000	0.000	0.000

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ANNUAL TOTALS FOR YEAR 39

	INCHES	CU. FEET	PERCENT
PRECIPITATION	59.13	214641.937	100.00

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON	5.833	5.833	5.833	5.833	5.833	5.833
TOP OF LAYER 4	5.833	5.833	5.833	5.833	5.833	5.833
STD. DEVIATION OF DAILY	0.000	0.000	0.000	0.000	0.000	0.000
HEAD ON TOP OF LAYER 4	0.000	0.000	0.000	0.000	0.000	0.000

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ANNUAL TOTALS FOR YEAR 40

	INCHES	CU. FEET	PERCENT
PRECIPITATION	49.04	178015.187	100.00
RUNOFF	9.571	34743.996	19.52
EVAPOTRANSPIRATION	33.225	120607.758	67.75
SUBSURFACE INFLOW INTO LAYER 3	4.572493	16598.150	9.32
DRAINAGE COLLECTED FROM LAYER 3	7.8920	28648.088	16.09
PERC./LEAKAGE THROUGH LAYER 4	1.252983	4548.330	2.56
AVG. HEAD ON TOP OF LAYER 4	5.8334		
CHANGE IN WATER STORAGE	6.243	22663.518	12.73
SOIL WATER AT START OF YEAR	887.590	3221951.250	
SOIL WATER AT END OF YEAR	893.644	3243928.750	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.189	686.110	0.39
ANNUAL WATER BUDGET BALANCE	-4.5725	-16598.350	-9.32

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AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1 THROUGH 40

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	3.51	2.48	4.54	3.60	3.57	4.75
	4.54	4.67	4.81	3.30	3.09	3.30
STD. DEVIATIONS	2.09	1.27	1.77	1.65	1.84	1.72
	2.19	2.72	2.88	1.80	1.46	2.20
RUNOFF						
TOTALS	1.259	1.294	1.506	0.434	0.513	0.775
	1.163	1.119	1.507	0.867	0.543	0.708
STD. DEVIATIONS	1.192	1.066	1.758	0.681	0.603	0.521
	1.163	1.180	1.607	0.938	0.601	0.993
EVAPOTRANSPIRATION						
TOTALS	0.698	0.717	2.196	3.476	3.250	5.373
	3.514	3.439	2.018	1.435	0.952	0.656
STD. DEVIATIONS	0.241	0.405	0.440	0.663	1.022	1.258
	1.293	1.544	0.812	0.246	0.213	0.162
SUBSURFACE INFLOW INTO LAYER 3						
TOTALS	0.3873	0.3623	0.3873	0.3748	0.3873	0.3748
	0.3873	0.3873	0.3748	0.3873	0.3748	0.3873
LATERAL DRAINAGE COLLECTED FROM LAYER 3						
TOTALS	0.6844	0.6197	0.6771	0.6530	0.6731	0.6502
	0.6710	0.6703	0.6482	0.6695	0.6476	0.6690
STD. DEVIATIONS	0.0982	0.0645	0.0530	0.0378	0.0288	0.0206
	0.0157	0.0115	0.0082	0.0062	0.0045	0.0033
PERCOLATION/LEAKAGE THROUGH LAYER 4						
TOTALS	0.1061	0.0967	0.1061	0.1027	0.1061	0.1027
	0.1061	0.1061	0.1027	0.1061	0.1027	0.1061
STD. DEVIATIONS	0.0001	0.0015	0.0001	0.0001	0.0001	0.0001
	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001

AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)

DAILY AVERAGE HEAD ON TOP OF LAYER 4

AVERAGES	5.9692	5.9340	5.9084	5.8887	5.8742	5.8635
	5.8556	5.8497	5.8454	5.8423	5.8399	5.8382
STD. DEVIATIONS	0.8361	0.6198	0.4617	0.3406	0.2514	0.1855
	0.1370	0.1006	0.0742	0.0548	0.0405	0.0299

AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1 THROUGH 40

	INCHES		CU. FEET	PERCENT
PRECIPITATION	46.15	(8.949)	167511.8	100.00
RUNOFF	11.689	(5.1277)	42431.09	25.330
EVAPOTRANSPIRATION	27.723	(3.1516)	100633.95	60.076
SUBSURFACE INFLOW INTO LAYER 3	4.57249		16598.150	9.90864
LATERAL DRAINAGE COLLECTED FROM LAYER 3	7.93315	(0.35199)	28797.344	17.19123
PERCOLATION/LEAKAGE THROUGH LAYER 4	1.25047	(0.00147)	4539.219	2.70979
AVERAGE HEAD ON TOP OF LAYER 4	5.876	(0.261)		
CHANGE IN WATER STORAGE	6.677	(2.5768)	24238.59	14.470

PEAK DAILY VALUES FOR YEARS 1 THROUGH 40

	(INCHES)	(CU. FT.)
PRECIPITATION	5.15	18694.500
RUNOFF	4.002	14528.6201
DRAINAGE COLLECTED FROM LAYER 3	0.04513	163.80904
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.003447	12.51093
AVERAGE HEAD ON TOP OF LAYER 4	11.976	
MAXIMUM HEAD ON TOP OF LAYER 4	15.182	
LOCATION OF MAXIMUM HEAD IN LAYER 3 (DISTANCE FROM DRAIN)	87.0 FEET	
SNOW WATER	8.08	29328.5547

MAXIMUM VEG. SOIL WATER (VOL/VOL) 0.3569

MINIMUM VEG. SOIL WATER (VOL/VOL) 0.1285

*** Maximum heads are computed using McEnroe's equations. ***

Reference: Maximum Saturated Depth over Landfill Liner
by Bruce M. McEnroe, University of Kansas
ASCE Journal of Environmental Engineering
Vol. 119, No. 2, March 1993, pp. 262-270.

FINAL WATER STORAGE AT END OF YEAR 40

LAYER	(INCHES)	(VOL/VOL)
1	3.4411	0.2868
2	501.1009	0.1670
3	2.7100	0.2258
4	386.3923	0.4270
SNOW WATER	0.189	

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**              HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE               **
**                HELP MODEL VERSION 3.07  (1 NOVEMBER 1997)                **
**                  DEVELOPED BY ENVIRONMENTAL LABORATORY                   **
**                    USAE WATERWAYS EXPERIMENT STATION                     **
**              FOR USEPA RISK REDUCTION ENGINEERING LABORATORY             **
**                                                                          **
**                                                                          **
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PRECIPITATION DATA FILE:      P:\PRJ1\MDENG\HELP3\ME0250\40YEARS.D4
TEMPERATURE DATA FILE:        P:\PRJ1\MDENG\HELP3\ME0250\40YEARS.D7
SOLAR RADIATION DATA FILE:    P:\PRJ1\MDENG\HELP3\ME0250\40YEARS.D13
EVAPOTRANSPIRATION DATA:      P:\PRJ1\MDENG\HELP3\ME0250\40YEARS.D11
SOIL AND DESIGN DATA FILE:    P:\PRJ1\MDENG\HELP3\ME0250\CIL4B2.D10
OUTPUT DATA FILE:             P:\PRJ1\MDENG\HELP3\ME0250\CIL4B2.OUT


TIME:  15:57      DATE:   2/26/2003


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     TITLE:  CHERRY ISLAND LANDFILL PHASE IV - RUN B2

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     NOTE:  INITIAL MOISTURE CONTENT OF THE LAYERS AND SNOW WATER
            WERE SPECIFIED BY THE USER.


                                  LAYER  1
                                  --------

                 TYPE 1 - VERTICAL PERCOLATION LAYER
                     MATERIAL TEXTURE NUMBER  22
       THICKNESS                    =     12.00   INCHES
       POROSITY                     =      0.4190 VOL/VOL
       FIELD CAPACITY               =      0.3070 VOL/VOL
       WILTING POINT                =      0.1800 VOL/VOL
       INITIAL SOIL WATER CONTENT   =      0.3621 VOL/VOL
       EFFECTIVE SAT. HYD. COND.    =  0.189999992000E-04 CM/SEC
     NOTE:  SATURATED HYDRAULIC CONDUCTIVITY IS MULTIPLIED BY  4.63
            FOR ROOT CHANNELS IN TOP HALF OF EVAPORATIVE ZONE.


                                  LAYER  2
                                  --------

                 TYPE 1 - VERTICAL PERCOLATION LAYER
                     MATERIAL TEXTURE NUMBER   0
       THICKNESS                    =   3000.00   INCHES
       POROSITY                     =      0.6100 VOL/VOL
       FIELD CAPACITY               =      0.2920 VOL/VOL
       WILTING POINT                =      0.0770 VOL/VOL
       INITIAL SOIL WATER CONTENT   =      0.0770 VOL/VOL
       EFFECTIVE SAT. HYD. COND.    =  0.100000005000E-02 CM/SEC


                                  LAYER  3
                                  --------

                 TYPE 2 - LATERAL DRAINAGE LAYER
                     MATERIAL TEXTURE NUMBER   1
       THICKNESS                    =     12.00   INCHES
       POROSITY                     =      0.4170 VOL/VOL
       FIELD CAPACITY               =      0.0450 VOL/VOL
       WILTING POINT                =      0.0180 VOL/VOL
       INITIAL SOIL WATER CONTENT   =      0.4170 VOL/VOL
       EFFECTIVE SAT. HYD. COND.    =  0.999999978000E-02 CM/SEC
       SLOPE                        =      2.00   PERCENT
       DRAINAGE LENGTH              =     60.0    FEET
       SUBSURFACE INFLOW            =      6.23   INCHES/YR


                                  LAYER  4
                                  --------

                 TYPE 3 - BARRIER SOIL LINER
                     MATERIAL TEXTURE NUMBER  16
       THICKNESS                    =    947.80   INCHES
       POROSITY                     =      0.4270 VOL/VOL
       FIELD CAPACITY               =      0.4180 VOL/VOL
       WILTING POINT                =      0.3670 VOL/VOL
       INITIAL SOIL WATER CONTENT   =      0.4270 VOL/VOL
       EFFECTIVE SAT. HYD. COND.    =  0.100000001000E-06 CM/SEC


                 GENERAL DESIGN AND EVAPORATIVE ZONE DATA
                 ----------------------------------------

     NOTE:  SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT
            SOIL DATA BASE USING SOIL TEXTURE #22 WITH A
            POOR STAND OF GRASS, A SURFACE SLOPE OF  2.%
            AND A SLOPE LENGTH OF 1200. FEET.

       SCS RUNOFF CURVE NUMBER              =     93.10
       FRACTION OF AREA ALLOWING RUNOFF     =    100.0    PERCENT
       AREA PROJECTED ON HORIZONTAL PLANE   =      1.000  ACRES
       EVAPORATIVE ZONE DEPTH               =     24.0    INCHES
       INITIAL WATER IN EVAPORATIVE ZONE    =      5.269  INCHES
       UPPER LIMIT OF EVAPORATIVE STORAGE   =     12.348  INCHES
       LOWER LIMIT OF EVAPORATIVE STORAGE   =      3.084  INCHES
       INITIAL SNOW WATER                   =      0.000  INCHES
       INITIAL WATER IN LAYER MATERIALS     =    645.060  INCHES
       TOTAL INITIAL WATER                  =    645.060  INCHES
       TOTAL SUBSURFACE INFLOW              =      6.23   INCHES/YEAR


                 EVAPOTRANSPIRATION AND WEATHER DATA
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     NOTE:  EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
            ALBANY                    NEW YORK

         STATION LATITUDE                      =  42.45 DEGREES
         MAXIMUM LEAF AREA INDEX               =   3.50
         START OF GROWING SEASON (JULIAN DATE) =   123
         END OF GROWING SEASON (JULIAN DATE)   =   282
         EVAPORATIVE ZONE DEPTH                =  24.0  INCHES
         AVERAGE ANNUAL WIND SPEED             =   8.90 MPH
         AVERAGE 1ST QUARTER RELATIVE HUMIDITY =  68.00 %
         AVERAGE 2ND QUARTER RELATIVE HUMIDITY =  66.00 %
         AVERAGE 3RD QUARTER RELATIVE HUMIDITY =  74.00 %
         AVERAGE 4TH QUARTER RELATIVE HUMIDITY =  74.00 %

     NOTE:  PRECIPITATION DATA FOR     CHERRY ISLAND LF
            WAS ENTERED BY THE USER.

     NOTE:  TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING
            COEFFICIENTS FOR     WILMINGTON          DELAWARE

            NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

       JAN/JUL   FEB/AUG   MAR/SEP   APR/OCT   MAY/NOV   JUN/DEC
       -------   -------   -------   -------   -------   -------
       31.20     33.20     41.80     52.40     62.20     71.20
       76.00     74.80     67.80     56.30     45.60     35.50

     NOTE:  SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
            COEFFICIENTS FOR     WILMINGTON          DELAWARE

            AND STATION LATITUDE  =  39.80 DEGREES

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                 MONTHLY TOTALS (IN INCHES) FOR YEAR    1
------------------------------------------------------------------------------

                              JAN/JUL  FEB/AUG  MAR/SEP  APR/OCT  MAY/NOV  JUN/DEC
                              -------  -------  -------  -------  -------  -------
PRECIPITATION                  1.87     1.39     4.15     2.02     1.86     5.95
                               2.42     5.10     3.84     3.78     1.81     7.26

RUNOFF                         0.095    0.001    0.577    0.031    0.038    0.439
                               0.088    0.761    1.492    0.644    0.157    1.816

EVAPOTRANSPIRATION             1.092    1.466    2.155    2.935    1.981    6.301
                               3.152    3.498    1.588    1.479    1.192    0.865

SUBSURFACE INFLOW INTO         0.5291   0.4779   0.5291   0.5121   0.5291   0.5121
  LAYER  3                     0.5291   0.5291   0.5121   0.5291   0.5121   0.5291

LATERAL DRAINAGE COLLECTED     4.1664   1.3509   1.0750   0.9466   0.9580   0.9230
  FROM LAYER  3                0.9529   0.9527   0.9219   0.9526   0.9219   0.9526

PERCOLATION/LEAKAGE THROUGH    0.1061   0.0955   0.1057   0.1022   0.1056   0.1022
  LAYER  4                     0.1056   0.1056   0.1022   0.1056   0.1022   0.1056

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                 MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)
------------------------------------------------------------------------------

AVERAGE DAILY HEAD ON          6.255    2.553    1.836    1.670    1.636    1.629
  TOP OF LAYER  4              1.627    1.627    1.627    1.627    1.627    1.627

STD. DEVIATION OF DAILY        2.411    0.383    0.095    0.019    0.004    0.001
  HEAD ON TOP OF LAYER  4      0.001    0.001    0.000    0.000    0.001    0.001

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                 ANNUAL TOTALS FOR YEAR    1
------------------------------------------------------------------------------
                                  INCHES          CU. FEET        PERCENT
                                  --------        ----------      -------
  PRECIPITATION                    41.45          150463.469      100.00
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RUNOFF	6.139	22283.998	14.81
EVAPOTRANSPIRATION	27.705	100567.484	66.84
SUBSURFACE INFLOW INTO LAYER 3	6.230000	22614.900	15.03
DRAINAGE COLLECTED FROM LAYER 3	15.0745	54720.383	36.37
PERC./LEAKAGE THROUGH LAYER 4	1.244323	4516.893	3.00
AVG. HEAD ON TOP OF LAYER 4	2.1117		
CHANGE IN WATER STORAGE	3.748	13604.523	9.04
SOIL WATER AT START OF YEAR	645.060	2341567.000	
SOIL WATER AT END OF YEAR	648.808	2355171.500	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	-6.2300	-22614.902	-15.03

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MONTHLY TOTALS (IN INCHES) FOR YEAR 2

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	2.12	4.54	4.19	4.19	7.87	5.80
	2.92	0.75	7.04	2.82	1.75	0.61
RUNOFF	0.337	1.022	3.785	0.176	1.729	1.012
	0.383	0.005	2.549	0.665	0.023	0.000
EVAPOTRANSPIRATION	0.723	0.498	1.731	3.957	4.502	6.707
	3.485	0.390	1.435	1.916	1.297	0.587
SUBSURFACE INFLOW INTO LAYER 3	0.5291	0.4779	0.5291	0.5121	0.5291	0.5121
	0.5291	0.5291	0.5121	0.5291	0.5121	0.5291
LATERAL DRAINAGE COLLECTED FROM LAYER 3	0.9526	0.8604	0.9526	0.9219	0.9526	0.9219
	0.9526	0.9526	0.9219	0.9526	0.9219	0.9526
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.1056	0.0954	0.1056	0.1022	0.1056	0.1022
	0.1056	0.1056	0.1022	0.1056	0.1022	0.1056

MONTHLY TOTALS (IN INCHES) FOR YEAR 3

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	7.06	1.11	2.48	2.14	2.69	7.65
	6.60	4.24	3.95	1.63	1.57	1.38
RUNOFF	2.786	0.003	0.009	0.057	0.477	1.445
	3.181	0.979	0.920	0.053	0.088	0.106
EVAPOTRANSPIRATION	0.690	1.503	2.295	2.863	2.854	6.305
	4.128	3.663	1.846	1.435	0.689	0.427
SUBSURFACE INFLOW INTO LAYER 3	0.5291	0.4779	0.5291	0.5121	0.5291	0.5121
	0.5291	0.5291	0.5121	0.5291	0.5121	0.5291
LATERAL DRAINAGE COLLECTED FROM LAYER 3	0.9526	0.8604	0.9526	0.9219	0.9526	0.9219
	0.9526	0.9526	0.9219	0.9526	0.9219	0.9526
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.1056	0.0954	0.1056	0.1022	0.1056	0.1022
	0.1056	0.1056	0.1022	0.1056	0.1022	0.1056

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 4	1.627	1.627	1.627	1.627	1.627	1.627
	1.627	1.627	1.627	1.627	1.627	1.627
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 4	0.001	0.001	0.001	0.001	0.001	0.001
	0.001	0.001	0.001	0.001	0.001	0.001

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ANNUAL TOTALS FOR YEAR 3

	INCHES	CU. FEET	PERCENT
PRECIPITATION	42.50	154274.984	100.00
RUNOFF	10.104	36679.020	23.78
EVAPOTRANSPIRATION	28.697	104170.680	67.52
SUBSURFACE INFLOW INTO LAYER 3	6.230000	22614.900	14.66
DRAINAGE COLLECTED FROM LAYER 3	11.2163	40715.141	26.39
PERC./LEAKAGE THROUGH LAYER 4	1.243686	4514.580	2.93

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 4	1.627	1.627	1.627	1.627	1.627	1.627
	1.627	1.627	1.627	1.627	1.627	1.627
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 4	0.001	0.001	0.001	0.001	0.001	0.001
	0.001	0.001	0.001	0.001	0.001	0.001

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ANNUAL TOTALS FOR YEAR 2

	INCHES	CU. FEET	PERCENT
PRECIPITATION	44.60	161897.969	100.00
RUNOFF	11.685	42417.039	26.20
EVAPOTRANSPIRATION	27.228	98839.391	61.05
SUBSURFACE INFLOW INTO LAYER 3	6.230000	22614.900	13.97
DRAINAGE COLLECTED FROM LAYER 3	11.2163	40715.141	25.15
PERC./LEAKAGE THROUGH LAYER 4	1.243686	4514.580	2.79
AVG. HEAD ON TOP OF LAYER 4	1.6268		
CHANGE IN WATER STORAGE	5.686	20641.416	12.75
SOIL WATER AT START OF YEAR	648.808	2355171.500	
SOIL WATER AT END OF YEAR	654.494	2375812.750	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	-6.2299	-22614.693	-13.97

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AVG. HEAD ON TOP OF LAYER 4	1.6268		
CHANGE IN WATER STORAGE	3.698	13425.397	8.70
SOIL WATER AT START OF YEAR	654.494	2375812.750	
SOIL WATER AT END OF YEAR	658.178	2389186.750	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.014	51.515	0.03
ANNUAL WATER BUDGET BALANCE	-6.2300	-22614.930	-14.66

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MONTHLY TOTALS (IN INCHES) FOR YEAR 4

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	4.44	2.19	3.41	4.62	2.81	4.90
	3.62	4.51	2.34	4.37	3.12	1.74
RUNOFF	2.726	1.113	0.788	0.220	0.263	0.505
	0.094	0.882	0.138	1.072	0.380	0.039
EVAPOTRANSPIRATION	0.369	0.669	1.921	3.518	4.263	5.143
	3.467	4.122	1.283	1.332	0.841	0.712
SUBSURFACE INFLOW INTO LAYER 3	0.5291	0.4950	0.5291	0.5121	0.5291	0.5121
	0.5291	0.5291	0.5121	0.5291	0.5121	0.5291
LATERAL DRAINAGE COLLECTED FROM LAYER 3	0.9526	0.8912	0.9526	0.9219	0.9526	0.9219
	0.9526	0.9526	0.9219	0.9526	0.9219	0.9526
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.1056	0.0988	0.1056	0.1022	0.1056	0.1022
	0.1056	0.1056	0.1022	0.1056	0.1022	0.1056

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 4	1.627	1.627	1.627	1.627	1.627	1.627
	1.627	1.627	1.627	1.627	1.627	1.627

STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 4	0.001 0.001	0.001 0.001	0.001 0.001	0.001 0.001	0.001 0.001	0.001 0.001

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ANNUAL TOTALS FOR YEAR 4

	INCHES	CU. FEET	PERCENT
PRECIPITATION	42.07	152714.141	100.00
RUNOFF	8.221	29843.949	19.54
EVAPOTRANSPIRATION	27.640	100332.555	65.70
SUBSURFACE INFLOW INTO LAYER 3	6.247069	22676.859	14.85
DRAINAGE COLLECTED FROM LAYER 3	11.2470	40826.687	26.73
PERC./LEAKAGE THROUGH LAYER 4	1.247093	4526.949	2.96
AVG. HEAD ON TOP OF LAYER 4	1.6268		
CHANGE IN WATER STORAGE	6.209	22537.836	14.76
SOIL WATER AT START OF YEAR	658.178	2389186.750	
SOIL WATER AT END OF YEAR	664.401	2411776.000	
SNOW WATER AT START OF YEAR	0.014	51.515	0.03
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	-6.2471	-22676.977	-14.85

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MONTHLY TOTALS (IN INCHES) FOR YEAR 5

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	0.98 5.57	4.73 8.02	8.53 7.27	3.09 4.94	5.72 3.35	3.65 3.28
RUNOFF	0.133 0.850	2.760 1.906	2.590 2.660	0.131 2.396	1.365 0.334	0.799 0.216
EVAPOTRANSPIRATION	0.596 5.703	0.573 4.535	2.376 3.263	3.493 1.387	4.680 1.287	3.663 0.835
SUBSURFACE INFLOW INTO LAYER 3	0.5291 0.5291	0.4779 0.5291	0.5291 0.5121	0.5121 0.5291	0.5291 0.5121	0.5121 0.5291
LATERAL DRAINAGE COLLECTED FROM LAYER 3	0.9526 0.9526	0.8604 0.9526	0.9526 0.9219	0.9219 0.9526	0.9526 0.9219	0.9219 0.9526
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.1056 0.1056	0.0954 0.1056	0.1056 0.1022	0.1022 0.1056	0.1056 0.1022	0.1022 0.1056

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 4	1.627 1.627	1.627 1.627	1.627 1.627	1.627 1.627	1.627 1.627	1.627 1.627
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 4	0.001 0.001	0.001 0.001	0.001 0.001	0.001 0.001	0.001 0.001	0.001 0.001

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ANNUAL TOTALS FOR YEAR 5

	INCHES	CU. FEET	PERCENT
PRECIPITATION	59.13	214641.937	100.00
RUNOFF	16.140	58589.238	27.30
EVAPOTRANSPIRATION	32.391	117580.430	54.78
SUBSURFACE INFLOW INTO LAYER 3	6.230000	22614.900	10.54
DRAINAGE COLLECTED FROM LAYER 3	11.2163	40715.141	18.97
PERC./LEAKAGE THROUGH LAYER 4	1.243686	4514.580	2.10
AVG. HEAD ON TOP OF LAYER 4	1.6268		
CHANGE IN WATER STORAGE	10.598	38471.930	17.92
SOIL WATER AT START OF YEAR	664.401	2411776.000	
SOIL WATER AT END OF YEAR	674.999	2450248.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	-6.2299	-22614.486	-10.54

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MONTHLY TOTALS (IN INCHES) FOR YEAR 6

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	3.86 5.26	2.45 7.83	4.12 3.95	3.55 2.25	4.92 4.13	5.49 1.23
RUNOFF	0.327 1.177	2.079 2.261	0.743 0.880	0.340 0.252	0.839 1.202	0.945 0.108
EVAPOTRANSPIRATION	0.695 4.321	0.997 4.933	2.723 2.883	3.955 1.023	3.285 0.824	6.703 0.511
SUBSURFACE INFLOW INTO LAYER 3	0.5291 0.5291	0.4779 0.5291	0.5291 0.5121	0.5121 0.5291	0.5291 0.5121	0.5121 0.5291
LATERAL DRAINAGE COLLECTED FROM LAYER 3	0.9526 0.9526	0.8604 0.9526	0.9526 0.9219	0.9219 0.9526	0.9526 0.9219	0.9219 0.9526
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.1056 0.1056	0.0954 0.1056	0.1056 0.1022	0.1022 0.1056	0.1056 0.1022	0.1022 0.1056

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 4	1.627 1.627	1.627 1.627	1.627 1.627	1.627 1.627	1.627 1.627	1.627 1.627
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 4	0.001 0.001	0.001 0.001	0.001 0.001	0.001 0.001	0.001 0.001	0.001 0.001

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ANNUAL TOTALS FOR YEAR 6

	INCHES	CU. FEET	PERCENT
PRECIPITATION	49.04	178015.187	100.00
RUNOFF	11.153	40483.594	22.74
EVAPOTRANSPIRATION	32.855	119262.039	67.00
SUBSURFACE INFLOW INTO LAYER 3	6.230000	22614.900	12.70
DRAINAGE COLLECTED FROM LAYER 3	11.2163	40715.141	22.87
PERC./LEAKAGE THROUGH LAYER 4	1.243686	4514.580	2.54
AVG. HEAD ON TOP OF LAYER 4	1.6268		
CHANGE IN WATER STORAGE	5.033	18269.420	10.26
SOIL WATER AT START OF YEAR	674.999	2450248.000	
SOIL WATER AT END OF YEAR	680.032	2468517.500	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	-6.2299	-22614.684	-12.70

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MONTHLY TOTALS (IN INCHES) FOR YEAR 7

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	4.59 1.55	1.40 5.61	5.75 5.53	4.02 1.83	1.74 7.03	2.86 4.38
RUNOFF	1.944 0.009	0.802 1.265	1.245 1.701	0.269 0.438	0.031 2.049	0.610 1.403
EVAPOTRANSPIRATION	0.766 1.548	0.316 4.181	1.594 1.916	3.708 1.522	3.106 1.198	3.802 0.814
SUBSURFACE INFLOW INTO LAYER 3	0.5291 0.5291	0.4779 0.5291	0.5291 0.5121	0.5121 0.5291	0.5291 0.5121	0.5121 0.5291

LATERAL DRAINAGE COLLECTED FROM LAYER 3	0.9526	0.8604	0.9526	0.9219	0.9526	0.9219
	0.9526	0.9526	0.9219	0.9526	0.9219	0.9526
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.1056	0.0954	0.1056	0.1022	0.1056	0.1022
	0.1056	0.1056	0.1022	0.1056	0.1022	0.1056

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 4	1.627	1.627	1.627	1.627	1.627	1.627
	1.627	1.627	1.627	1.627	1.627	1.627
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 4	0.001	0.001	0.001	0.001	0.001	0.001
	0.001	0.001	0.001	0.001	0.001	0.001

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ANNUAL TOTALS FOR YEAR 7

	INCHES	CU. FEET	PERCENT
PRECIPITATION	46.29	168032.703	100.00
RUNOFF	11.764	42704.168	25.41
EVAPOTRANSPIRATION	24.471	88829.359	52.86
SUBSURFACE INFLOW INTO LAYER 3	6.230000	22614.900	13.46
DRAINAGE COLLECTED FROM LAYER 3	11.2163	40715.141	24.23
PERC./LEAKAGE THROUGH LAYER 4	1.243686	4514.580	2.69
AVG. HEAD ON TOP OF LAYER 4	1.6268		
CHANGE IN WATER STORAGE	10.055	36499.402	21.72
SOIL WATER AT START OF YEAR	680.032	2468517.500	
SOIL WATER AT END OF YEAR	690.087	2505016.750	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	-6.2300	-22615.043	-13.46

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SUBSURFACE INFLOW INTO LAYER 3	6.247069	22676.859	15.15			
DRAINAGE COLLECTED FROM LAYER 3	11.2470	40826.687	27.27			
PERC./LEAKAGE THROUGH LAYER 4	1.247093	4526.949	3.02			
AVG. HEAD ON TOP OF LAYER 4	1.6268					
CHANGE IN WATER STORAGE	5.910	21451.873	14.33			
SOIL WATER AT START OF YEAR	690.087	2505016.750				
SOIL WATER AT END OF YEAR	695.997	2526468.750				
SNOW WATER AT START OF YEAR	0.000	0.000	0.00			
SNOW WATER AT END OF YEAR	0.000	0.000	0.00			
ANNUAL WATER BUDGET BALANCE	-6.2470	-22676.787	-15.15			

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MONTHLY TOTALS (IN INCHES) FOR YEAR 9

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	4.63	2.81	2.61	4.64	3.92	5.10
	5.22	6.98	10.80	0.60	4.39	3.09
RUNOFF	2.828	2.240	0.612	0.613	0.132	0.846
	1.666	2.141	4.366	0.018	0.420	0.651
EVAPOTRANSPIRATION	0.399	0.192	1.613	3.944	4.339	5.133
	3.647	4.345	3.169	1.601	1.170	0.623
SUBSURFACE INFLOW INTO LAYER 3	0.5291	0.4779	0.5291	0.5121	0.5291	0.5121
	0.5291	0.5291	0.5121	0.5291	0.5121	0.5291
LATERAL DRAINAGE COLLECTED FROM LAYER 3	0.9526	0.8604	0.9526	0.9219	0.9526	0.9219
	0.9526	0.9526	0.9219	0.9526	0.9219	0.9526
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.1056	0.0954	0.1056	0.1022	0.1056	0.1022
	0.1056	0.1056	0.1022	0.1056	0.1022	0.1056

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

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MONTHLY TOTALS (IN INCHES) FOR YEAR 8

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	5.72	2.50	3.55	6.62	2.47	3.30
	1.89	4.41	1.64	3.14	2.70	3.30
RUNOFF	1.759	0.688	0.446	1.820	0.029	0.442
	0.179	0.857	0.138	0.599	0.654	0.559
EVAPOTRANSPIRATION	1.216	1.661	2.692	4.385	3.188	4.667
	1.539	3.809	1.536	1.138	0.871	0.460
SUBSURFACE INFLOW INTO LAYER 3	0.5291	0.4950	0.5291	0.5121	0.5291	0.5121
	0.5291	0.5291	0.5121	0.5291	0.5121	0.5291
LATERAL DRAINAGE COLLECTED FROM LAYER 3	0.9526	0.8912	0.9526	0.9219	0.9526	0.9219
	0.9526	0.9526	0.9219	0.9526	0.9219	0.9526
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.1056	0.0988	0.1056	0.1022	0.1056	0.1022
	0.1056	0.1056	0.1022	0.1056	0.1022	0.1056

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 4	1.627	1.627	1.627	1.627	1.627	1.627
	1.627	1.627	1.627	1.627	1.627	1.627
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 4	0.001	0.001	0.001	0.001	0.001	0.001
	0.001	0.001	0.001	0.001	0.001	0.001

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ANNUAL TOTALS FOR YEAR 8

	INCHES	CU. FEET	PERCENT
PRECIPITATION	41.24	149701.187	100.00
RUNOFF	8.169	29654.473	19.81
EVAPOTRANSPIRATION	27.161	98594.859	65.86

AVERAGE DAILY HEAD ON TOP OF LAYER 4	1.627	1.627	1.627	1.627	1.627	1.627
	1.627	1.627	1.627	1.627	1.627	1.627
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 4	0.001	0.001	0.001	0.001	0.001	0.001
	0.001	0.001	0.001	0.001	0.001	0.001

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ANNUAL TOTALS FOR YEAR 9

	INCHES	CU. FEET	PERCENT
PRECIPITATION	54.79	198887.719	100.00
RUNOFF	16.532	60010.840	30.17
EVAPOTRANSPIRATION	30.175	109536.453	55.07
SUBSURFACE INFLOW INTO LAYER 3	6.230000	22614.900	11.37
DRAINAGE COLLECTED FROM LAYER 3	11.2163	40715.141	20.47
PERC./LEAKAGE THROUGH LAYER 4	1.243686	4514.580	2.27
AVG. HEAD ON TOP OF LAYER 4	1.6268		
CHANGE IN WATER STORAGE	8.083	29340.520	14.75
SOIL WATER AT START OF YEAR	695.997	2526468.750	
SOIL WATER AT END OF YEAR	703.783	2554733.500	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.296	1075.748	0.54
ANNUAL WATER BUDGET BALANCE	-6.2300	-22614.912	-11.37

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MONTHLY TOTALS (IN INCHES) FOR YEAR 10

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	3.98	2.12	4.68	3.52	3.38	4.46
	6.20	5.67	11.97	7.03	2.02	2.41
RUNOFF	2.512	1.409	1.382	0.471	0.110	0.557
	2.408	1.455	6.389	2.106	0.061	0.167
EVAPOTRANSPIRATION	0.475	0.417	2.738	3.000	3.158	6.169
	3.085	3.928	2.535	1.719	1.062	0.583
SUBSURFACE INFLOW INTO LAYER 3	0.5291	0.4779	0.5291	0.5121	0.5291	0.5121
	0.5291	0.5291	0.5121	0.5291	0.5121	0.5291
LATERAL DRAINAGE COLLECTED FROM LAYER 3	0.9526	0.8604	0.9526	0.9219	0.9526	0.9219
	0.9526	0.9526	0.9219	0.9526	0.9219	0.9526
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.1056	0.0954	0.1056	0.1022	0.1056	0.1022
	0.1056	0.1056	0.1022	0.1056	0.1022	0.1056

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 4	1.627	1.627	1.627	1.627	1.627	1.627
	1.627	1.627	1.627	1.627	1.627	1.627
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 4	0.001	0.001	0.001	0.001	0.001	0.001
	0.001	0.001	0.001	0.001	0.001	0.001

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ANNUAL TOTALS FOR YEAR 10

	INCHES	CU. FEET	PERCENT
PRECIPITATION	57.44	208507.234	100.00
RUNOFF	19.027	69066.852	33.12
EVAPOTRANSPIRATION	28.870	104798.945	50.26
SUBSURFACE INFLOW INTO LAYER 3	6.230000	22614.900	10.85
DRAINAGE COLLECTED FROM LAYER 3	11.2163	40715.141	19.53
PERC./LEAKAGE THROUGH LAYER 4	1.243686	4514.580	2.17
AVG. HEAD ON TOP OF LAYER 4	1.6268		

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ANNUAL TOTALS FOR YEAR 11

	INCHES	CU. FEET	PERCENT
PRECIPITATION	45.18	164003.359	100.00
RUNOFF	11.625	42199.598	25.73
EVAPOTRANSPIRATION	29.950	108717.641	66.29
SUBSURFACE INFLOW INTO LAYER 3	6.230000	22614.900	13.79
DRAINAGE COLLECTED FROM LAYER 3	11.2163	40715.141	24.83
PERC./LEAKAGE THROUGH LAYER 4	1.243686	4514.580	2.75
AVG. HEAD ON TOP OF LAYER 4	1.6268		
CHANGE IN WATER STORAGE	3.605	13085.857	7.98
SOIL WATER AT START OF YEAR	713.623	2590450.500	
SOIL WATER AT END OF YEAR	717.228	2603536.500	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	-6.2299	-22614.559	-13.79

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MONTHLY TOTALS (IN INCHES) FOR YEAR 12

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	8.05	2.10	8.59	9.03	4.39	8.03
	5.35	3.72	2.36	6.26	5.12	5.83
RUNOFF	0.436	3.049	8.575	3.208	0.547	2.506
	1.712	0.574	0.455	2.480	1.866	1.370

CHANGE IN WATER STORAGE	9.543	34641.332	16.61
SOIL WATER AT START OF YEAR	703.783	2554733.500	
SOIL WATER AT END OF YEAR	713.623	2590450.500	
SNOW WATER AT START OF YEAR	0.296	1075.748	0.52
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	-6.2299	-22614.715	-10.85

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MONTHLY TOTALS (IN INCHES) FOR YEAR 11

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	3.93	3.22	3.86	2.79	1.90	6.67
	10.86	3.62	1.46	1.67	2.93	2.27
RUNOFF	2.682	1.434	0.499	0.307	0.093	0.986
	3.871	0.526	0.217	0.159	0.498	0.353
EVAPOTRANSPIRATION	0.152	0.758	2.953	3.862	2.045	6.084
	6.811	4.078	0.705	1.234	0.764	0.503
SUBSURFACE INFLOW INTO LAYER 3	0.5291	0.4779	0.5291	0.5121	0.5291	0.5121
	0.5291	0.5291	0.5121	0.5291	0.5121	0.5291
LATERAL DRAINAGE COLLECTED FROM LAYER 3	0.9526	0.8604	0.9526	0.9219	0.9526	0.9219
	0.9526	0.9526	0.9219	0.9526	0.9219	0.9526
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.1056	0.0954	0.1056	0.1022	0.1056	0.1022
	0.1056	0.1056	0.1022	0.1056	0.1022	0.1056

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 4	1.627	1.627	1.627	1.627	1.627	1.627
	1.627	1.627	1.627	1.627	1.627	1.627
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 4	0.001	0.001	0.001	0.001	0.001	0.001
	0.001	0.001	0.001	0.001	0.001	0.001

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ANNUAL TOTALS FOR YEAR 12

	INCHES	CU. FEET	PERCENT
PRECIPITATION	68.83	249852.844	100.00
RUNOFF	26.778	97205.555	38.91
EVAPOTRANSPIRATION	30.414	110404.172	44.19
SUBSURFACE INFLOW INTO LAYER 3	6.247069	22676.859	9.08
DRAINAGE COLLECTED FROM LAYER 3	11.2470	40826.687	16.34
PERC./LEAKAGE THROUGH LAYER 4	1.247093	4526.949	1.81
AVG. HEAD ON TOP OF LAYER 4	1.6268		
CHANGE IN WATER STORAGE	11.637	42243.359	16.91
SOIL WATER AT START OF YEAR	717.228	2603536.500	
SOIL WATER AT END OF YEAR	726.823	2638368.250	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	2.042	7411.400	2.97

ANNUAL WATER BUDGET BALANCE	-6.2471	-22677.006	-9.08

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MONTHLY TOTALS (IN INCHES) FOR YEAR 13

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	2.02 3.99	1.24 0.38	5.86 6.34	2.65 6.41	2.08 1.89	1.82 4.28
RUNOFF	0.692 1.401	0.523 0.000	1.699 1.821	0.262 3.027	0.019 0.095	0.193 0.857
EVAPOTRANSPIRATION	0.550 2.589	0.240 0.380	2.354 2.126	3.218 1.840	2.230 1.181	3.507 0.768
SUBSURFACE INFLOW INTO LAYER 3	0.5291 0.5291	0.4779 0.5291	0.5291 0.5121	0.5121 0.5291	0.5291 0.5121	0.5121 0.5291
LATERAL DRAINAGE COLLECTED FROM LAYER 3	0.9526 0.9526	0.8604 0.9526	0.9526 0.9219	0.9219 0.9526	0.9526 0.9219	0.9219 0.9526
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.1056 0.1056	0.0954 0.1056	0.1056 0.1022	0.1022 0.1056	0.1056 0.1022	0.1022 0.1056

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 4	1.627 1.627	1.627 1.627	1.627 1.627	1.627 1.627	1.627 1.627	1.627 1.627
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 4	0.001 0.001	0.001 0.001	0.001 0.001	0.001 0.001	0.001 0.001	0.001 0.001

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ANNUAL TOTALS FOR YEAR 13

	INCHES	CU. FEET	PERCENT
PRECIPITATION	38.96	141424.828	100.00
RUNOFF	10.589	38439.430	27.18
EVAPOTRANSPIRATION	20.982	76165.945	53.86
SUBSURFACE INFLOW INTO LAYER 3	6.230000	22614.900	15.99
DRAINAGE COLLECTED FROM LAYER 3	11.2163	40715.141	28.79
PERC./LEAKAGE THROUGH LAYER 4	1.243686	4514.580	3.19
AVG. HEAD ON TOP OF LAYER 4	1.6268		
CHANGE IN WATER STORAGE	7.388	26819.229	18.96
SOIL WATER AT START OF YEAR	726.823	2638368.250	
SOIL WATER AT END OF YEAR	735.535	2669990.500	
SNOW WATER AT START OF YEAR	2.042	7411.400	5.24
SNOW WATER AT END OF YEAR	0.719	2608.595	1.84
ANNUAL WATER BUDGET BALANCE	-6.2299	-22614.602	-15.99

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MONTHLY TOTALS (IN INCHES) FOR YEAR 14

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	1.68 2.56	0.64 1.74	4.01 2.98	4.21 2.88	3.90 1.21	3.86 8.76
RUNOFF	0.046 0.344	0.630 0.150	0.512 0.205	0.384 0.143	0.213 0.076	0.364 3.412
EVAPOTRANSPIRATION	0.658 2.987	0.321 1.493	2.773 2.264	4.338 1.616	3.226 0.762	5.094 0.617
SUBSURFACE INFLOW INTO LAYER 3	0.5291 0.5291	0.4779 0.5291	0.5291 0.5121	0.5121 0.5291	0.5291 0.5121	0.5121 0.5291
LATERAL DRAINAGE COLLECTED FROM LAYER 3	0.9526 0.9526	0.8604 0.9526	0.9526 0.9219	0.9219 0.9526	0.9526 0.9219	0.9219 0.9526
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.1056 0.1056	0.0954 0.1056	0.1056 0.1022	0.1022 0.1056	0.1056 0.1022	0.1022 0.1056

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 4	1.627 1.627	1.627 1.627	1.627 1.627	1.627 1.627	1.627 1.627	1.627 1.627
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 4	0.001 0.001	0.001 0.001	0.001 0.001	0.001 0.001	0.001 0.001	0.001 0.001

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ANNUAL TOTALS FOR YEAR 14

	INCHES	CU. FEET	PERCENT
PRECIPITATION	38.43	139500.906	100.00
RUNOFF	6.480	23520.609	16.86
EVAPOTRANSPIRATION	26.150	94923.398	68.05
SUBSURFACE INFLOW INTO LAYER 3	6.230000	22614.900	16.21
DRAINAGE COLLECTED FROM LAYER 3	11.2163	40715.141	29.19
PERC./LEAKAGE THROUGH LAYER 4	1.243686	4514.580	3.24
AVG. HEAD ON TOP OF LAYER 4	1.6268		
CHANGE IN WATER STORAGE	5.801	21057.088	15.09
SOIL WATER AT START OF YEAR	735.535	2669990.500	
SOIL WATER AT END OF YEAR	740.512	2688057.250	
SNOW WATER AT START OF YEAR	0.719	2608.595	1.87
SNOW WATER AT END OF YEAR	1.542	5598.767	4.01
ANNUAL WATER BUDGET BALANCE	-6.2300	-22615.016	-16.21

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MONTHLY TOTALS (IN INCHES) FOR YEAR 15

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	0.95 2.68	4.60 12.91	4.04 4.59	0.69 3.00	3.91 3.10	2.40 4.24
RUNOFF	0.756 0.227	3.549 6.362	1.093 1.216	0.000 0.451	1.501 0.612	0.364 0.196
EVAPOTRANSPIRATION	0.627 2.454	0.524 5.616	2.292 2.975	1.757 1.405	1.861 0.777	4.181 0.460
SUBSURFACE INFLOW INTO LAYER 3	0.5291 0.5291	0.4779 0.5291	0.5291 0.5121	0.5121 0.5291	0.5291 0.5121	0.5121 0.5291
LATERAL DRAINAGE COLLECTED FROM LAYER 3	0.9526 0.9526	0.8604 0.9526	0.9526 0.9219	0.9219 0.9526	0.9526 0.9219	0.9219 0.9526
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.1056 0.1056	0.0954 0.1056	0.1056 0.1022	0.1022 0.1056	0.1056 0.1022	0.1022 0.1056

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 4	1.627 1.627	1.627 1.627	1.627 1.627	1.627 1.627	1.627 1.627	1.627 1.627
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 4	0.001 0.001	0.001 0.001	0.001 0.001	0.001 0.001	0.001 0.001	0.001 0.001

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ANNUAL TOTALS FOR YEAR 15

	INCHES	CU. FEET	PERCENT
PRECIPITATION	47.11	171009.375	100.00
RUNOFF	16.327	59265.539	34.66
EVAPOTRANSPIRATION	24.929	90491.781	52.92
SUBSURFACE INFLOW INTO LAYER 3	6.230000	22614.900	13.22

DRAINAGE COLLECTED FROM LAYER 3	11.2163	40715.141	23.81
PERC./LEAKAGE THROUGH LAYER 4	1.243686	4514.580	2.64
AVG. HEAD ON TOP OF LAYER 4	1.6268		
CHANGE IN WATER STORAGE	5.855	21251.996	12.43
SOIL WATER AT START OF YEAR	740.512	2688057.250	
SOIL WATER AT END OF YEAR	745.757	2707097.250	
SNOW WATER AT START OF YEAR	1.542	5598.767	3.27
SNOW WATER AT END OF YEAR	2.152	7810.766	4.57
ANNUAL WATER BUDGET BALANCE	-6.2300	-22614.768	-13.22

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MONTHLY TOTALS (IN INCHES) FOR YEAR 16

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	3.42	2.71	4.10	3.22	1.44	4.36
	5.56	3.22	3.06	0.90	2.77	3.04
RUNOFF	1.533	1.711	0.993	0.297	0.037	0.750
	0.959	0.399	0.334	0.132	0.283	0.231
EVAPOTRANSPIRATION	0.649	0.356	2.176	4.061	2.249	4.714
	3.578	4.229	1.231	1.112	0.715	0.488
SUBSURFACE INFLOW INTO LAYER 3	0.5291	0.4950	0.5291	0.5121	0.5291	0.5121
	0.5291	0.5291	0.5121	0.5291	0.5121	0.5291
LATERAL DRAINAGE COLLECTED FROM LAYER 3	0.9526	0.8912	0.9526	0.9219	0.9526	0.9219
	0.9526	0.9526	0.9219	0.9526	0.9219	0.9526
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.1056	0.0988	0.1056	0.1022	0.1056	0.1022
	0.1056	0.1056	0.1022	0.1056	0.1022	0.1056

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 4	1.627	1.627	1.627	1.627	1.627	1.627
	1.627	1.627	1.627	1.627	1.627	1.627
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 4	0.001	0.001	0.001	0.001	0.001	0.001
	0.001	0.001	0.001	0.001	0.001	0.001

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ANNUAL TOTALS FOR YEAR 16

	INCHES	CU. FEET	PERCENT
PRECIPITATION	37.80	137213.984	100.00
RUNOFF	7.659	27802.449	20.26
EVAPOTRANSPIRATION	25.558	92773.930	67.61
SUBSURFACE INFLOW INTO LAYER 3	6.247069	22676.859	16.53
DRAINAGE COLLECTED FROM LAYER 3	11.2470	40826.687	29.75
PERC./LEAKAGE THROUGH LAYER 4	1.247093	4526.949	3.30
AVG. HEAD ON TOP OF LAYER 4	1.6268		
CHANGE IN WATER STORAGE	4.583	16637.676	12.13
SOIL WATER AT START OF YEAR	745.757	2707097.250	
SOIL WATER AT END OF YEAR	752.492	2731545.750	
SNOW WATER AT START OF YEAR	2.152	7810.766	5.69
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	-6.2471	-22676.848	-16.53

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MONTHLY TOTALS (IN INCHES) FOR YEAR 17

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	0.66	1.49	3.09	2.64	1.65	2.73
	2.67	1.56	3.30	2.64	5.00	1.38
RUNOFF	0.000	0.472	0.473	0.018	0.022	0.232
	0.235	0.004	0.189	0.380	1.105	0.018
EVAPOTRANSPIRATION	0.680	0.382	2.418	2.419	2.109	4.551
	2.301	1.426	2.747	1.613	0.920	0.645
SUBSURFACE INFLOW INTO LAYER 3	0.5291	0.4779	0.5291	0.5121	0.5291	0.5121
	0.5291	0.5291	0.5121	0.5291	0.5121	0.5291
LATERAL DRAINAGE COLLECTED FROM LAYER 3	0.9526	0.8604	0.9526	0.9219	0.9526	0.9219
	0.9526	0.9526	0.9219	0.9526	0.9219	0.9526
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.1056	0.0954	0.1056	0.1022	0.1056	0.1022
	0.1056	0.1056	0.1022	0.1056	0.1022	0.1056

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 4	1.627	1.627	1.627	1.627	1.627	1.627
	1.627	1.627	1.627	1.627	1.627	1.627
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 4	0.001	0.001	0.001	0.001	0.001	0.001
	0.001	0.001	0.001	0.001	0.001	0.001

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ANNUAL TOTALS FOR YEAR 17

	INCHES	CU. FEET	PERCENT
PRECIPITATION	28.81	104580.328	100.00
RUNOFF	3.148	11425.474	10.93
EVAPOTRANSPIRATION	22.210	80621.289	77.09
SUBSURFACE INFLOW INTO LAYER 3	6.230000	22614.900	21.62
DRAINAGE COLLECTED FROM LAYER 3	11.2163	40715.141	38.93
PERC./LEAKAGE THROUGH LAYER 4	1.243686	4514.580	4.32
AVG. HEAD ON TOP OF LAYER 4	1.6268		
CHANGE IN WATER STORAGE	3.453	12533.515	11.98
SOIL WATER AT START OF YEAR	752.492	2731545.750	
SOIL WATER AT END OF YEAR	755.945	2744079.250	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	-6.2300	-22614.768	-21.62

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MONTHLY TOTALS (IN INCHES) FOR YEAR 18

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	1.87	1.39	4.15	2.02	1.86	5.95
	2.42	5.10	3.84	3.78	1.81	7.26
RUNOFF	0.106	0.139	2.006	0.028	0.034	0.471
	0.088	0.738	1.507	0.657	0.164	2.034
EVAPOTRANSPIRATION	0.967	0.595	1.893	2.788	1.925	6.364
	3.337	3.493	1.579	1.463	1.101	0.655
SUBSURFACE INFLOW INTO LAYER 3	0.5291	0.4779	0.5291	0.5121	0.5291	0.5121
	0.5291	0.5291	0.5121	0.5291	0.5121	0.5291
LATERAL DRAINAGE COLLECTED FROM LAYER 3	0.9526	0.8604	0.9526	0.9219	0.9526	0.9219
	0.9526	0.9526	0.9219	0.9526	0.9219	0.9526
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.1056	0.0954	0.1056	0.1022	0.1056	0.1022
	0.1056	0.1056	0.1022	0.1056	0.1022	0.1056

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 4	1.627	1.627	1.627	1.627	1.627	1.627
	1.627	1.627	1.627	1.627	1.627	1.627
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 4	0.001	0.001	0.001	0.001	0.001	0.001
	0.001	0.001	0.001	0.001	0.001	0.001

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ANNUAL TOTALS FOR YEAR 18

	INCHES	CU. FEET	PERCENT
PRECIPITATION	41.45	150463.469	100.00
RUNOFF	7.971	28933.273	19.23
EVAPOTRANSPIRATION	26.160	94962.250	63.11
SUBSURFACE INFLOW INTO LAYER 3	6.230000	22614.900	15.03
DRAINAGE COLLECTED FROM LAYER 3	11.2163	40715.141	27.06
PERC./LEAKAGE THROUGH LAYER 4	1.243686	4514.580	3.00
AVG. HEAD ON TOP OF LAYER 4	1.6268		
CHANGE IN WATER STORAGE	7.319	26567.859	17.66
SOIL WATER AT START OF YEAR	755.945	2744079.250	
SOIL WATER AT END OF YEAR	763.264	2770647.250	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	-6.2300	-22614.732	-15.03

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MONTHLY TOTALS (IN INCHES) FOR YEAR 19

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	2.12	4.54	4.19	4.19	7.87	5.80
	2.92	0.75	7.04	2.82	1.75	0.61
RUNOFF	0.403	1.156	2.459	0.190	1.733	1.001
	0.388	0.005	2.515	0.661	0.030	0.000
EVAPOTRANSPIRATION	0.807	0.664	1.740	4.066	4.564	6.615
	3.334	0.357	1.542	1.781	1.228	0.749

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MONTHLY TOTALS (IN INCHES) FOR YEAR 20

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	7.06	1.11	2.48	2.14	2.69	7.65
	6.60	4.40	3.85	1.57	1.57	1.38
RUNOFF	4.385	0.002	0.491	0.062	0.448	1.478
	3.148	0.977	0.921	0.061	0.100	0.064
EVAPOTRANSPIRATION	0.546	1.403	0.939	2.937	2.861	6.820
	4.041	3.489	1.649	1.429	0.595	0.578
SUBSURFACE INFLOW INTO LAYER 3	0.5291	0.4950	0.5291	0.5121	0.5291	0.5121
	0.5291	0.5291	0.5121	0.5291	0.5121	0.5291
LATERAL DRAINAGE COLLECTED FROM LAYER 3	0.9526	0.8912	0.9526	0.9219	0.9526	0.9219
	0.9526	0.9526	0.9219	0.9526	0.9219	0.9526
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.1056	0.0988	0.1056	0.1022	0.1056	0.1022
	0.1056	0.1056	0.1022	0.1056	0.1022	0.1056

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 4	1.627	1.627	1.627	1.627	1.627	1.627
	1.627	1.627	1.627	1.627	1.627	1.627
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 4	0.001	0.001	0.001	0.001	0.001	0.001
	0.001	0.001	0.001	0.001	0.001	0.001

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ANNUAL TOTALS FOR YEAR 20

	INCHES	CU. FEET	PERCENT
PRECIPITATION	42.50	154274.984	100.00
RUNOFF	12.138	44061.629	28.56
EVAPOTRANSPIRATION	27.290	99064.391	64.21
SUBSURFACE INFLOW INTO LAYER 3	6.247069	22676.859	14.70
DRAINAGE COLLECTED FROM LAYER 3	11.2470	40826.687	26.46
PERC./LEAKAGE THROUGH LAYER 4	1.247093	4526.949	2.93
AVG. HEAD ON TOP OF LAYER 4	1.6268		
CHANGE IN WATER STORAGE	3.071	11148.779	7.23
SOIL WATER AT START OF YEAR	769.876	2794651.500	
SOIL WATER AT END OF YEAR	772.948	2805800.250	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	-6.2470	-22676.594	-14.70

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MONTHLY TOTALS (IN INCHES) FOR YEAR 21

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	4.44	2.19	3.41	4.62	2.81	4.90
	3.62	4.51	2.28	4.43	3.12	1.74
RUNOFF	0.717	1.766	1.049	0.201	0.233	0.500
	0.094	0.881	0.139	1.064	0.378	0.036
EVAPOTRANSPIRATION	0.946	0.399	2.172	3.447	4.393	4.896
	3.593	4.305	1.252	1.438	0.903	0.740
SUBSURFACE INFLOW INTO LAYER 3	0.5291	0.4779	0.5291	0.5121	0.5291	0.5121
	0.5291	0.5291	0.5121	0.5291	0.5121	0.5291
LATERAL DRAINAGE COLLECTED FROM LAYER 3	0.9526	0.8604	0.9526	0.9219	0.9526	0.9219
	0.9526	0.9526	0.9219	0.9526	0.9219	0.9526
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.1056	0.0954	0.1056	0.1022	0.1056	0.1022
	0.1056	0.1056	0.1022	0.1056	0.1022	0.1056

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 4	1.627	1.627	1.627	1.627	1.627	1.627
	1.627	1.627	1.627	1.627	1.627	1.627
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 4	0.001	0.001	0.001	0.001	0.001	0.001
	0.001	0.001	0.001	0.001	0.001	0.001

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MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON	1.627	1.627	1.627	1.627	1.627	1.627
TOP OF LAYER 4	1.627	1.627	1.627	1.627	1.627	1.627
STD. DEVIATION OF DAILY	0.001	0.001	0.001	0.001	0.001	0.001
HEAD ON TOP OF LAYER 4	0.001	0.001	0.001	0.001	0.001	0.001

ANNUAL TOTALS FOR YEAR 21

	INCHES	CU. FEET	PERCENT
PRECIPITATION	42.07	152714.141	100.00
RUNOFF	7.059	25623.549	16.78
EVAPOTRANSPIRATION	28.485	103399.289	67.71
SUBSURFACE INFLOW INTO LAYER 3	6.230000	22614.900	14.81
DRAINAGE COLLECTED FROM LAYER 3	11.2163	40715.141	26.66
PERC./LEAKAGE THROUGH LAYER 4	1.243686	4514.580	2.96
AVG. HEAD ON TOP OF LAYER 4	1.6268		
CHANGE IN WATER STORAGE	6.527	23691.377	15.51
SOIL WATER AT START OF YEAR	772.948	2805800.250	
SOIL WATER AT END OF YEAR	779.474	2829491.750	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	-6.2300	-22614.898	-14.81

MONTHLY TOTALS (IN INCHES) FOR YEAR 22

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	0.98	4.73	8.53	3.09	5.72	3.65
	5.57	8.02	7.27	4.94	3.35	3.28
RUNOFF	0.010	3.089	3.430	0.125	1.363	0.797
	0.872	1.915	2.550	2.397	0.335	0.067
EVAPOTRANSPIRATION	0.897	0.432	2.231	3.806	4.535	3.308
	5.705	4.526	3.523	1.450	1.151	0.582
SUBSURFACE INFLOW INTO	0.5291	0.4779	0.5291	0.5121	0.5291	0.5121
LAYER 3	0.5291	0.5291	0.5121	0.5291	0.5121	0.5291
LATERAL DRAINAGE COLLECTED	0.9526	0.8604	0.9526	0.9219	0.9526	0.9219
FROM LAYER 3	0.9526	0.9526	0.9219	0.9526	0.9219	0.9526
PERCOLATION/LEAKAGE THROUGH	0.1056	0.0954	0.1056	0.1022	0.1056	0.1022
LAYER 4	0.1056	0.1056	0.1022	0.1056	0.1022	0.1056

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON	1.627	1.627	1.627	1.627	1.627	1.627
TOP OF LAYER 4	1.627	1.627	1.627	1.627	1.627	1.627
STD. DEVIATION OF DAILY	0.001	0.001	0.001	0.001	0.001	0.001
HEAD ON TOP OF LAYER 4	0.001	0.001	0.001	0.001	0.001	0.001

ANNUAL TOTALS FOR YEAR 22

	INCHES	CU. FEET	PERCENT
PRECIPITATION	59.13	214641.937	100.00
RUNOFF	16.949	61524.535	28.66
EVAPOTRANSPIRATION	32.146	116689.578	54.36
SUBSURFACE INFLOW INTO LAYER 3	6.230000	22614.900	10.54
DRAINAGE COLLECTED FROM LAYER 3	11.2163	40715.141	18.97
PERC./LEAKAGE THROUGH LAYER 4	1.243686	4514.580	2.10
AVG. HEAD ON TOP OF LAYER 4	1.6268		
CHANGE IN WATER STORAGE	10.035	36427.848	16.97
SOIL WATER AT START OF YEAR	779.474	2829491.750	
SOIL WATER AT END OF YEAR	789.089	2864392.500	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.421	1526.985	0.71
ANNUAL WATER BUDGET BALANCE	-6.2300	-22614.850	-10.54

MONTHLY TOTALS (IN INCHES) FOR YEAR 23

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	3.86	2.45	4.12	3.55	4.92	5.49
	5.26	7.83	3.95	2.25	4.13	1.23
RUNOFF	2.816	0.321	0.736	0.361	0.816	0.942
	1.198	2.258	0.875	0.247	1.193	0.108
EVAPOTRANSPIRATION	0.505	1.229	2.797	3.775	3.254	6.675
	4.306	4.987	3.249	1.196	0.788	0.525
SUBSURFACE INFLOW INTO	0.5291	0.4779	0.5291	0.5121	0.5291	0.5121
LAYER 3	0.5291	0.5291	0.5121	0.5291	0.5121	0.5291
LATERAL DRAINAGE COLLECTED	0.9526	0.8604	0.9526	0.9219	0.9526	0.9219
FROM LAYER 3	0.9526	0.9526	0.9219	0.9526	0.9219	0.9526
PERCOLATION/LEAKAGE THROUGH	0.1056	0.0954	0.1056	0.1022	0.1056	0.1022
LAYER 4	0.1056	0.1056	0.1022	0.1056	0.1022	0.1056

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON	1.627	1.627	1.627	1.627	1.627	1.627
TOP OF LAYER 4	1.627	1.627	1.627	1.627	1.627	1.627
STD. DEVIATION OF DAILY	0.001	0.001	0.001	0.001	0.001	0.001
HEAD ON TOP OF LAYER 4	0.001	0.001	0.001	0.001	0.001	0.001

ANNUAL TOTALS FOR YEAR 23

	INCHES	CU. FEET	PERCENT
PRECIPITATION	49.04	178015.187	100.00
RUNOFF	11.871	43092.879	24.21
EVAPOTRANSPIRATION	33.288	120834.461	67.88
SUBSURFACE INFLOW INTO LAYER 3	6.230000	22614.900	12.70
DRAINAGE COLLECTED FROM LAYER 3	11.2163	40715.141	22.87
PERC./LEAKAGE THROUGH LAYER 4	1.243686	4514.580	2.54
AVG. HEAD ON TOP OF LAYER 4	1.6268		
CHANGE IN WATER STORAGE	3.881	14087.952	7.91
SOIL WATER AT START OF YEAR	789.089	2864392.500	
SOIL WATER AT END OF YEAR	793.391	2880007.500	
SNOW WATER AT START OF YEAR	0.421	1526.985	0.86
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	-6.2300	-22614.926	-12.70

MONTHLY TOTALS (IN INCHES) FOR YEAR 24

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	4.59	1.40	6.05	3.72	1.78	2.82
	2.29	5.56	4.84	1.83	7.03	4.79

RUNOFF	0.202	1.845	2.226	0.225	0.031	0.610
	0.069	1.252	1.659	0.439	2.086	1.367
EVAPOTRANSPIRATION	0.678	0.437	2.229	3.449	2.855	3.817
	1.649	4.152	1.881	1.511	1.167	0.788
SUBSURFACE INFLOW INTO LAYER 3	0.5291	0.4950	0.5291	0.5121	0.5291	0.5121
	0.5291	0.5291	0.5121	0.5291	0.5121	0.5291
LATERAL DRAINAGE COLLECTED FROM LAYER 3	0.9526	0.8912	0.9526	0.9219	0.9526	0.9219
	0.9526	0.9526	0.9219	0.9526	0.9219	0.9526
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.1056	0.0988	0.1056	0.1022	0.1056	0.1022
	0.1056	0.1056	0.1022	0.1056	0.1022	0.1056

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 4	1.627	1.627	1.627	1.627	1.627	1.627
	1.627	1.627	1.627	1.627	1.627	1.627
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 4	0.001	0.001	0.001	0.001	0.001	0.001
	0.001	0.001	0.001	0.001	0.001	0.001

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ANNUAL TOTALS FOR YEAR 24

	INCHES	CU. FEET	PERCENT
PRECIPITATION	46.70	169521.000	100.00
RUNOFF	12.009	43591.117	25.71
EVAPOTRANSPIRATION	24.611	89338.828	52.70
SUBSURFACE INFLOW INTO LAYER 3	6.247069	22676.859	13.38
DRAINAGE COLLECTED FROM LAYER 3	11.2470	40826.687	24.08
PERC./LEAKAGE THROUGH LAYER 4	1.247093	4526.949	2.67
AVG. HEAD ON TOP OF LAYER 4	1.6268		
CHANGE IN WATER STORAGE	10.080	36590.906	21.58
SOIL WATER AT START OF YEAR	793.391	2880007.500	
SOIL WATER AT END OF YEAR	803.471	2916598.500	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	-6.2470	-22676.629	-13.38

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ANNUAL TOTALS FOR YEAR 25

	INCHES	CU. FEET	PERCENT
PRECIPITATION	41.03	148938.891	100.00
RUNOFF	9.099	33030.348	22.18
EVAPOTRANSPIRATION	24.813	90072.211	60.48
SUBSURFACE INFLOW INTO LAYER 3	6.230000	22614.900	15.18
DRAINAGE COLLECTED FROM LAYER 3	11.2163	40715.141	27.34
PERC./LEAKAGE THROUGH LAYER 4	1.243686	4514.580	3.03
AVG. HEAD ON TOP OF LAYER 4	1.6268		
CHANGE IN WATER STORAGE	7.117	25836.412	17.35
SOIL WATER AT START OF YEAR	803.471	2916598.500	
SOIL WATER AT END OF YEAR	810.071	2940557.250	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.517	1877.615	1.26
ANNUAL WATER BUDGET BALANCE	-6.2300	-22614.898	-15.18

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MONTHLY TOTALS (IN INCHES) FOR YEAR 26

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	4.63	2.81	2.61	4.64	3.92	5.10
	5.22	6.98	10.80	0.60	4.39	3.09
RUNOFF	2.142	3.506	0.064	0.546	0.137	0.818
	1.759	2.133	4.406	0.018	0.733	0.221
EVAPOTRANSPIRATION	0.385	1.056	2.618	4.154	4.082	5.127
	3.486	4.363	3.039	1.499	1.276	0.807
SUBSURFACE INFLOW INTO LAYER 3	0.5291	0.4779	0.5291	0.5121	0.5291	0.5121
	0.5291	0.5291	0.5121	0.5291	0.5121	0.5291

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MONTHLY TOTALS (IN INCHES) FOR YEAR 25

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	5.72	2.50	3.55	6.62	2.37	3.40
	1.71	4.59	1.64	3.14	2.70	3.09
RUNOFF	1.819	1.641	0.505	1.880	0.032	0.443
	0.179	0.854	0.138	0.599	0.668	0.339
EVAPOTRANSPIRATION	0.865	0.283	2.307	4.292	2.959	4.702
	1.388	3.860	1.744	0.929	0.899	0.586
SUBSURFACE INFLOW INTO LAYER 3	0.5291	0.4779	0.5291	0.5121	0.5291	0.5121
	0.5291	0.5291	0.5121	0.5291	0.5121	0.5291
LATERAL DRAINAGE COLLECTED FROM LAYER 3	0.9526	0.8604	0.9526	0.9219	0.9526	0.9219
	0.9526	0.9526	0.9219	0.9526	0.9219	0.9526
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.1056	0.0954	0.1056	0.1022	0.1056	0.1022
	0.1056	0.1056	0.1022	0.1056	0.1022	0.1056

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 4	1.627	1.627	1.627	1.627	1.627	1.627
	1.627	1.627	1.627	1.627	1.627	1.627
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 4	0.001	0.001	0.001	0.001	0.001	0.001
	0.001	0.001	0.001	0.001	0.001	0.001

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ANNUAL TOTALS FOR YEAR 26

	INCHES	CU. FEET	PERCENT
PRECIPITATION	54.79	198887.719	100.00
RUNOFF	16.484	59835.863	30.09
EVAPOTRANSPIRATION	31.894	115774.953	58.21
SUBSURFACE INFLOW INTO LAYER 3	6.230000	22614.900	11.37
DRAINAGE COLLECTED FROM LAYER 3	11.2163	40715.141	20.47
PERC./LEAKAGE THROUGH LAYER 4	1.243686	4514.580	2.27
AVG. HEAD ON TOP OF LAYER 4	1.6268		
CHANGE IN WATER STORAGE	6.412	23276.930	11.70
SOIL WATER AT START OF YEAR	810.071	2940557.250	
SOIL WATER AT END OF YEAR	817.000	2965711.750	
SNOW WATER AT START OF YEAR	0.517	1877.615	0.94
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	-6.2300	-22614.850	-11.37

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MONTHLY TOTALS (IN INCHES) FOR YEAR 27

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	3.98	2.12	4.68	3.52	3.38	4.46
	6.20	5.67	11.97	7.03	2.02	2.41
RUNOFF	0.783	1.354	1.713	0.478	0.106	0.565
	2.394	1.452	6.423	2.114	0.014	0.169
EVAPOTRANSPIRATION	1.266	0.466	1.852	3.245	3.132	6.184
	3.100	4.100	2.386	1.760	1.119	1.074
SUBSURFACE INFLOW INTO LAYER 3	0.5291	0.4779	0.5291	0.5121	0.5291	0.5121
	0.5291	0.5291	0.5121	0.5291	0.5121	0.5291
LATERAL DRAINAGE COLLECTED FROM LAYER 3	0.9526	0.8604	0.9526	0.9219	0.9526	0.9219
	0.9526	0.9526	0.9219	0.9526	0.9219	0.9526
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.1056	0.0954	0.1056	0.1022	0.1056	0.1022
	0.1056	0.1056	0.1022	0.1056	0.1022	0.1056

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 4	1.627	1.627	1.627	1.627	1.627	1.627
	1.627	1.627	1.627	1.627	1.627	1.627
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 4	0.001	0.001	0.001	0.001	0.001	0.001
	0.001	0.001	0.001	0.001	0.001	0.001

ANNUAL TOTALS FOR YEAR 27

	INCHES	CU. FEET	PERCENT
PRECIPITATION	57.44	208507.234	100.00
RUNOFF	17.565	63762.047	30.58
EVAPOTRANSPIRATION	29.684	107753.109	51.68
SUBSURFACE INFLOW INTO LAYER 3	6.230000	22614.900	10.85
DRAINAGE COLLECTED FROM LAYER 3	11.2163	40715.141	19.53
PERC./LEAKAGE THROUGH LAYER 4	1.243686	4514.580	2.17
AVG. HEAD ON TOP OF LAYER 4	1.6268		
CHANGE IN WATER STORAGE	10.191	36992.145	17.74
SOIL WATER AT START OF YEAR	817.000	2965711.750	
SOIL WATER AT END OF YEAR	827.191	3002704.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	-6.2300	-22614.881	-10.85

MONTHLY TOTALS (IN INCHES) FOR YEAR 28

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	3.93	3.22	4.40	2.25	2.75	5.82
	10.86	3.65	1.43	1.67	2.93	2.27
RUNOFF	1.362	2.257	0.895	0.353	0.183	0.891
	3.824	0.531	0.217	0.158	0.496	0.080
EVAPOTRANSPIRATION	0.716	0.607	1.475	2.857	2.071	6.234
	7.000	3.900	0.815	1.164	0.617	0.531
SUBSURFACE INFLOW INTO LAYER 3	0.5291	0.4950	0.5291	0.5121	0.5291	0.5121
	0.5291	0.5291	0.5121	0.5291	0.5121	0.5291
LATERAL DRAINAGE COLLECTED FROM LAYER 3	0.9526	0.8912	0.9526	0.9219	0.9526	0.9219
	0.9526	0.9526	0.9219	0.9526	0.9219	0.9526
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.1056	0.0988	0.1056	0.1022	0.1056	0.1022
	0.1056	0.1056	0.1022	0.1056	0.1022	0.1056

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 4	1.627	1.627	1.627	1.627	1.627	1.627
	1.627	1.627	1.627	1.627	1.627	1.627
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 4	0.001	0.001	0.001	0.001	0.001	0.001
	0.001	0.001	0.001	0.001	0.001	0.001

ANNUAL TOTALS FOR YEAR 28

	INCHES	CU. FEET	PERCENT
PRECIPITATION	45.18	164003.359	100.00
RUNOFF	11.247	40827.258	24.89
EVAPOTRANSPIRATION	27.987	101594.547	61.95
SUBSURFACE INFLOW INTO LAYER 3	6.247069	22676.859	13.83
DRAINAGE COLLECTED FROM LAYER 3	11.2470	40826.687	24.89
PERC./LEAKAGE THROUGH LAYER 4	1.247093	4526.949	2.76
AVG. HEAD ON TOP OF LAYER 4	1.6268		
CHANGE IN WATER STORAGE	5.945	21581.484	13.16
SOIL WATER AT START OF YEAR	827.191	3002704.000	
SOIL WATER AT END OF YEAR	833.136	3024285.500	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	-6.2470	-22676.705	-13.83

MONTHLY TOTALS (IN INCHES) FOR YEAR 29

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	8.05	2.10	8.59	7.13	6.01	8.31
	5.35	3.72	2.36	6.26	5.12	5.36
RUNOFF	2.880	3.263	3.073	2.395	1.400	2.509
	1.712	0.578	0.441	2.482	1.880	0.919
EVAPOTRANSPIRATION	0.661	0.567	2.436	3.642	5.227	7.298
	3.864	3.154	0.876	1.371	0.861	0.578
SUBSURFACE INFLOW INTO LAYER 3	0.5291	0.4779	0.5291	0.5121	0.5291	0.5121
	0.5291	0.5291	0.5121	0.5291	0.5121	0.5291
LATERAL DRAINAGE COLLECTED FROM LAYER 3	0.9526	0.8604	0.9526	0.9219	0.9526	0.9219
	0.9526	0.9526	0.9219	0.9526	0.9219	0.9526
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.1056	0.0954	0.1056	0.1022	0.1056	0.1022
	0.1056	0.1056	0.1022	0.1056	0.1022	0.1056

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 4	1.627	1.627	1.627	1.627	1.627	1.627
	1.627	1.627	1.627	1.627	1.627	1.627
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 4	0.001	0.001	0.001	0.001	0.001	0.001
	0.001	0.001	0.001	0.001	0.001	0.001

ANNUAL TOTALS FOR YEAR 29

	INCHES	CU. FEET	PERCENT
PRECIPITATION	68.36	248146.750	100.00
RUNOFF	23.531	85415.812	34.42
EVAPOTRANSPIRATION	30.535	110840.922	44.67
SUBSURFACE INFLOW INTO LAYER 3	6.230000	22614.900	9.11
DRAINAGE COLLECTED FROM LAYER 3	11.2163	40715.141	16.41
PERC./LEAKAGE THROUGH LAYER 4	1.243686	4514.580	1.82
AVG. HEAD ON TOP OF LAYER 4	1.6268		

CHANGE IN WATER STORAGE	14.295	51890.102	20.91
SOIL WATER AT START OF YEAR	833.136	3024285.500	
SOIL WATER AT END OF YEAR	845.826	3070349.750	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	1.605	5825.835	2.35
ANNUAL WATER BUDGET BALANCE	-6.2300	-22614.908	-9.11

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MONTHLY TOTALS (IN INCHES) FOR YEAR 30

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	2.02	1.24	5.86	2.65	2.08	1.82
	3.99	0.38	6.34	6.41	1.89	4.28
RUNOFF	1.473	0.557	1.539	0.254	0.018	0.195
	1.413	0.000	1.818	3.012	0.076	0.813
EVAPOTRANSPIRATION	0.572	0.431	2.378	3.450	2.236	3.430
	2.577	0.380	2.107	1.974	1.168	1.045
SUBSURFACE INFLOW INTO LAYER 3	0.5291	0.4779	0.5291	0.5121	0.5291	0.5121
	0.5291	0.5291	0.5121	0.5291	0.5121	0.5291
LATERAL DRAINAGE COLLECTED FROM LAYER 3	0.9526	0.8604	0.9526	0.9219	0.9526	0.9219
	0.9526	0.9526	0.9219	0.9526	0.9219	0.9526
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.1056	0.0954	0.1056	0.1022	0.1056	0.1022
	0.1056	0.1056	0.1022	0.1056	0.1022	0.1056

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 4	1.627	1.627	1.627	1.627	1.627	1.627
	1.627	1.627	1.627	1.627	1.627	1.627
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 4	0.001	0.001	0.001	0.001	0.001	0.001
	0.001	0.001	0.001	0.001	0.001	0.001

EVAPOTRANSPIRATION	0.395	1.045	2.015	4.138	3.263	5.107
	3.000	1.572	2.158	1.551	0.887	0.774
SUBSURFACE INFLOW INTO LAYER 3	0.5291	0.4779	0.5291	0.5121	0.5291	0.5121
	0.5291	0.5291	0.5121	0.5291	0.5121	0.5291
LATERAL DRAINAGE COLLECTED FROM LAYER 3	0.9526	0.8604	0.9526	0.9219	0.9526	0.9219
	0.9526	0.9526	0.9219	0.9526	0.9219	0.9526
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.1056	0.0954	0.1056	0.1022	0.1056	0.1022
	0.1056	0.1056	0.1022	0.1056	0.1022	0.1056

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 4	1.627	1.627	1.627	1.627	1.627	1.627
	1.627	1.627	1.627	1.627	1.627	1.627
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 4	0.001	0.001	0.001	0.001	0.001	0.001
	0.001	0.001	0.001	0.001	0.001	0.001

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ANNUAL TOTALS FOR YEAR 31

	INCHES	CU. FEET	PERCENT
PRECIPITATION	38.43	139500.906	100.00
RUNOFF	6.751	24506.750	17.57
EVAPOTRANSPIRATION	25.905	94035.906	67.41
SUBSURFACE INFLOW INTO LAYER 3	6.230000	22614.900	16.21
DRAINAGE COLLECTED FROM LAYER 3	11.2163	40715.141	29.19
PERC./LEAKAGE THROUGH LAYER 4	1.243686	4514.580	3.24
AVG. HEAD ON TOP OF LAYER 4	1.6268		
CHANGE IN WATER STORAGE	5.774	20958.223	15.02
SOIL WATER AT START OF YEAR	853.042	3096541.000	
SOIL WATER AT END OF YEAR	859.250	3119075.750	
SNOW WATER AT START OF YEAR	0.434	1576.404	1.13
SNOW WATER AT END OF YEAR	0.000	0.000	0.00

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ANNUAL TOTALS FOR YEAR 30

	INCHES	CU. FEET	PERCENT
PRECIPITATION	38.96	141424.828	100.00
RUNOFF	11.167	40535.691	28.66
EVAPOTRANSPIRATION	21.748	78947.023	55.82
SUBSURFACE INFLOW INTO LAYER 3	6.230000	22614.900	15.99
DRAINAGE COLLECTED FROM LAYER 3	11.2163	40715.141	28.79
PERC./LEAKAGE THROUGH LAYER 4	1.243686	4514.580	3.19
AVG. HEAD ON TOP OF LAYER 4	1.6268		
CHANGE IN WATER STORAGE	6.045	21942.002	15.51
SOIL WATER AT START OF YEAR	845.826	3070349.750	
SOIL WATER AT END OF YEAR	853.042	3096541.000	
SNOW WATER AT START OF YEAR	1.605	5825.835	4.12
SNOW WATER AT END OF YEAR	0.434	1576.404	1.11
ANNUAL WATER BUDGET BALANCE	-6.2299	-22614.711	-15.99

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MONTHLY TOTALS (IN INCHES) FOR YEAR 31

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	1.68	0.64	4.01	4.21	3.90	3.86
	2.56	1.74	2.98	2.88	1.21	8.76
RUNOFF	0.957	0.000	0.269	0.406	0.213	0.363
	0.343	0.151	0.204	0.149	0.072	3.624

ANNUAL WATER BUDGET BALANCE	-6.2300	-22614.799	-16.21

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MONTHLY TOTALS (IN INCHES) FOR YEAR 32

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	0.95	4.60	4.09	0.64	3.91	2.40
	7.38	8.21	4.59	3.00	3.10	4.24
RUNOFF	0.009	2.373	1.180	0.000	1.507	0.365
	3.249	3.365	1.214	0.438	0.073	2.060
EVAPOTRANSPIRATION	0.772	0.645	2.225	1.738	1.967	4.022
	2.565	6.375	2.516	1.238	0.652	0.397
SUBSURFACE INFLOW INTO LAYER 3	0.5291	0.4950	0.5291	0.5121	0.5291	0.5121
	0.5291	0.5291	0.5121	0.5291	0.5121	0.5291
LATERAL DRAINAGE COLLECTED FROM LAYER 3	0.9526	0.8912	0.9526	0.9219	0.9526	0.9219
	0.9526	0.9526	0.9219	0.9526	0.9219	0.9526
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.1056	0.0988	0.1056	0.1022	0.1056	0.1022
	0.1056	0.1056	0.1022	0.1056	0.1022	0.1056

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 4	1.627	1.627	1.627	1.627	1.627	1.627
	1.627	1.627	1.627	1.627	1.627	1.627
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 4	0.001	0.001	0.001	0.001	0.001	0.001
	0.001	0.001	0.001	0.001	0.001	0.001

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ANNUAL TOTALS FOR YEAR 32

	INCHES	CU. FEET	PERCENT

PRECIPITATION	47.11	171009.375	100.00
RUNOFF	15.835	57479.812	33.61
EVAPOTRANSPIRATION	25.113	91159.437	53.31
SUBSURFACE INFLOW INTO LAYER 3	6.247069	22676.859	13.26
DRAINAGE COLLECTED FROM LAYER 3	11.2470	40826.687	23.87
PERC./LEAKAGE THROUGH LAYER 4	1.247093	4526.949	2.65
AVG. HEAD ON TOP OF LAYER 4	1.6268		
CHANGE IN WATER STORAGE	6.163	22370.127	13.08
SOIL WATER AT START OF YEAR	859.250	3119075.750	
SOIL WATER AT END OF YEAR	865.384	3141342.250	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.029	103.587	0.06
ANNUAL WATER BUDGET BALANCE	-6.2470	-22676.781	-13.26

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MONTHLY TOTALS (IN INCHES) FOR YEAR 33

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	3.42	2.71	4.10	3.03	1.63	4.32
	5.60	3.22	2.02	1.94	2.77	3.04
RUNOFF	0.841	0.309	0.619	0.310	0.037	0.748
	0.947	0.380	0.121	0.351	0.232	1.233
EVAPOTRANSPIRATION	0.870	1.309	2.163	3.657	2.656	4.487
	3.693	4.277	1.167	1.179	0.523	0.539
SUBSURFACE INFLOW INTO LAYER 3	0.5291	0.4779	0.5291	0.5121	0.5291	0.5121
	0.5291	0.5291	0.5121	0.5291	0.5121	0.5291
LATERAL DRAINAGE COLLECTED FROM LAYER 3	0.9526	0.8604	0.9526	0.9219	0.9526	0.9219
	0.9526	0.9526	0.9219	0.9526	0.9219	0.9526
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.1056	0.0954	0.1056	0.1022	0.1056	0.1022
	0.1056	0.1056	0.1022	0.1056	0.1022	0.1056

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 4	1.627	1.627	1.627	1.627	1.627	1.627
	1.627	1.627	1.627	1.627	1.627	1.627
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 4	0.001	0.001	0.001	0.001	0.001	0.001
	0.001	0.001	0.001	0.001	0.001	0.001

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ANNUAL TOTALS FOR YEAR 33

	INCHES	CU. FEET	PERCENT
PRECIPITATION	37.80	137213.984	100.00
RUNOFF	6.129	22248.230	16.21
EVAPOTRANSPIRATION	26.519	96265.578	70.16
SUBSURFACE INFLOW INTO LAYER 3	6.230000	22614.900	16.48
DRAINAGE COLLECTED FROM LAYER 3	11.2163	40715.141	29.67
PERC./LEAKAGE THROUGH LAYER 4	1.243686	4514.580	3.29
AVG. HEAD ON TOP OF LAYER 4	1.6268		
CHANGE IN WATER STORAGE	5.152	18700.230	13.63
SOIL WATER AT START OF YEAR	865.384	3141342.250	
SOIL WATER AT END OF YEAR	870.564	3160146.000	
SNOW WATER AT START OF YEAR	0.029	103.587	0.08
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	-6.2300	-22614.877	-16.48

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MONTHLY TOTALS (IN INCHES) FOR YEAR 34

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	0.66	1.49	3.09	2.64	1.65	2.73
	2.67	1.56	3.30	2.64	5.00	1.38
RUNOFF	0.014	0.224	0.099	0.011	0.022	0.223
	0.235	0.004	0.188	0.387	1.132	0.003
EVAPOTRANSPIRATION	0.536	0.996	2.316	2.657	2.412	4.329
	2.258	1.468	2.649	1.302	1.035	0.610
SUBSURFACE INFLOW INTO LAYER 3	0.5291	0.4779	0.5291	0.5121	0.5291	0.5121
	0.5291	0.5291	0.5121	0.5291	0.5121	0.5291
LATERAL DRAINAGE COLLECTED FROM LAYER 3	0.9526	0.8604	0.9526	0.9219	0.9526	0.9219
	0.9526	0.9526	0.9219	0.9526	0.9219	0.9526
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.1056	0.0954	0.1056	0.1022	0.1056	0.1022
	0.1056	0.1056	0.1022	0.1056	0.1022	0.1056

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 4	1.627	1.627	1.627	1.627	1.627	1.627
	1.627	1.627	1.627	1.627	1.627	1.627
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 4	0.001	0.001	0.001	0.001	0.001	0.001
	0.001	0.001	0.001	0.001	0.001	0.001

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ANNUAL TOTALS FOR YEAR 34

	INCHES	CU. FEET	PERCENT
PRECIPITATION	28.81	104580.328	100.00
RUNOFF	2.542	9229.107	8.82
EVAPOTRANSPIRATION	22.568	81920.195	78.33
SUBSURFACE INFLOW INTO LAYER 3	6.230000	22614.900	21.62
DRAINAGE COLLECTED FROM LAYER 3	11.2163	40715.141	38.93
PERC./LEAKAGE THROUGH LAYER 4	1.243686	4514.580	4.32
AVG. HEAD ON TOP OF LAYER 4	1.6268		
CHANGE IN WATER STORAGE	3.700	13431.044	12.84
SOIL WATER AT START OF YEAR	870.564	3160146.000	
SOIL WATER AT END OF YEAR	874.264	3173577.250	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	-6.2300	-22614.840	-21.62

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MONTHLY TOTALS (IN INCHES) FOR YEAR 35

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	1.87	1.39	4.15	2.02	1.86	5.95
	2.42	5.10	3.84	3.78	1.81	7.26
RUNOFF	0.408	0.277	0.479	0.034	0.033	0.477
	0.088	0.747	1.528	0.650	0.180	3.353
EVAPOTRANSPIRATION	0.602	0.728	2.636	2.925	1.954	6.331
	3.311	3.463	1.557	1.484	0.927	0.440
SUBSURFACE INFLOW INTO LAYER 3	0.5291	0.4779	0.5291	0.5121	0.5291	0.5121
	0.5291	0.5291	0.5121	0.5291	0.5121	0.5291
LATERAL DRAINAGE COLLECTED FROM LAYER 3	0.9526	0.8604	0.9526	0.9219	0.9526	0.9219
	0.9526	0.9526	0.9219	0.9526	0.9219	0.9526
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.1056	0.0954	0.1056	0.1022	0.1056	0.1022
	0.1056	0.1056	0.1022	0.1056	0.1022	0.1056

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 4	1.627 1.627	1.627 1.627	1.627 1.627	1.627 1.627	1.627 1.627	1.627 1.627
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 4	0.001 0.001	0.001 0.001	0.001 0.001	0.001 0.001	0.001 0.001	0.001 0.001

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ANNUAL TOTALS FOR YEAR 35

	INCHES	CU. FEET	PERCENT
PRECIPITATION	41.45	150463.469	100.00
RUNOFF	8.255	29964.439	19.91
EVAPOTRANSPIRATION	26.358	95679.812	63.59
SUBSURFACE INFLOW INTO LAYER 3	6.230000	22614.900	15.03
DRAINAGE COLLECTED FROM LAYER 3	11.2163	40715.141	27.06
PERC./LEAKAGE THROUGH LAYER 4	1.243686	4514.580	3.00
AVG. HEAD ON TOP OF LAYER 4	1.6268		
CHANGE IN WATER STORAGE	6.837	24819.328	16.50
SOIL WATER AT START OF YEAR	874.264	3173577.250	
SOIL WATER AT END OF YEAR	881.101	3198396.500	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	-6.2300	-22614.926	-15.03

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MONTHLY TOTALS (IN INCHES) FOR YEAR 36

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	2.12 2.92	4.54 0.75	4.19 8.39	4.19 1.47	8.03 1.75	5.64 0.61
RUNOFF	0.626 0.394	1.582 0.005	1.161 3.150	0.193 0.038	1.721 0.025	1.022 0.000
EVAPOTRANSPIRATION	1.019 2.638	0.897 0.417	2.732 1.490	4.351 1.782	4.527 1.136	7.213 0.809
SUBSURFACE INFLOW INTO LAYER 3	0.5291 0.5291	0.4950 0.5291	0.5291 0.5121	0.5121 0.5291	0.5291 0.5121	0.5121 0.5291
LATERAL DRAINAGE COLLECTED FROM LAYER 3	0.9526 0.9526	0.8912 0.9526	0.9526 0.9219	0.9219 0.9526	0.9526 0.9219	0.9219 0.9526
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.1056 0.1056	0.0988 0.1056	0.1056 0.1022	0.1022 0.1056	0.1056 0.1022	0.1022 0.1056

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 4	1.627 1.627	1.627 1.627	1.627 1.627	1.627 1.627	1.627 1.627	1.627 1.627
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 4	0.001 0.001	0.001 0.001	0.001 0.001	0.001 0.001	0.001 0.001	0.001 0.001

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ANNUAL TOTALS FOR YEAR 36

	INCHES	CU. FEET	PERCENT
PRECIPITATION	44.60	161897.969	100.00
RUNOFF	9.914	35988.570	22.23
EVAPOTRANSPIRATION	29.011	105308.687	65.05
SUBSURFACE INFLOW INTO LAYER 3	6.247069	22676.859	14.01
DRAINAGE COLLECTED FROM LAYER 3	11.2470	40826.687	25.22
PERC./LEAKAGE THROUGH LAYER 4	1.247093	4526.949	2.80
AVG. HEAD ON TOP OF LAYER 4	1.6268		
CHANGE IN WATER STORAGE	5.675	20600.428	12.72
SOIL WATER AT START OF YEAR	881.101	3198396.500	
SOIL WATER AT END OF YEAR	886.776	3218997.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	-6.2470	-22676.496	-14.01

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MONTHLY TOTALS (IN INCHES) FOR YEAR 37

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	7.06 6.60	1.11 4.24	2.48 3.95	2.14 1.63	2.69 1.57	7.65 1.38
RUNOFF	3.601 3.182	0.312 0.987	0.001 0.922	0.055 0.059	0.427 0.082	1.499 0.063
EVAPOTRANSPIRATION	0.778 3.887	0.949 3.555	2.460 1.613	2.764 1.524	2.871 0.761	6.736 0.532
SUBSURFACE INFLOW INTO LAYER 3	0.5291 0.5291	0.4779 0.5291	0.5291 0.5121	0.5121 0.5291	0.5291 0.5121	0.5121 0.5291
LATERAL DRAINAGE COLLECTED FROM LAYER 3	0.9526 0.9526	0.8604 0.9526	0.9526 0.9219	0.9219 0.9526	0.9526 0.9219	0.9219 0.9526
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.1056 0.1056	0.0954 0.1056	0.1056 0.1022	0.1022 0.1056	0.1056 0.1022	0.1022 0.1056

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 4	1.627 1.627	1.627 1.627	1.627 1.627	1.627 1.627	1.627 1.627	1.627 1.627
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 4	0.001 0.001	0.001 0.001	0.001 0.001	0.001 0.001	0.001 0.001	0.001 0.001

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ANNUAL TOTALS FOR YEAR 37

	INCHES	CU. FEET	PERCENT
PRECIPITATION	42.50	154274.984	100.00
RUNOFF	11.191	40625.117	26.33
EVAPOTRANSPIRATION	28.431	103205.461	66.90
SUBSURFACE INFLOW INTO LAYER 3	6.230000	22614.900	14.66
DRAINAGE COLLECTED FROM LAYER 3	11.2163	40715.141	26.39
PERC./LEAKAGE THROUGH LAYER 4	1.243686	4514.580	2.93
AVG. HEAD ON TOP OF LAYER 4	1.6268		
CHANGE IN WATER STORAGE	2.877	10444.447	6.77
SOIL WATER AT START OF YEAR	886.776	3218997.000	
SOIL WATER AT END OF YEAR	889.653	3229441.250	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	-6.2300	-22614.859	-14.66

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MONTHLY TOTALS (IN INCHES) FOR YEAR 38

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	4.44 3.62	2.19 4.51	3.41 2.28	4.62 4.43	2.81 3.12	4.90 1.74
RUNOFF	2.724 0.094	1.260 0.885	1.778 0.140	0.185 1.075	0.230 0.366	0.49. 0.046
EVAPOTRANSPIRATION	0.511 3.328	0.460 4.411	1.911 1.171	3.765 1.326	4.311 0.915	4.977 0.762

SUBSURFACE INFLOW INTO LAYER 3	0.5291	0.4779	0.5291	0.5121	0.5291	0.5121
	0.5291	0.5291	0.5121	0.5291	0.5121	0.5291
LATERAL DRAINAGE COLLECTED FROM LAYER 3	0.9526	0.8604	0.9526	0.9219	0.9526	0.9219
	0.9526	0.9526	0.9219	0.9526	0.9219	0.9526
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.1056	0.0954	0.1056	0.1022	0.1056	0.1022
	0.1056	0.1056	0.1022	0.1056	0.1022	0.1056

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 4	1.627	1.627	1.627	1.627	1.627	1.627
	1.627	1.627	1.627	1.627	1.627	1.627
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 4	0.001	0.001	0.001	0.001	0.001	0.001
	0.001	0.001	0.001	0.001	0.001	0.001

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ANNUAL TOTALS FOR YEAR 38

	INCHES	CU. FEET	PERCENT
PRECIPITATION	42.07	152714.141	100.00
RUNOFF	9.274	33664.473	22.04
EVAPOTRANSPIRATION	27.849	101090.656	66.20
SUBSURFACE INFLOW INTO LAYER 3	6.230000	22614.900	14.81
DRAINAGE COLLECTED FROM LAYER 3	11.2163	40715.141	26.66
PERC./LEAKAGE THROUGH LAYER 4	1.243686	4514.580	2.96
AVG. HEAD ON TOP OF LAYER 4	1.6268		
CHANGE IN WATER STORAGE	4.947	17959.238	11.76
SOIL WATER AT START OF YEAR	889.653	3229441.250	
SOIL WATER AT END OF YEAR	894.601	3247400.500	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	-6.2300	-22615.043	-14.81
RUNOFF	18.928	68707.094	32.01
EVAPOTRANSPIRATION	30.460	110568.914	51.51
SUBSURFACE INFLOW INTO LAYER 3	6.230000	22614.900	10.54
DRAINAGE COLLECTED FROM LAYER 3	11.2163	40715.141	18.97
PERC./LEAKAGE THROUGH LAYER 4	1.243686	4514.580	2.10
AVG. HEAD ON TOP OF LAYER 4	1.6268		
CHANGE IN WATER STORAGE	9.743	35365.691	16.48
SOIL WATER AT START OF YEAR	894.601	3247400.500	
SOIL WATER AT END OF YEAR	904.343	3282766.250	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	-6.2299	-22614.584	-10.54

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MONTHLY TOTALS (IN INCHES) FOR YEAR 40

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	3.86	2.74	3.83	3.55	5.78	4.63
	5.26	7.89	3.89	2.25	4.13	1.23
RUNOFF	0.334	0.166	1.171	0.341	0.963	0.809
	1.179	2.258	0.894	0.247	1.208	0.002
EVAPOTRANSPIRATION	1.114	1.458	2.241	3.984	3.294	6.795
	4.231	4.655	2.913	1.174	0.790	0.576
SUBSURFACE INFLOW INTO LAYER 3	0.5291	0.4950	0.5291	0.5121	0.5291	0.5121
	0.5291	0.5291	0.5121	0.5291	0.5121	0.5291
LATERAL DRAINAGE COLLECTED FROM LAYER 3	0.9526	0.8912	0.9526	0.9219	0.9526	0.9219
	0.9526	0.9526	0.9219	0.9526	0.9219	0.9526
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.1056	0.0988	0.1056	0.1022	0.1056	0.1022
	0.1056	0.1056	0.1022	0.1056	0.1022	0.1056

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MONTHLY TOTALS (IN INCHES) FOR YEAR 39

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	0.98	4.73	8.53	3.09	5.72	3.65
	5.57	8.02	7.27	4.94	3.35	3.28
RUNOFF	0.153	0.890	7.276	0.139	1.396	0.797
	0.875	1.887	2.629	2.380	0.277	0.228
EVAPOTRANSPIRATION	0.477	0.285	1.306	3.692	4.297	3.308
	5.808	4.530	3.603	1.374	0.931	0.849
SUBSURFACE INFLOW INTO LAYER 3	0.5291	0.4779	0.5291	0.5121	0.5291	0.5121
	0.5291	0.5291	0.5121	0.5291	0.5121	0.5291
LATERAL DRAINAGE COLLECTED FROM LAYER 3	0.9526	0.8604	0.9526	0.9219	0.9526	0.9219
	0.9526	0.9526	0.9219	0.9526	0.9219	0.9526
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.1056	0.0954	0.1056	0.1022	0.1056	0.1022
	0.1056	0.1056	0.1022	0.1056	0.1022	0.1056

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 4	1.627	1.627	1.627	1.627	1.627	1.627
	1.627	1.627	1.627	1.627	1.627	1.627
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 4	0.001	0.001	0.001	0.001	0.001	0.001
	0.001	0.001	0.001	0.001	0.001	0.001

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ANNUAL TOTALS FOR YEAR 39

	INCHES	CU. FEET	PERCENT
PRECIPITATION	59.13	214641.937	100.00

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 4	1.627	1.627	1.627	1.627	1.627	1.627
	1.627	1.627	1.627	1.627	1.627	1.627
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 4	0.001	0.001	0.001	0.001	0.001	0.001
	0.001	0.001	0.001	0.001	0.001	0.001

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ANNUAL TOTALS FOR YEAR 40

	INCHES	CU. FEET	PERCENT
PRECIPITATION	49.04	178015.187	100.00
RUNOFF	9.571	34743.996	19.52
EVAPOTRANSPIRATION	33.225	120607.758	67.75
SUBSURFACE INFLOW INTO LAYER 3	6.247069	22676.859	12.74
DRAINAGE COLLECTED FROM LAYER 3	11.2470	40826.687	22.93
PERC./LEAKAGE THROUGH LAYER 4	1.247093	4526.949	2.54
AVG. HEAD ON TOP OF LAYER 4	1.6268		
CHANGE IN WATER STORAGE	6.243	22663.518	12.73
SOIL WATER AT START OF YEAR	904.343	3282766.250	
SOIL WATER AT END OF YEAR	910.398	3304743.750	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.189	686.110	0.39
ANNUAL WATER BUDGET BALANCE	-6.2471	-22676.857	-12.74

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AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1 THROUGH 40

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	3.51	2.48	4.54	3.60	3.57	4.75
	4.54	4.67	4.81	3.30	3.09	3.30
STD. DEVIATIONS	2.09	1.27	1.77	1.65	1.84	1.72
	2.19	2.72	2.88	1.80	1.46	2.20
RUNOFF						
TOTALS	1.259	1.294	1.506	0.434	0.513	0.775
	1.163	1.119	1.507	0.867	0.543	0.708
STD. DEVIATIONS	1.192	1.066	1.758	0.681	0.603	0.521
	1.163	1.180	1.607	0.938	0.601	0.993
EVAPOTRANSPIRATION						
TOTALS	0.698	0.717	2.196	3.476	3.250	5.373
	3.514	3.439	2.018	1.435	0.952	0.656
STD. DEVIATIONS	0.241	0.405	0.440	0.663	1.022	1.258
	1.293	1.544	0.812	0.246	0.213	0.162
SUBSURFACE INFLOW INTO LAYER 3						
TOTALS	0.5291	0.4950	0.5291	0.5121	0.5291	0.5121
	0.5291	0.5291	0.5121	0.5291	0.5121	0.5291
LATERAL DRAINAGE COLLECTED FROM LAYER 3						
TOTALS	1.0330	0.8804	0.9557	0.9225	0.9528	0.9219
	0.9526	0.9526	0.9219	0.9526	0.9219	0.9526
STD. DEVIATIONS	0.5081	0.0775	0.0193	0.0040	0.0005	0.0008
	0.0000	0.0000	0.0008	0.0000	0.0007	0.0000
PERCOLATION/LEAKAGE THROUGH LAYER 4						
TOTALS	0.1056	0.0963	0.1056	0.1022	0.1056	0.1022
	0.1056	0.1056	0.1022	0.1056	0.1022	0.1056
STD. DEVIATIONS	0.0001	0.0015	0.0001	0.0000	0.0001	0.0000
	0.0001	0.0001	0.0000	0.0001	0.0000	0.0001

AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)

DAILY AVERAGE HEAD ON TOP OF LAYER 4

AVERAGES	1.7425	1.6500	1.6320	1.6279	1.6270	1.6268
	1.6268	1.6268	1.6268	1.6268	1.6268	1.6268
STD. DEVIATIONS	0.7318	0.1465	0.0330	0.0070	0.0016	0.0007
	0.0008	0.0005	0.0007	0.0008	0.0005	0.0005

AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1 THROUGH 40

	INCHES		CU. FEET	PERCENT
PRECIPITATION	46.15	(8.949)	167511.8	100.00
RUNOFF	11.689	(5.1277)	42431.09	25.330
EVAPOTRANSPIRATION	27.723	(3.1516)	100633.95	60.076
SUBSURFACE INFLOW INTO LAYER 3	6.24707		22676.859	13.53747
LATERAL DRAINAGE COLLECTED FROM LAYER 3	11.32042	(0.60903)	41093.141	24.53149
PERCOLATION/LEAKAGE THROUGH LAYER 4	1.24455	(0.00080)	4517.731	2.69696
AVERAGE HEAD ON TOP OF LAYER 4	1.639	(0.077)		
CHANGE IN WATER STORAGE	6.638	(2.6098)	24096.57	14.385

PEAK DAILY VALUES FOR YEARS 1 THROUGH 40

	(INCHES)	(CU. FT.)
PRECIPITATION	5.15	18694.500
RUNOFF	4.002	14528.6201
DRAINAGE COLLECTED FROM LAYER 3	0.29696	1077.95544
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.003444	12.50028
AVERAGE HEAD ON TOP OF LAYER 4	11.726	
MAXIMUM HEAD ON TOP OF LAYER 4	13.700	
LOCATION OF MAXIMUM HEAD IN LAYER 3 (DISTANCE FROM DRAIN)	33.8 FEET	
SNOW WATER	8.08	29328.5547

MAXIMUM VEG. SOIL WATER (VOL/VOL) 0.3569

MINIMUM VEG. SOIL WATER (VOL/VOL) 0.1285

*** Maximum heads are computed using McEnroe's equations. ***

Reference: Maximum Saturated Depth over Landfill Liner
by Bruce M. McEnroe, University of Kansas
ASCE Journal of Environmental Engineering
Vol. 119, No. 2, March 1993, pp. 262-270.

FINAL WATER STORAGE AT END OF YEAR 40

LAYER	(INCHES)	(VOL/VOL)
1	3.4411	0.2868
2	501.1009	0.1670
3	1.1452	0.0954
4	404.7106	0.4270
SNOW WATER	0.189	

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**                                                                          **
**              HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE               **
**                HELP MODEL VERSION 3.07  (1 NOVEMBER 1997)                **
**                  DEVELOPED BY ENVIRONMENTAL LABORATORY                   **
**                     USAE WATERWAYS EXPERIMENT STATION                    **
**             FOR USEPA RISK REDUCTION ENGINEERING LABORATORY              **
**                                                                          **
**                                                                          **
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PRECIPITATION DATA FILE:      P:\PRJ1\MDENG\HELP3\ME0250\40YEARS.D4
TEMPERATURE DATA FILE:        P:\PRJ1\MDENG\HELP3\ME0250\40YEARS.D7
SOLAR RADIATION DATA FILE:    P:\PRJ1\MDENG\HELP3\ME0250\40YEARS.D13
EVAPOTRANSPIRATION DATA:      P:\PRJ1\MDENG\HELP3\ME0250\40YEARS.D11
SOIL AND DESIGN DATA FILE:    P:\PRJ1\MDENG\HELP3\ME0250\CIL5B2.D10
OUTPUT DATA FILE:             P:\PRJ1\MDENG\HELP3\ME0250\CIL5B2.OUT


TIME:  15:58      DATE:   2/26/2003


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     TITLE:  CHERRY ISLAND LANDFILL PHASE V - RUN B2

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     NOTE:  INITIAL MOISTURE CONTENT OF THE LAYERS AND SNOW WATER
            WERE SPECIFIED BY THE USER.


                                   LAYER  1
                                   --------

                  TYPE 1 - VERTICAL PERCOLATION LAYER
                      MATERIAL TEXTURE NUMBER  22
       THICKNESS                    =     12.00   INCHES
       POROSITY                     =      0.4190 VOL/VOL
       FIELD CAPACITY               =      0.3070 VOL/VOL
       WILTING POINT                =      0.1800 VOL/VOL
       INITIAL SOIL WATER CONTENT   =      0.3621 VOL/VOL
       EFFECTIVE SAT. HYD. COND.    =  0.189999992000E-04 CM/SEC
     NOTE:  SATURATED HYDRAULIC CONDUCTIVITY IS MULTIPLIED BY  4.63
            FOR ROOT CHANNELS IN TOP HALF OF EVAPORATIVE ZONE.


                                   LAYER  2
                                   --------

                  TYPE 1 - VERTICAL PERCOLATION LAYER
                      MATERIAL TEXTURE NUMBER   0
       THICKNESS                    =   3000.00   INCHES
       POROSITY                     =      0.6100 VOL/VOL
       FIELD CAPACITY               =      0.2920 VOL/VOL
       WILTING POINT                =      0.0770 VOL/VOL
       INITIAL SOIL WATER CONTENT   =      0.0770 VOL/VOL
       EFFECTIVE SAT. HYD. COND.    =  0.100000005000E-02 CM/SEC


                                   LAYER  3
                                   --------

                  TYPE 2 - LATERAL DRAINAGE LAYER
                      MATERIAL TEXTURE NUMBER   1
       THICKNESS                    =     12.00   INCHES
       POROSITY                     =      0.4170 VOL/VOL
       FIELD CAPACITY               =      0.0450 VOL/VOL
       WILTING POINT                =      0.0180 VOL/VOL
       INITIAL SOIL WATER CONTENT   =      0.4170 VOL/VOL
       EFFECTIVE SAT. HYD. COND.    =  0.999999978000E-02 CM/SEC
       SLOPE                        =      2.00   PERCENT
       DRAINAGE LENGTH              =     75.0    FEET
       SUBSURFACE INFLOW            =      8.04   INCHES/YR


                                   LAYER  4
                                   --------

                  TYPE 3 - BARRIER SOIL LINER
                      MATERIAL TEXTURE NUMBER  16
       THICKNESS                    =   1011.60   INCHES
       POROSITY                     =      0.4270 VOL/VOL
       FIELD CAPACITY               =      0.4180 VOL/VOL
       WILTING POINT                =      0.3670 VOL/VOL
       INITIAL SOIL WATER CONTENT   =      0.4270 VOL/VOL
       EFFECTIVE SAT. HYD. COND.    =  0.100000001000E-06 CM/SEC


                 GENERAL DESIGN AND EVAPORATIVE ZONE DATA
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     NOTE:  SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT
            SOIL DATA BASE USING SOIL TEXTURE #22 WITH A
            POOR STAND OF GRASS, A SURFACE SLOPE OF  2.%
            AND A SLOPE LENGTH OF 1200. FEET.

       SCS RUNOFF CURVE NUMBER              =     93.10
       FRACTION OF AREA ALLOWING RUNOFF     =    100.0    PERCENT
       AREA PROJECTED ON HORIZONTAL PLANE   =      1.000  ACRES
       EVAPORATIVE ZONE DEPTH               =     24.0    INCHES
       INITIAL WATER IN EVAPORATIVE ZONE    =      5.269  INCHES
       UPPER LIMIT OF EVAPORATIVE STORAGE   =     12.348  INCHES
       LOWER LIMIT OF EVAPORATIVE STORAGE   =      3.084  INCHES
       INITIAL SNOW WATER                   =      0.000  INCHES
       INITIAL WATER IN LAYER MATERIALS     =    672.302  INCHES
       TOTAL INITIAL WATER                  =    672.302  INCHES
       TOTAL SUBSURFACE INFLOW              =      8.04   INCHES/YEAR


                 EVAPOTRANSPIRATION AND WEATHER DATA
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     NOTE:  EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
            ALBANY                    NEW YORK

       STATION LATITUDE                     =  42.45 DEGREES
       MAXIMUM LEAF AREA INDEX              =   3.50
       START OF GROWING SEASON (JULIAN DATE) =   123
       END OF GROWING SEASON (JULIAN DATE)  =    282
       EVAPORATIVE ZONE DEPTH               =  24.0  INCHES
       AVERAGE ANNUAL WIND SPEED            =   8.90 MPH
       AVERAGE 1ST QUARTER RELATIVE HUMIDITY =  68.00 %
       AVERAGE 2ND QUARTER RELATIVE HUMIDITY =  66.00 %
       AVERAGE 3RD QUARTER RELATIVE HUMIDITY =  74.00 %
       AVERAGE 4TH QUARTER RELATIVE HUMIDITY =  74.00 %


     NOTE:  PRECIPITATION DATA FOR     CHERRY ISLAND LF
            WAS ENTERED BY THE USER.


     NOTE:  TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING
            COEFFICIENTS FOR     WILMINGTON          DELAWARE

       NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

     JAN/JUL     FEB/AUG     MAR/SEP     APR/OCT     MAY/NOV     JUN/DEC
     -------     -------     -------     -------     -------     -------
      31.20       33.20       41.80       52.40       62.20       71.20
      76.00       74.80       67.80       56.30       45.60       35.50


     NOTE:  SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
            COEFFICIENTS FOR     WILMINGTON          DELAWARE

                AND STATION LATITUDE  =  39.80 DEGREES


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                 MONTHLY TOTALS (IN INCHES) FOR YEAR    1
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                              JAN/JUL FEB/AUG MAR/SEP APR/OCT MAY/NOV JUN/DEC
                              ------- ------- ------- ------- ------- -------
PRECIPITATION                  1.87    1.39    4.15    2.02    1.86    5.95
                               2.42    5.10    3.84    3.78    1.81    7.26

RUNOFF                         0.095   0.001   0.577   0.031   0.038   0.439
                               0.088   0.761   1.492   0.644   0.157   1.816

EVAPOTRANSPIRATION             1.092   1.466   2.155   2.935   1.981   6.301
                               3.152   3.498   1.588   1.479   1.192   0.865

SUBSURFACE INFLOW INTO         0.6828  0.6168  0.6828  0.6608  0.6828  0.6608
  LAYER  3                     0.6828  0.6828  0.6608  0.6828  0.6608  0.6828

LATERAL DRAINAGE COLLECTED     3.8939  1.7050  1.4481  1.2715  1.2755  1.2236
  FROM LAYER  3                1.2613  1.2603  1.2194  1.2600  1.2193  1.2600

PERCOLATION/LEAKAGE THROUGH    0.1062  0.0956  0.1058  0.1023  0.1057  0.1023
  LAYER  4                     0.1057  0.1057  0.1023  0.1057  0.1023  0.1057

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                 MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)
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AVERAGE DAILY HEAD ON          7.533   4.016   3.091   2.805   2.723   2.699
  TOP OF LAYER  4              2.692   2.690   2.690   2.690   2.690   2.690

STD. DEVIATION OF DAILY        2.020   0.444   0.147   0.041   0.012   0.004
  HEAD ON TOP OF LAYER  4      0.002   0.000   0.000   0.000   0.000   0.000
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                      ANNUAL TOTALS FOR YEAR    1
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                                  INCHES          CU. FEET       PERCENT
                                  --------        ----------     -------
  PRECIPITATION                    41.45          150463.469     100.00
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RUNOFF	6.139	22283.998	14.81
EVAPOTRANSPIRATION	27.705	100567.484	66.84
SUBSURFACE INFLOW INTO LAYER 3	8.040000	29185.201	19.40
DRAINAGE COLLECTED FROM LAYER 3	18.2979	66421.375	44.14
PERC./LEAKAGE THROUGH LAYER 4	1.245546	4521.332	3.00
AVG. HEAD ON TOP OF LAYER 4	3.2507		
CHANGE IN WATER STORAGE	4.143	15039.553	10.00
SOIL WATER AT START OF YEAR	672.302	2440457.500	
SOIL WATER AT END OF YEAR	676.445	2455497.250	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	-8.0400	-29185.064	-19.40

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MONTHLY TOTALS (IN INCHES) FOR YEAR 2

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	2.12	4.54	4.19	4.19	7.87	5.80
	2.92	0.75	7.04	2.82	1.75	0.61
RUNOFF	0.337	1.022	3.785	0.176	1.729	1.012
	0.383	0.005	2.549	0.665	0.023	0.000
EVAPOTRANSPIRATION	0.723	0.498	1.731	3.957	4.502	6.707
	3.485	0.390	1.435	1.916	1.297	0.587
SUBSURFACE INFLOW INTO LAYER 3	0.6828	0.6168	0.6828	0.6608	0.6828	0.6608
	0.6828	0.6828	0.6608	0.6828	0.6608	0.6828
LATERAL DRAINAGE COLLECTED FROM LAYER 3	1.2600	1.1380	1.2600	1.2193	1.2600	1.2193
	1.2600	1.2600	1.2193	1.2600	1.2193	1.2600
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.1057	0.0955	0.1057	0.1023	0.1057	0.1023
	0.1057	0.1057	0.1023	0.1057	0.1023	0.1057

MONTHLY TOTALS (IN INCHES) FOR YEAR 3

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	7.06	1.11	2.48	2.14	2.69	7.65
	6.60	4.24	3.95	1.63	1.57	1.38
RUNOFF	2.786	0.003	0.009	0.057	0.477	1.445
	3.181	0.979	0.920	0.053	0.088	0.106
EVAPOTRANSPIRATION	0.690	1.503	2.295	2.863	2.854	6.305
	4.128	3.663	1.846	1.435	0.689	0.427
SUBSURFACE INFLOW INTO LAYER 3	0.6828	0.6168	0.6828	0.6608	0.6828	0.6608
	0.6828	0.6828	0.6608	0.6828	0.6608	0.6828
LATERAL DRAINAGE COLLECTED FROM LAYER 3	1.2600	1.1380	1.2600	1.2193	1.2600	1.2193
	1.2600	1.2600	1.2193	1.2600	1.2193	1.2600
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.1057	0.0955	0.1057	0.1023	0.1057	0.1023
	0.1057	0.1057	0.1023	0.1057	0.1023	0.1057

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 4	2.690	2.690	2.690	2.690	2.690	2.690
	2.690	2.690	2.690	2.690	2.690	2.690
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 4	0.001	0.002	0.001	0.002	0.001	0.002
	0.001	0.001	0.002	0.001	0.002	0.001

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ANNUAL TOTALS FOR YEAR 3

	INCHES	CU. FEET	PERCENT
PRECIPITATION	42.50	154274.984	100.00
RUNOFF	10.104	36679.020	23.78
EVAPOTRANSPIRATION	28.697	104170.680	67.52
SUBSURFACE INFLOW INTO LAYER 3	8.040000	29185.201	18.92
DRAINAGE COLLECTED FROM LAYER 3	14.8352	53851.801	34.91
PERC./LEAKAGE THROUGH LAYER 4	1.244860	4518.841	2.93

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 4	2.690	2.690	2.690	2.690	2.690	2.690
	2.690	2.690	2.690	2.690	2.690	2.690
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 4	0.000	0.002	0.001	0.002	0.001	0.002
	0.001	0.001	0.002	0.001	0.002	0.001

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ANNUAL TOTALS FOR YEAR 2

	INCHES	CU. FEET	PERCENT
PRECIPITATION	44.60	161897.969	100.00
RUNOFF	11.685	42417.039	26.20
EVAPOTRANSPIRATION	27.228	98839.391	61.05
SUBSURFACE INFLOW INTO LAYER 3	8.040000	29185.201	18.03
DRAINAGE COLLECTED FROM LAYER 3	14.8352	53851.801	33.26
PERC./LEAKAGE THROUGH LAYER 4	1.244860	4518.841	2.79
AVG. HEAD ON TOP OF LAYER 4	2.6896		
CHANGE IN WATER STORAGE	5.686	20641.637	12.75
SOIL WATER AT START OF YEAR	676.445	2455497.250	
SOIL WATER AT END OF YEAR	682.132	2476138.750	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	-8.0401	-29185.539	-18.03

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AVG. HEAD ON TOP OF LAYER 4	2.6896		
CHANGE IN WATER STORAGE	3.698	13425.397	8.70
SOIL WATER AT START OF YEAR	682.132	2476138.750	
SOIL WATER AT END OF YEAR	685.816	2489512.750	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.014	51.515	0.03
ANNUAL WATER BUDGET BALANCE	-8.0401	-29185.553	-18.92

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MONTHLY TOTALS (IN INCHES) FOR YEAR 4

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	4.44	2.19	3.41	4.62	2.81	4.90
	3.62	4.51	2.34	4.37	3.12	1.74
RUNOFF	2.726	1.113	0.788	0.220	0.263	0.505
	0.094	0.882	0.138	1.072	0.380	0.039
EVAPOTRANSPIRATION	0.369	0.669	1.921	3.518	4.263	5.143
	3.467	4.122	1.283	1.332	0.841	0.712
SUBSURFACE INFLOW INTO LAYER 3	0.6828	0.6388	0.6828	0.6608	0.6828	0.6608
	0.6828	0.6828	0.6608	0.6828	0.6608	0.6828
LATERAL DRAINAGE COLLECTED FROM LAYER 3	1.2600	1.1787	1.2600	1.2193	1.2600	1.2193
	1.2600	1.2600	1.2193	1.2600	1.2193	1.2600
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.1057	0.0989	0.1057	0.1023	0.1057	0.1023
	0.1057	0.1057	0.1023	0.1057	0.1023	0.1057

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 4	2.690	2.690	2.690	2.690	2.690	2.690
	2.690	2.690	2.690	2.690	2.690	2.690

STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 4	0.001 0.001	0.002 0.001	0.001 0.002	0.002 0.001	0.001 0.002	0.002 0.001

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ANNUAL TOTALS FOR YEAR 4

	INCHES	CU. FEET	PERCENT
PRECIPITATION	42.07	152714.141	100.00
RUNOFF	8.221	29843.949	19.54
EVAPOTRANSPIRATION	27.640	100332.555	65.70
SUBSURFACE INFLOW INTO LAYER 3	8.062028	29265.160	19.16
DRAINAGE COLLECTED FROM LAYER 3	14.8759	53999.340	35.36
PERC./LEAKAGE THROUGH LAYER 4	1.248270	4531.222	2.97
AVG. HEAD ON TOP OF LAYER 4	2.6896		
CHANGE IN WATER STORAGE	6.209	22537.615	14.76
SOIL WATER AT START OF YEAR	685.816	2489512.750	
SOIL WATER AT END OF YEAR	692.039	2512101.750	
SNOW WATER AT START OF YEAR	0.014	51.515	0.03
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	-8.0621	-29265.379	-19.16

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MONTHLY TOTALS (IN INCHES) FOR YEAR 5

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	0.98 5.57	4.73 8.02	8.53 7.27	3.09 4.94	5.72 3.35	3.65 3.28
RUNOFF	0.133 0.850	2.760 1.906	2.590 2.660	0.131 2.396	1.365 0.334	0.799 0.216
EVAPOTRANSPIRATION	0.596 5.703	0.573 4.535	2.376 3.263	3.493 1.387	4.680 1.287	3.663 0.835
SUBSURFACE INFLOW INTO LAYER 3	0.6828 0.6828	0.6168 0.6828	0.6828 0.6608	0.6608 0.6828	0.6828 0.6608	0.6608 0.6828
LATERAL DRAINAGE COLLECTED FROM LAYER 3	1.2600 1.2600	1.1380 1.2600	1.2600 1.2193	1.2193 1.2600	1.2600 1.2193	1.2193 1.2600
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.1057 0.1057	0.0955 0.1057	0.1057 0.1023	0.1023 0.1057	0.1057 0.1023	0.1023 0.1057

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 4	2.690 2.690	2.690 2.690	2.690 2.690	2.690 2.690	2.690 2.690	2.690 2.690
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 4	0.001 0.001	0.002 0.001	0.001 0.002	0.002 0.001	0.001 0.002	0.002 0.001

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ANNUAL TOTALS FOR YEAR 5

	INCHES	CU. FEET	PERCENT
PRECIPITATION	59.13	214641.937	100.00
RUNOFF	16.140	58589.238	27.30
EVAPOTRANSPIRATION	32.391	117580.430	54.78
SUBSURFACE INFLOW INTO LAYER 3	8.040000	29185.201	13.60
DRAINAGE COLLECTED FROM LAYER 3	14.8352	53851.801	25.09
PERC./LEAKAGE THROUGH LAYER 4	1.244860	4518.841	2.11
AVG. HEAD ON TOP OF LAYER 4	2.6896		
CHANGE IN WATER STORAGE	10.598	38472.152	17.92
SOIL WATER AT START OF YEAR	692.039	2512101.750	
SOIL WATER AT END OF YEAR	702.637	2550574.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	-8.0400	-29185.332	-13.60

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MONTHLY TOTALS (IN INCHES) FOR YEAR 6

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	3.86 5.26	2.45 7.83	4.12 3.95	3.55 2.25	4.92 4.13	5.49 1.23
RUNOFF	0.327 1.177	2.079 2.261	0.743 0.880	0.340 0.252	0.839 1.202	0.945 0.108
EVAPOTRANSPIRATION	0.695 4.321	0.997 4.933	2.723 2.883	3.955 1.023	3.285 0.824	6.703 0.511
SUBSURFACE INFLOW INTO LAYER 3	0.6828 0.6828	0.6168 0.6828	0.6828 0.6608	0.6608 0.6828	0.6828 0.6608	0.6608 0.6828
LATERAL DRAINAGE COLLECTED FROM LAYER 3	1.2600 1.2600	1.1380 1.2600	1.2600 1.2193	1.2193 1.2600	1.2600 1.2193	1.2193 1.2600
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.1057 0.1057	0.0955 0.1057	0.1057 0.1023	0.1023 0.1057	0.1057 0.1023	0.1023 0.1057

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 4	2.690 2.690	2.690 2.690	2.690 2.690	2.690 2.690	2.690 2.690	2.690 2.690
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 4	0.001 0.001	0.002 0.001	0.001 0.002	0.002 0.001	0.001 0.002	0.002 0.001

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ANNUAL TOTALS FOR YEAR 6

	INCHES	CU. FEET	PERCENT
PRECIPITATION	49.04	178015.187	100.00
RUNOFF	11.153	40483.594	22.74
EVAPOTRANSPIRATION	32.855	119262.039	67.00
SUBSURFACE INFLOW INTO LAYER 3	8.040000	29185.201	16.39
DRAINAGE COLLECTED FROM LAYER 3	14.8352	53851.801	30.25
PERC./LEAKAGE THROUGH LAYER 4	1.244860	4518.841	2.54
AVG. HEAD ON TOP OF LAYER 4	2.6896		
CHANGE IN WATER STORAGE	5.033	18269.420	10.26
SOIL WATER AT START OF YEAR	702.637	2550574.000	
SOIL WATER AT END OF YEAR	707.670	2568843.250	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	-8.0400	-29185.307	-16.39

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MONTHLY TOTALS (IN INCHES) FOR YEAR 7

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	4.59 1.55	1.40 5.61	5.75 5.53	4.02 1.83	1.74 7.03	2.86 4.38
RUNOFF	1.944 0.009	0.802 1.265	1.245 1.701	0.269 0.438	0.031 2.049	0.610 1.403
EVAPOTRANSPIRATION	0.766 1.548	0.316 4.181	1.594 1.916	3.708 1.522	3.106 1.198	3.802 0.814
SUBSURFACE INFLOW INTO LAYER 3	0.6828 0.6828	0.6168 0.6828	0.6828 0.6608	0.6608 0.6828	0.6828 0.6608	0.6608 0.6828

LATERAL DRAINAGE COLLECTED FROM LAYER 3	1.2600	1.1380	1.2600	1.2193	1.2600	1.2193
	1.2600	1.2600	1.2193	1.2600	1.2193	1.2600
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.1057	0.0955	0.1057	0.1023	0.1057	0.1023
	0.1057	0.1057	0.1023	0.1057	0.1023	0.1057

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 4	2.690	2.690	2.690	2.690	2.690	2.690
	2.690	2.690	2.690	2.690	2.690	2.690
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 4	0.001	0.002	0.001	0.002	0.001	0.002
	0.001	0.001	0.002	0.001	0.002	0.001

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ANNUAL TOTALS FOR YEAR 7

	INCHES	CU. FEET	PERCENT
PRECIPITATION	46.29	168032.703	100.00
RUNOFF	11.764	42704.168	25.41
EVAPOTRANSPIRATION	24.471	88829.359	52.86
SUBSURFACE INFLOW INTO LAYER 3	8.040000	29185.201	17.37
DRAINAGE COLLECTED FROM LAYER 3	14.8352	53851.801	32.05
PERC./LEAKAGE THROUGH LAYER 4	1.244860	4518.841	2.69
AVG. HEAD ON TOP OF LAYER 4	2.6896		
CHANGE IN WATER STORAGE	10.055	36499.180	21.72
SOIL WATER AT START OF YEAR	707.670	2568843.250	
SOIL WATER AT END OF YEAR	717.725	2605342.500	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	-8.0401	-29185.445	-17.37

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MONTHLY TOTALS (IN INCHES) FOR YEAR 8

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	5.72	2.50	3.55	6.62	2.47	3.30
	1.89	4.41	1.64	3.14	2.70	3.30
RUNOFF	1.759	0.688	0.446	1.820	0.029	0.442
	0.179	0.857	0.138	0.599	0.654	0.559
EVAPOTRANSPIRATION	1.216	1.661	2.692	4.385	3.188	4.667
	1.539	3.809	1.536	1.138	0.871	0.460
SUBSURFACE INFLOW INTO LAYER 3	0.6828	0.6388	0.6828	0.6608	0.6828	0.6608
	0.6828	0.6828	0.6608	0.6828	0.6608	0.6828
LATERAL DRAINAGE COLLECTED FROM LAYER 3	1.2600	1.1787	1.2600	1.2193	1.2600	1.2193
	1.2600	1.2600	1.2193	1.2600	1.2193	1.2600
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.1057	0.0989	0.1057	0.1023	0.1057	0.1023
	0.1057	0.1057	0.1023	0.1057	0.1023	0.1057

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 4	2.690	2.690	2.690	2.690	2.690	2.690
	2.690	2.690	2.690	2.690	2.690	2.690
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 4	0.001	0.002	0.001	0.002	0.001	0.002
	0.001	0.001	0.002	0.001	0.002	0.001

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ANNUAL TOTALS FOR YEAR 8

	INCHES	CU. FEET	PERCENT
PRECIPITATION	41.24	149701.187	100.00
RUNOFF	8.169	29654.473	19.81
EVAPOTRANSPIRATION	27.161	98594.859	65.86
SUBSURFACE INFLOW INTO LAYER 3	8.062028	29265.160	19.55
DRAINAGE COLLECTED FROM LAYER 3	14.8759	53999.340	36.07
PERC./LEAKAGE THROUGH LAYER 4	1.248270	4531.222	3.03
AVG. HEAD ON TOP OF LAYER 4	2.6896		
CHANGE IN WATER STORAGE	5.910	21452.094	14.33
SOIL WATER AT START OF YEAR	717.725	2605342.500	
SOIL WATER AT END OF YEAR	723.635	2626794.750	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	-8.0622	-29265.635	-19.55

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MONTHLY TOTALS (IN INCHES) FOR YEAR 9

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	4.63	2.81	2.61	4.64	3.92	5.10
	5.22	6.98	10.80	0.60	4.39	3.09
RUNOFF	2.828	2.240	0.612	0.613	0.132	0.846
	1.666	2.141	4.366	0.018	0.420	0.651
EVAPOTRANSPIRATION	0.399	0.192	1.613	3.944	4.339	5.133
	3.647	4.345	3.169	1.601	1.170	0.623
SUBSURFACE INFLOW INTO LAYER 3	0.6828	0.6168	0.6828	0.6608	0.6828	0.6608
	0.6828	0.6828	0.6608	0.6828	0.6608	0.6828
LATERAL DRAINAGE COLLECTED FROM LAYER 3	1.2600	1.1380	1.2600	1.2193	1.2600	1.2193
	1.2600	1.2600	1.2193	1.2600	1.2193	1.2600
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.1057	0.0955	0.1057	0.1023	0.1057	0.1023
	0.1057	0.1057	0.1023	0.1057	0.1023	0.1057

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 4	2.690	2.690	2.690	2.690	2.690	2.690
	2.690	2.690	2.690	2.690	2.690	2.690
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 4	0.001	0.002	0.001	0.002	0.001	0.002
	0.001	0.001	0.002	0.001	0.002	0.001

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ANNUAL TOTALS FOR YEAR 9

	INCHES	CU. FEET	PERCENT
PRECIPITATION	54.79	198887.719	100.00
RUNOFF	16.532	60010.840	30.17
EVAPOTRANSPIRATION	30.175	109536.453	55.07
SUBSURFACE INFLOW INTO LAYER 3	8.040000	29185.201	14.67
DRAINAGE COLLECTED FROM LAYER 3	14.8352	53851.801	27.08
PERC./LEAKAGE THROUGH LAYER 4	1.244860	4518.841	2.27
AVG. HEAD ON TOP OF LAYER 4	2.6896		
CHANGE IN WATER STORAGE	8.083	29340.297	14.75
SOIL WATER AT START OF YEAR	723.635	2626794.750	
SOIL WATER AT END OF YEAR	731.421	2655059.250	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.296	1075.748	0.54
ANNUAL WATER BUDGET BALANCE	-8.0400	-29185.314	-14.67

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MONTHLY TOTALS (IN INCHES) FOR YEAR 10

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	3.98	2.12	4.68	3.52	3.38	4.46
	6.20	5.67	11.97	7.03	2.02	2.41
RUNOFF	2.512	1.409	1.382	0.471	0.110	0.557
	2.408	1.455	6.389	2.106	0.061	0.167
EVAPOTRANSPIRATION	0.475	0.417	2.738	3.000	3.158	6.169
	3.085	3.928	2.535	1.719	1.062	0.583
SUBSURFACE INFLOW INTO LAYER 3	0.6828	0.6168	0.6828	0.6608	0.6828	0.6608
	0.6828	0.6828	0.6608	0.6828	0.6608	0.6828
LATERAL DRAINAGE COLLECTED FROM LAYER 3	1.2600	1.1380	1.2600	1.2193	1.2600	1.2193
	1.2600	1.2600	1.2193	1.2600	1.2193	1.2600
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.1057	0.0955	0.1057	0.1023	0.1057	0.1023
	0.1057	0.1057	0.1023	0.1057	0.1023	0.1057

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 4	2.690	2.690	2.690	2.690	2.690	2.690
	2.690	2.690	2.690	2.690	2.690	2.690
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 4	0.001	0.002	0.001	0.002	0.001	0.002
	0.001	0.001	0.002	0.001	0.002	0.001

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ANNUAL TOTALS FOR YEAR 10

	INCHES	CU. FEET	PERCENT
PRECIPITATION	57.44	208507.234	100.00
RUNOFF	19.027	69066.852	33.12
EVAPOTRANSPIRATION	28.870	104798.945	50.26
SUBSURFACE INFLOW INTO LAYER 3	8.040000	29185.201	14.00
DRAINAGE COLLECTED FROM LAYER 3	14.8352	53851.801	25.83
PERC./LEAKAGE THROUGH LAYER 4	1.244860	4518.841	2.17
AVG. HEAD ON TOP OF LAYER 4	2.6896		

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ANNUAL TOTALS FOR YEAR 11

	INCHES	CU. FEET	PERCENT
PRECIPITATION	45.18	164003.359	100.00
RUNOFF	11.625	42199.598	25.73
EVAPOTRANSPIRATION	29.950	108717.641	66.29
SUBSURFACE INFLOW INTO LAYER 3	8.040000	29185.201	17.80
DRAINAGE COLLECTED FROM LAYER 3	14.8352	53851.801	32.84
PERC./LEAKAGE THROUGH LAYER 4	1.244860	4518.841	2.76
AVG. HEAD ON TOP OF LAYER 4	2.6896		
CHANGE IN WATER STORAGE	3.605	13085.857	7.98
SOIL WATER AT START OF YEAR	741.261	2690776.500	
SOIL WATER AT END OF YEAR	744.866	2703862.250	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	-8.0400	-29185.182	-17.80

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MONTHLY TOTALS (IN INCHES) FOR YEAR 12

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	8.05	2.10	8.59	9.03	4.39	8.03
	5.35	3.72	2.36	6.26	5.12	5.83
RUNOFF	0.436	3.049	8.575	3.208	0.547	2.506
	1.712	0.574	0.455	2.480	1.866	1.370
EVAPOTRANSPIRATION	0.693	0.450	1.951	4.034	5.292	7.422
	3.646	3.146	0.754	1.114	1.104	0.809
SUBSURFACE INFLOW INTO LAYER 3	0.6828	0.6388	0.6828	0.6608	0.6828	0.6608
	0.6828	0.6828	0.6608	0.6828	0.6608	0.6828
LATERAL DRAINAGE COLLECTED FROM LAYER 3	1.2600	1.1787	1.2600	1.2193	1.2600	1.2193
	1.2600	1.2600	1.2193	1.2600	1.2193	1.2600
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.1057	0.0989	0.1057	0.1023	0.1057	0.1023
	0.1057	0.1057	0.1023	0.1057	0.1023	0.1057

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 4	2.690	2.690	2.690	2.690	2.690	2.690
	2.690	2.690	2.690	2.690	2.690	2.690
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 4	0.001	0.002	0.001	0.002	0.001	0.002
	0.001	0.001	0.002	0.001	0.002	0.001

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ANNUAL TOTALS FOR YEAR 12

	INCHES	CU. FEET	PERCENT
PRECIPITATION	68.83	249852.844	100.00
RUNOFF	26.778	97205.555	38.91
EVAPOTRANSPIRATION	30.414	110404.172	44.19
SUBSURFACE INFLOW INTO LAYER 3	8.062028	29265.160	11.71
DRAINAGE COLLECTED FROM LAYER 3	14.8759	53999.340	21.61
PERC./LEAKAGE THROUGH LAYER 4	1.248270	4531.222	1.81
AVG. HEAD ON TOP OF LAYER 4	2.6896		
CHANGE IN WATER STORAGE	11.637	42243.137	16.91
SOIL WATER AT START OF YEAR	744.866	2703862.250	
SOIL WATER AT END OF YEAR	754.461	2738694.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	2.042	7411.400	2.97
CHANGE IN WATER STORAGE	9.543	34641.555	16.61
SOIL WATER AT START OF YEAR	731.421	2655059.250	
SOIL WATER AT END OF YEAR	741.261	2690776.500	
SNOW WATER AT START OF YEAR	0.296	1075.748	0.52
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	-8.0401	-29185.557	-14.00

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MONTHLY TOTALS (IN INCHES) FOR YEAR 11

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	3.93	3.22	3.86	2.79	1.90	6.67
	10.86	3.62	1.46	1.67	2.93	2.27
RUNOFF	2.682	1.434	0.499	0.307	0.093	0.986
	3.871	0.526	0.217	0.159	0.498	0.353
EVAPOTRANSPIRATION	0.152	0.758	2.953	3.862	2.045	6.084
	6.811	4.078	0.705	1.234	0.764	0.503
SUBSURFACE INFLOW INTO LAYER 3	0.6828	0.6168	0.6828	0.6608	0.6828	0.6608
	0.6828	0.6828	0.6608	0.6828	0.6608	0.6828
LATERAL DRAINAGE COLLECTED FROM LAYER 3	1.2600	1.1380	1.2600	1.2193	1.2600	1.2193
	1.2600	1.2600	1.2193	1.2600	1.2193	1.2600
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.1057	0.0955	0.1057	0.1023	0.1057	0.1023
	0.1057	0.1057	0.1023	0.1057	0.1023	0.1057

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 4	2.690	2.690	2.690	2.690	2.690	2.690
	2.690	2.690	2.690	2.690	2.690	2.690
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 4	0.001	0.002	0.001	0.002	0.001	0.002
	0.001	0.001	0.002	0.001	0.002	0.001

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ANNUAL WATER BUDGET BALANCE	-8.0621	-29265.410	-11.71

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MONTHLY TOTALS (IN INCHES) FOR YEAR 13

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	2.02	1.24	5.86	2.65	2.08	1.82
	3.99	0.38	6.34	6.41	1.89	4.28
RUNOFF	0.692	0.523	1.699	0.262	0.019	0.193
	1.401	0.000	1.821	3.027	0.095	0.857
EVAPOTRANSPIRATION	0.550	0.240	2.354	3.218	2.230	3.507
	2.589	0.380	2.126	1.840	1.181	0.768
SUBSURFACE INFLOW INTO LAYER 3	0.6828	0.6168	0.6828	0.6608	0.6828	0.6608
	0.6828	0.6828	0.6608	0.6828	0.6608	0.6828
LATERAL DRAINAGE COLLECTED FROM LAYER 3	1.2600	1.1380	1.2600	1.2193	1.2600	1.2193
	1.2600	1.2600	1.2193	1.2600	1.2193	1.2600
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.1057	0.0955	0.1057	0.1023	0.1057	0.1023
	0.1057	0.1057	0.1023	0.1057	0.1023	0.1057

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 4	2.690	2.690	2.690	2.690	2.690	2.690
	2.690	2.690	2.690	2.690	2.690	2.690
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 4	0.001	0.002	0.001	0.002	0.001	0.002
	0.001	0.001	0.002	0.001	0.002	0.001

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ANNUAL TOTALS FOR YEAR 13

	INCHES	CU. FEET	PERCENT
PRECIPITATION	38.96	141424.828	100.00
RUNOFF	10.589	38439.430	27.18
EVAPOTRANSPIRATION	20.982	76165.945	53.86
SUBSURFACE INFLOW INTO LAYER 3	8.040000	29185.201	20.64
DRAINAGE COLLECTED FROM LAYER 3	14.8352	53851.801	38.08
PERC./LEAKAGE THROUGH LAYER 4	1.244860	4518.841	3.20
AVG. HEAD ON TOP OF LAYER 4	2.6896		
CHANGE IN WATER STORAGE	7.388	26819.449	18.96
SOIL WATER AT START OF YEAR	754.461	2738694.000	
SOIL WATER AT END OF YEAR	763.173	2770316.250	
SNOW WATER AT START OF YEAR	2.042	7411.400	5.24
SNOW WATER AT END OF YEAR	0.719	2608.595	1.84
ANNUAL WATER BUDGET BALANCE	-8.0401	-29185.445	-20.64

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MONTHLY TOTALS (IN INCHES) FOR YEAR 14

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	1.68	0.64	4.01	4.21	3.90	3.86
	2.56	1.74	2.98	2.88	1.21	8.76
RUNOFF	0.046	0.630	0.512	0.384	0.213	0.364
	0.344	0.150	0.205	0.143	0.076	3.412
EVAPOTRANSPIRATION	0.658	0.321	2.773	4.338	3.226	5.094
	2.987	1.493	2.264	1.616	0.762	0.617
SUBSURFACE INFLOW INTO LAYER 3	0.6828	0.6168	0.6828	0.6608	0.6828	0.6608
	0.6828	0.6828	0.6608	0.6828	0.6608	0.6828
LATERAL DRAINAGE COLLECTED FROM LAYER 3	1.2600	1.1380	1.2600	1.2193	1.2600	1.2193
	1.2600	1.2600	1.2193	1.2600	1.2193	1.2600
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.1057	0.0955	0.1057	0.1023	0.1057	0.1023
	0.1057	0.1057	0.1023	0.1057	0.1023	0.1057

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 4	2.690	2.690	2.690	2.690	2.690	2.690
	2.690	2.690	2.690	2.690	2.690	2.690
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 4	0.001	0.002	0.001	0.002	0.001	0.002
	0.001	0.001	0.002	0.001	0.002	0.001

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ANNUAL TOTALS FOR YEAR 14

	INCHES	CU. FEET	PERCENT
PRECIPITATION	38.43	139500.906	100.00
RUNOFF	6.480	23520.609	16.86
EVAPOTRANSPIRATION	26.150	94923.398	68.05
SUBSURFACE INFLOW INTO LAYER 3	8.040000	29185.201	20.92
DRAINAGE COLLECTED FROM LAYER 3	14.8352	53851.801	38.60
PERC./LEAKAGE THROUGH LAYER 4	1.244860	4518.841	3.24
AVG. HEAD ON TOP OF LAYER 4	2.6896		
CHANGE IN WATER STORAGE	5.801	21057.088	15.09
SOIL WATER AT START OF YEAR	763.173	2770316.250	
SOIL WATER AT END OF YEAR	768.150	2788383.250	
SNOW WATER AT START OF YEAR	0.719	2608.595	1.87
SNOW WATER AT END OF YEAR	1.542	5598.767	4.01
ANNUAL WATER BUDGET BALANCE	-8.0401	-29185.637	-20.92

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MONTHLY TOTALS (IN INCHES) FOR YEAR 15

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	0.95	4.60	4.04	0.69	3.91	2.40
	2.68	12.91	4.59	3.00	3.10	4.24
RUNOFF	0.756	3.549	1.093	0.000	1.501	0.364
	0.227	6.362	1.216	0.451	0.612	0.196
EVAPOTRANSPIRATION	0.627	0.524	2.292	1.757	1.861	4.181
	2.454	5.616	2.975	1.405	0.777	0.460
SUBSURFACE INFLOW INTO LAYER 3	0.6828	0.6168	0.6828	0.6608	0.6828	0.6608
	0.6828	0.6828	0.6608	0.6828	0.6608	0.6828
LATERAL DRAINAGE COLLECTED FROM LAYER 3	1.2600	1.1380	1.2600	1.2193	1.2600	1.2193
	1.2600	1.2600	1.2193	1.2600	1.2193	1.2600
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.1057	0.0955	0.1057	0.1023	0.1057	0.1023
	0.1057	0.1057	0.1023	0.1057	0.1023	0.1057

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 4	2.690	2.690	2.690	2.690	2.690	2.690
	2.690	2.690	2.690	2.690	2.690	2.690
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 4	0.001	0.002	0.001	0.002	0.001	0.002
	0.001	0.001	0.002	0.001	0.002	0.001

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ANNUAL TOTALS FOR YEAR 15

	INCHES	CU. FEET	PERCENT
PRECIPITATION	47.11	171009.375	100.00
RUNOFF	16.327	59265.539	34.66
EVAPOTRANSPIRATION	24.929	90491.781	52.92
SUBSURFACE INFLOW INTO LAYER 3	8.040000	29185.201	17.07

DRAINAGE COLLECTED FROM LAYER 3	14.8352	53851.801	31.49
PERC./LEAKAGE THROUGH LAYER 4	1.244860	4518.841	2.64
AVG. HEAD ON TOP OF LAYER 4	2.6896		
CHANGE IN WATER STORAGE	5.854	21251.773	12.43
SOIL WATER AT START OF YEAR	768.150	2788383.250	
SOIL WATER AT END OF YEAR	773.395	2807423.000	
SNOW WATER AT START OF YEAR	1.542	5598.767	3.27
SNOW WATER AT END OF YEAR	2.152	7810.766	4.57
ANNUAL WATER BUDGET BALANCE	-8.0400	-29185.168	-17.07

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MONTHLY TOTALS (IN INCHES) FOR YEAR 16

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	3.42	2.71	4.10	3.22	1.44	4.36
	5.56	3.22	3.06	0.90	2.77	3.04
RUNOFF	1.533	1.711	0.993	0.297	0.037	0.750
	0.959	0.399	0.334	0.132	0.283	0.231
EVAPOTRANSPIRATION	0.649	0.356	2.176	4.061	2.249	4.714
	3.578	4.229	1.231	1.112	0.715	0.488
SUBSURFACE INFLOW INTO	0.6828	0.6388	0.6828	0.6608	0.6828	0.6608
LAYER 3	0.6828	0.6828	0.6608	0.6828	0.6608	0.6828
LATERAL DRAINAGE COLLECTED	1.2600	1.1787	1.2600	1.2193	1.2600	1.2193
FROM LAYER 3	1.2600	1.2600	1.2193	1.2600	1.2193	1.2600
PERCOLATION/LEAKAGE THROUGH	0.1057	0.0989	0.1057	0.1023	0.1057	0.1023
LAYER 4	0.1057	0.1057	0.1023	0.1057	0.1023	0.1057

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

PRECIPITATION	0.66	1.49	3.09	2.64	1.65	2.73
	2.67	1.56	3.30	2.64	5.00	1.38
RUNOFF	0.000	0.472	0.473	0.018	0.022	0.232
	0.235	0.004	0.189	0.380	1.105	0.018
EVAPOTRANSPIRATION	0.680	0.382	2.418	2.419	2.109	4.551
	2.301	1.426	2.747	1.613	0.920	0.645
SUBSURFACE INFLOW INTO	0.6828	0.6168	0.6828	0.6608	0.6828	0.6608
LAYER 3	0.6828	0.6828	0.6608	0.6828	0.6608	0.6828
LATERAL DRAINAGE COLLECTED	1.2600	1.1380	1.2600	1.2193	1.2600	1.2193
FROM LAYER 3	1.2600	1.2600	1.2193	1.2600	1.2193	1.2600
PERCOLATION/LEAKAGE THROUGH	0.1057	0.0955	0.1057	0.1023	0.1057	0.1023
LAYER 4	0.1057	0.1057	0.1023	0.1057	0.1023	0.1057

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON	2.690	2.690	2.690	2.690	2.690	2.690
TOP OF LAYER 4	2.690	2.690	2.690	2.690	2.690	2.690
STD. DEVIATION OF DAILY	0.001	0.002	0.001	0.002	0.001	0.002
HEAD ON TOP OF LAYER 4	0.001	0.001	0.002	0.001	0.002	0.001

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ANNUAL TOTALS FOR YEAR 17

	INCHES	CU. FEET	PERCENT
PRECIPITATION	28.81	104580.328	100.00
RUNOFF	3.148	11425.474	10.93
EVAPOTRANSPIRATION	22.210	80621.289	77.09
SUBSURFACE INFLOW INTO LAYER 3	8.040000	29185.201	27.91
DRAINAGE COLLECTED FROM LAYER 3	14.8352	53851.801	51.49
PERC./LEAKAGE THROUGB LAYER 4	1.244860	4518.841	4.32
AVG. HEAD ON TOP OF LAYER 4	2.6896		
CHANGE IN WATER STORAGE	3.453	12533.515	11.98
SOIL WATER AT START OF YEAR	780.130	2831871.500	
SOIL WATER AT END OF YEAR	783.583	2844405.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	-8.0401	-29185.391	-27.91

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MONTHLY TOTALS (IN INCHES) FOR YEAR 18

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	1.87	1.39	4.15	2.02	1.86	5.95
	2.42	5.10	3.84	3.78	1.81	7.26
RUNOFF	0.106	0.139	2.006	0.028	0.034	0.471
	0.088	0.738	1.507	0.657	0.164	2.034
EVAPOTRANSPIRATION	0.967	0.595	1.893	2.788	1.925	6.364
	3.337	3.493	1.579	1.463	1.101	0.655
SUBSURFACE INFLOW INTO	0.6828	0.6168	0.6828	0.6608	0.6828	0.6608
LAYER 3	0.6828	0.6828	0.6608	0.6828	0.6608	0.6828
LATERAL DRAINAGE COLLECTED	1.2600	1.1380	1.2600	1.2193	1.2600	1.2193
FROM LAYER 3	1.2600	1.2600	1.2193	1.2600	1.2193	1.2600
PERCOLATION/LEAKAGE THROUGH	0.1057	0.0955	0.1057	0.1023	0.1057	0.1023
LAYER 4	0.1057	0.1057	0.1023	0.1057	0.1023	0.1057

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON	2.690	2.690	2.690	2.690	2.690	2.690
TOP OF LAYER 4	2.690	2.690	2.690	2.690	2.690	2.690
STD. DEVIATION OF DAILY	0.001	0.002	0.001	0.002	0.001	0.002
HEAD ON TOP OF LAYER 4	0.001	0.001	0.002	0.001	0.002	0.001

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ANNUAL TOTALS FOR YEAR 16

	INCHES	CU. FEET	PERCENT
PRECIPITATION	37.80	137213.984	100.00
RUNOFF	7.659	27802.449	20.26
EVAPOTRANSPIRATION	25.558	92773.930	67.61
SUBSURFACE INFLOW INTO LAYER 3	8.062028	29265.160	21.33
DRAINAGE COLLECTED FROM LAYER 3	14.8759	53999.340	39.35
PERC./LEAKAGE THROUGH LAYER 4	1.248270	4531.222	3.30
AVG. HEAD ON TOP OF LAYER 4	2.6896		
CHANGE IN WATER STORAGE	4.583	16637.676	12.13
SOIL WATER AT START OF YEAR	773.395	2807423.000	
SOIL WATER AT END OF YEAR	780.130	2831871.500	
SNOW WATER AT START OF YEAR	2.152	7810.766	5.69
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	-8.0621	-29265.473	-21.33

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MONTHLY TOTALS (IN INCHES) FOR YEAR 17

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC

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ANNUAL TOTALS FOR YEAR 18

	INCHES	CU. FEET	PERCENT
PRECIPITATION	41.45	150463.469	100.00
RUNOFF	7.971	28933.273	19.23
EVAPOTRANSPIRATION	26.160	94962.250	63.11
SUBSURFACE INFLOW INTO LAYER 3	8.040000	29185.201	19.40
DRAINAGE COLLECTED FROM LAYER 3	14.8352	53851.801	35.79
PERC./LEAKAGE THROUGH LAYER 4	1.244860	4518.841	3.00
AVG. HEAD ON TOP OF LAYER 4	2.6896		
CHANGE IN WATER STORAGE	7.319	26568.082	17.66
SOIL WATER AT START OF YEAR	783.583	2844405.000	
SOIL WATER AT END OF YEAR	790.902	2870973.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	-8.0401	-29185.578	-19.40

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MONTHLY TOTALS (IN INCHES) FOR YEAR 19

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	2.12	4.54	4.19	4.19	7.87	5.80
	2.92	0.75	7.04	2.82	1.75	0.61
RUNOFF	0.403	1.156	2.459	0.190	1.733	1.001
	0.388	0.005	2.515	0.661	0.030	0.000
EVAPOTRANSPIRATION	0.807	0.664	1.740	4.066	4.564	6.615
	3.334	0.357	1.542	1.781	1.228	0.749
SUBSURFACE INFLOW INTO LAYER 3	0.6828	0.6168	0.6828	0.6608	0.6828	0.6608
	0.6828	0.6828	0.6608	0.6828	0.6608	0.6828
LATERAL DRAINAGE COLLECTED FROM LAYER 3	1.2600	1.1380	1.2600	1.2193	1.2600	1.2193
	1.2600	1.2600	1.2193	1.2600	1.2193	1.2600
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.1057	0.0955	0.1057	0.1023	0.1057	0.1023
	0.1057	0.1057	0.1023	0.1057	0.1023	0.1057

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 4	2.690	2.690	2.690	2.690	2.690	2.690
	2.690	2.690	2.690	2.690	2.690	2.690
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 4	0.001	0.002	0.001	0.002	0.001	0.002
	0.001	0.001	0.002	0.001	0.002	0.001

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MONTHLY TOTALS (IN INCHES) FOR YEAR 20

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	7.06	1.11	2.48	2.14	2.69	7.65
	6.60	4.40	3.85	1.57	1.57	1.38
RUNOFF	4.385	0.002	0.491	0.062	0.448	1.478
	3.148	0.977	0.921	0.061	0.100	0.064
EVAPOTRANSPIRATION	0.546	1.403	0.939	2.937	2.861	6.820
	4.041	3.489	1.649	1.429	0.595	0.578
SUBSURFACE INFLOW INTO LAYER 3	0.6828	0.6388	0.6828	0.6608	0.6828	0.6608
	0.6828	0.6828	0.6608	0.6828	0.6608	0.6828
LATERAL DRAINAGE COLLECTED FROM LAYER 3	1.2600	1.1787	1.2600	1.2193	1.2600	1.2193
	1.2600	1.2600	1.2193	1.2600	1.2193	1.2600
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.1057	0.0989	0.1057	0.1023	0.1057	0.1023
	0.1057	0.1057	0.1023	0.1057	0.1023	0.1057

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 4	2.690	2.690	2.690	2.690	2.690	2.690
	2.690	2.690	2.690	2.690	2.690	2.690
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 4	0.001	0.002	0.001	0.002	0.001	0.002
	0.001	0.001	0.002	0.001	0.002	0.001

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ANNUAL TOTALS FOR YEAR 20

	INCHES	CU. FEET	PERCENT
PRECIPITATION	42.50	154274.984	100.00
RUNOFF	12.138	44061.629	28.56
EVAPOTRANSPIRATION	27.290	99064.391	64.21
SUBSURFACE INFLOW INTO LAYER 3	8.062028	29265.160	18.97
DRAINAGE COLLECTED FROM LAYER 3	14.8759	53999.340	35.00
PERC./LEAKAGE THROUGH LAYER 4	1.248270	4531.222	2.94
AVG. HEAD ON TOP OF LAYER 4	2.6896		
CHANGE IN WATER STORAGE	3.071	11149.001	7.23
SOIL WATER AT START OF YEAR	797.514	2894977.250	
SOIL WATER AT END OF YEAR	800.586	2906126.250	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	-8.0621	-29265.441	-18.97

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MONTHLY TOTALS (IN INCHES) FOR YEAR 21

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	4.44	2.19	3.41	4.62	2.81	4.90
	3.62	4.51	2.28	4.43	3.12	1.74
RUNOFF	0.717	1.766	1.049	0.201	0.233	0.500
	0.094	0.881	0.139	1.064	0.378	0.036
EVAPOTRANSPIRATION	0.946	0.399	2.172	3.447	4.393	4.896
	3.593	4.305	1.252	1.438	0.903	0.740
SUBSURFACE INFLOW INTO LAYER 3	0.6828	0.6168	0.6828	0.6608	0.6828	0.6608
	0.6828	0.6828	0.6608	0.6828	0.6608	0.6828
LATERAL DRAINAGE COLLECTED FROM LAYER 3	1.2600	1.1380	1.2600	1.2193	1.2600	1.2193
	1.2600	1.2600	1.2193	1.2600	1.2193	1.2600
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.1057	0.0955	0.1057	0.1023	0.1057	0.1023
	0.1057	0.1057	0.1023	0.1057	0.1023	0.1057

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 4	2.690 2.690	2.690 2.690	2.690 2.690	2.690 2.690	2.690 2.690	2.690 2.690
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 4	0.001 0.001	0.002 0.001	0.001 0.002	0.002 0.001	0.001 0.002	0.002 0.001

ANNUAL TOTALS FOR YEAR 21

	INCHES	CU. FEET	PERCENT
PRECIPITATION	42.07	152714.141	100.00
RUNOFF	7.059	25623.549	16.78
EVAPOTRANSPIRATION	28.485	103399.289	67.71
SUBSURFACE INFLOW INTO LAYER 3	8.040000	29185.201	19.11
DRAINAGE COLLECTED FROM LAYER 3	14.8352	53851.801	35.26
PERC./LEAKAGE THROUGH LAYER 4	1.244860	4518.841	2.96
AVG. HEAD ON TOP OF LAYER 4	2.6896		
CHANGE IN WATER STORAGE	6.527	23691.377	15.51
SOIL WATER AT START OF YEAR	800.586	2906126.250	
SOIL WATER AT END OF YEAR	807.112	2929817.750	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	-8.0401	-29185.521	-19.11

AVG. HEAD ON TOP OF LAYER 4	2.6896					
CHANGE IN WATER STORAGE	10.035	36427.629	16.97			
SOIL WATER AT START OF YEAR	807.112	2929817.750				
SOIL WATER AT END OF YEAR	816.727	2964718.250				
SNOW WATER AT START OF YEAR	0.000	0.000	0.00			
SNOW WATER AT END OF YEAR	0.421	1526.985	0.71			
ANNUAL WATER BUDGET BALANCE	-8.0400	-29185.252	-13.60			

MONTHLY TOTALS (IN INCHES) FOR YEAR 23

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	3.86 5.26	2.45 7.83	4.12 3.95	3.55 2.25	4.92 4.13	5.49 1.23
RUNOFF	2.816 1.198	0.321 2.258	0.736 0.875	0.361 0.247	0.816 1.193	0.942 0.108
EVAPOTRANSPIRATION	0.505 4.306	1.229 4.987	2.797 3.249	3.775 1.196	3.254 0.788	6.675 0.525
SUBSURFACE INFLOW INTO LAYER 3	0.6828 0.6828	0.6168 0.6828	0.6828 0.6608	0.6608 0.6828	0.6828 0.6608	0.6608 0.6828
LATERAL DRAINAGE COLLECTED FROM LAYER 3	1.2600 1.2600	1.1380 1.2600	1.2600 1.2193	1.2193 1.2600	1.2600 1.2193	1.2193 1.2600
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.1057 0.1057	0.0955 0.1057	0.1057 0.1023	0.1023 0.1057	0.1057 0.1023	0.1023 0.1057

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 4	2.690 2.690	2.690 2.690	2.690 2.690	2.690 2.690	2.690 2.690	2.690 2.690

MONTHLY TOTALS (IN INCHES) FOR YEAR 22

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	0.98 5.57	4.73 8.02	8.53 7.27	3.09 4.94	5.72 3.35	3.65 3.28
RUNOFF	0.010 0.872	3.089 1.915	3.430 2.550	0.125 2.397	1.363 0.335	0.797 0.067
EVAPOTRANSPIRATION	0.897 5.705	0.432 4.526	2.231 3.523	3.806 1.450	4.535 1.151	3.308 0.582
SUBSURFACE INFLOW INTO LAYER 3	0.6828 0.6828	0.6168 0.6828	0.6828 0.6608	0.6608 0.6828	0.6828 0.6608	0.6608 0.6828
LATERAL DRAINAGE COLLECTED FROM LAYER 3	1.2600 1.2600	1.1380 1.2600	1.2600 1.2193	1.2193 1.2600	1.2600 1.2193	1.2193 1.2600
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.1057 0.1057	0.0955 0.1057	0.1057 0.1023	0.1023 0.1057	0.1057 0.1023	0.1023 0.1057

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 4	2.690 2.690	2.690 2.690	2.690 2.690	2.690 2.690	2.690 2.690	2.690 2.690
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 4	0.001 0.001	0.002 0.001	0.001 0.002	0.002 0.001	0.001 0.002	0.002 0.001

ANNUAL TOTALS FOR YEAR 22

	INCHES	CU. FEET	PERCENT
PRECIPITATION	59.13	214641.937	100.00
RUNOFF	16.949	61524.535	28.66
EVAPOTRANSPIRATION	32.146	116689.578	54.36
SUBSURFACE INFLOW INTO LAYER 3	8.040000	29185.201	13.60
DRAINAGE COLLECTED FROM LAYER 3	14.8352	53851.801	25.09
PERC./LEAKAGE THROUGH LAYER 4	1.244860	4518.841	2.11

ANNUAL TOTALS FOR YEAR 23

	INCHES	CU. FEET	PERCENT
PRECIPITATION	49.04	178015.187	100.00
RUNOFF	11.871	43092.879	24.21
EVAPOTRANSPIRATION	33.288	120834.461	67.88
SUBSURFACE INFLOW INTO LAYER 3	8.040000	29185.201	16.39
DRAINAGE COLLECTED FROM LAYER 3	14.8352	53851.801	30.25
PERC./LEAKAGE THROUGH LAYER 4	1.244860	4518.841	2.54
AVG. HEAD ON TOP OF LAYER 4	2.6896		
CHANGE IN WATER STORAGE	3.881	14087.952	7.91
SOIL WATER AT START OF YEAR	816.727	2964718.250	
SOIL WATER AT END OF YEAR	821.028	2980333.250	
SNOW WATER AT START OF YEAR	0.421	1526.985	0.86
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	-8.0401	-29185.549	-16.39

MONTHLY TOTALS (IN INCHES) FOR YEAR 24

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	4.59 2.29	1.40 5.56	6.05 4.84	3.72 1.83	1.78 7.03	2.82 4.79

RUNOFF	0.202	1.845	2.226	0.225	0.031	0.610
	0.069	1.252	1.659	0.439	2.086	1.367
EVAPOTRANSPIRATION	0.678	0.437	2.229	3.449	2.855	3.817
	1.649	4.152	1.881	1.511	1.167	0.788
SUBSURFACE INFLOW INTO LAYER 3	0.6828	0.6388	0.6828	0.6608	0.6828	0.6608
	0.6828	0.6828	0.6608	0.6828	0.6608	0.6828
LATERAL DRAINAGE COLLECTED FROM LAYER 3	1.2600	1.1787	1.2600	1.2193	1.2600	1.2193
	1.2600	1.2600	1.2193	1.2600	1.2193	1.2600
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.1057	0.0989	0.1057	0.1023	0.1057	0.1023
	0.1057	0.1057	0.1023	0.1057	0.1023	0.1057

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 4	2.690	2.690	2.690	2.690	2.690	2.690
	2.690	2.690	2.690	2.690	2.690	2.690
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 4	0.001	0.002	0.001	0.002	0.001	0.002
	0.001	0.001	0.002	0.001	0.002	0.001

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ANNUAL TOTALS FOR YEAR 24

	INCHES	CU. FEET	PERCENT
PRECIPITATION	46.70	169521.000	100.00
RUNOFF	12.009	43591.117	25.71
EVAPOTRANSPIRATION	24.611	89338.828	52.70
SUBSURFACE INFLOW INTO LAYER 3	8.062028	29265.160	17.26
DRAINAGE COLLECTED FROM LAYER 3	14.8759	53999.340	31.85
PERC./LEAKAGE THROUGH LAYER 4	1.248270	4531.222	2.67
AVG. HEAD ON TOP OF LAYER 4	2.6896		
CHANGE IN WATER STORAGE	10.080	36591.125	21.59
SOIL WATER AT START OF YEAR	821.028	2980333.250	
SOIL WATER AT END OF YEAR	831.109	3016924.250	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	-8.0621	-29265.477	-17.26

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MONTHLY TOTALS (IN INCHES) FOR YEAR 25

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	5.72	2.50	3.55	6.62	2.37	3.40
	1.71	4.59	1.64	3.14	2.70	3.09
RUNOFF	1.819	1.641	0.505	1.880	0.032	0.443
	0.179	0.854	0.138	0.599	0.668	0.339
EVAPOTRANSPIRATION	0.865	0.283	2.307	4.292	2.959	4.702
	1.388	3.860	1.744	0.929	0.899	0.586
SUBSURFACE INFLOW INTO LAYER 3	0.6828	0.6168	0.6828	0.6608	0.6828	0.6608
	0.6828	0.6828	0.6608	0.6828	0.6608	0.6828
LATERAL DRAINAGE COLLECTED FROM LAYER 3	1.2600	1.1380	1.2600	1.2193	1.2600	1.2193
	1.2600	1.2600	1.2193	1.2600	1.2193	1.2600
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.1057	0.0955	0.1057	0.1023	0.1057	0.1023
	0.1057	0.1057	0.1023	0.1057	0.1023	0.1057

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 4	2.690	2.690	2.690	2.690	2.690	2.690
	2.690	2.690	2.690	2.690	2.690	2.690
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 4	0.001	0.002	0.001	0.002	0.001	0.002
	0.001	0.001	0.002	0.001	0.002	0.001

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ANNUAL TOTALS FOR YEAR 25

	INCHES	CU. FEET	PERCENT
PRECIPITATION	41.03	148938.891	100.00
RUNOFF	9.099	33030.348	22.18
EVAPOTRANSPIRATION	24.813	90072.211	60.48
SUBSURFACE INFLOW INTO LAYER 3	8.040000	29185.201	19.60
DRAINAGE COLLECTED FROM LAYER 3	14.8352	53851.801	36.16
PERC./LEAKAGE THROUGH LAYER 4	1.244860	4518.841	3.03
AVG. HEAD ON TOP OF LAYER 4	2.6896		
CHANGE IN WATER STORAGE	7.117	25836.412	17.35
SOIL WATER AT START OF YEAR	831.109	3016924.250	
SOIL WATER AT END OF YEAR	837.709	3040883.250	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.517	1877.615	1.26
ANNUAL WATER BUDGET BALANCE	-8.0401	-29185.518	-19.60

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MONTHLY TOTALS (IN INCHES) FOR YEAR 26

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	4.63	2.81	2.61	4.64	3.92	5.10
	5.22	6.98	10.80	0.60	4.39	3.09
RUNOFF	2.142	3.506	0.064	0.546	0.137	0.818
	1.759	2.133	4.406	0.018	0.733	0.221
EVAPOTRANSPIRATION	0.385	1.056	2.618	4.154	4.082	5.127
	3.486	4.363	3.039	1.499	1.276	0.807
SUBSURFACE INFLOW INTO LAYER 3	0.6828	0.6168	0.6828	0.6608	0.6828	0.6608
	0.6828	0.6828	0.6608	0.6828	0.6608	0.6828
LATERAL DRAINAGE COLLECTED FROM LAYER 3	1.2600	1.1380	1.2600	1.2193	1.2600	1.2193
	1.2600	1.2600	1.2193	1.2600	1.2193	1.2600
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.1057	0.0955	0.1057	0.1023	0.1057	0.1023
	0.1057	0.1057	0.1023	0.1057	0.1023	0.1057

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 4	2.690	2.690	2.690	2.690	2.690	2.690
	2.690	2.690	2.690	2.690	2.690	2.690
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 4	0.001	0.002	0.001	0.002	0.001	0.002
	0.001	0.001	0.002	0.001	0.002	0.001

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ANNUAL TOTALS FOR YEAR 26

	INCHES	CU. FEET	PERCENT
PRECIPITATION	54.79	198887.719	100.00
RUNOFF	16.484	59835.863	30.09
EVAPOTRANSPIRATION	31.894	115774.953	58.21
SUBSURFACE INFLOW INTO LAYER 3	8.040000	29185.201	14.67
DRAINAGE COLLECTED FROM LAYER 3	14.8352	53851.801	27.08
PERC./LEAKAGE THROUGH LAYER 4	1.244860	4518.841	2.27
AVG. HEAD ON TOP OF LAYER 4	2.6896		
CHANGE IN WATER STORAGE	6.412	23276.709	11.70
SOIL WATER AT START OF YEAR	837.709	3040883.250	
SOIL WATER AT END OF YEAR	844.638	3066037.500	
SNOW WATER AT START OF YEAR	0.517	1877.615	0.94
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	-8.0400	-29185.252	-14.67

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MONTHLY TOTALS (IN INCHES) FOR YEAR 27

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	3.98	2.12	4.68	3.52	3.38	4.46
	6.20	5.67	11.97	7.03	2.02	2.41
RUNOFF	0.783	1.354	1.713	0.478	0.106	0.565
	2.394	1.452	6.423	2.114	0.014	0.169
EVAPOTRANSPIRATION	1.266	0.466	1.852	3.245	3.132	6.184
	3.100	4.100	2.386	1.760	1.119	1.074
SUBSURFACE INFLOW INTO LAYER 3	0.6828	0.6168	0.6828	0.6608	0.6828	0.6608
	0.6828	0.6828	0.6608	0.6828	0.6608	0.6828
LATERAL DRAINAGE COLLECTED FROM LAYER 3	1.2600	1.1380	1.2600	1.2193	1.2600	1.2193
	1.2600	1.2600	1.2193	1.2600	1.2193	1.2600
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.1057	0.0955	0.1057	0.1023	0.1057	0.1023
	0.1057	0.1057	0.1023	0.1057	0.1023	0.1057

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 4	2.690	2.690	2.690	2.690	2.690	2.690
	2.690	2.690	2.690	2.690	2.690	2.690
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 4	0.001	0.002	0.001	0.002	0.001	0.002
	0.001	0.001	0.002	0.001	0.002	0.001

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ANNUAL TOTALS FOR YEAR 27

	INCHES	CU. FEET	PERCENT
PRECIPITATION	57.44	208507.234	100.00
RUNOFF	17.565	63762.047	30.58
EVAPOTRANSPIRATION	29.684	107753.109	51.68
SUBSURFACE INFLOW INTO LAYER 3	8.040000	29185.201	14.00
DRAINAGE COLLECTED FROM LAYER 3	14.8352	53851.801	25.83
PERC./LEAKAGE THROUGH LAYER 4	1.244860	4518.841	2.17
AVG. HEAD ON TOP OF LAYER 4	2.6896		
CHANGE IN WATER STORAGE	10.191	36992.145	17.74
SOIL WATER AT START OF YEAR	844.638	3066037.500	
SOIL WATER AT END OF YEAR	854.829	3103029.750	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	-8.0401	-29185.504	-14.00

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MONTHLY TOTALS (IN INCHES) FOR YEAR 28

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	3.93	3.22	4.40	2.25	2.75	5.82
	10.86	3.65	1.43	1.67	2.93	2.27
RUNOFF	1.362	2.257	0.895	0.353	0.183	0.891
	3.824	0.531	0.217	0.158	0.496	0.080
EVAPOTRANSPIRATION	0.716	0.607	1.475	2.857	2.071	6.234
	7.000	3.900	0.815	1.164	0.617	0.531
SUBSURFACE INFLOW INTO LAYER 3	0.6828	0.6388	0.6828	0.6608	0.6828	0.6608
	0.6828	0.6828	0.6608	0.6828	0.6608	0.6828
LATERAL DRAINAGE COLLECTED FROM LAYER 3	1.2600	1.1787	1.2600	1.2193	1.2600	1.2193
	1.2600	1.2600	1.2193	1.2600	1.2193	1.2600
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.1057	0.0989	0.1057	0.1023	0.1057	0.1023
	0.1057	0.1057	0.1023	0.1057	0.1023	0.1057

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 4	2.690	2.690	2.690	2.690	2.690	2.690
	2.690	2.690	2.690	2.690	2.690	2.690
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 4	0.001	0.002	0.001	0.002	0.001	0.002
	0.001	0.001	0.002	0.001	0.002	0.001

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ANNUAL TOTALS FOR YEAR 28

	INCHES	CU. FEET	PERCENT
PRECIPITATION	45.18	164003.359	100.00
RUNOFF	11.247	40827.258	24.89
EVAPOTRANSPIRATION	27.987	101594.547	61.95
SUBSURFACE INFLOW INTO LAYER 3	8.062028	29265.160	17.84
DRAINAGE COLLECTED FROM LAYER 3	14.8759	53999.340	32.93
PERC./LEAKAGE THROUGH LAYER 4	1.248270	4531.222	2.76
AVG. HEAD ON TOP OF LAYER 4	2.6896		
CHANGE IN WATER STORAGE	5.945	21581.705	13.16
SOIL WATER AT START OF YEAR	854.829	3103029.750	
SOIL WATER AT END OF YEAR	860.774	3124611.250	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	-8.0621	-29265.553	-17.84

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MONTHLY TOTALS (IN INCHES) FOR YEAR 29

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	8.05	2.10	8.59	7.13	6.01	8.31
	5.35	3.72	2.36	6.26	5.12	5.36
RUNOFF	2.880	3.263	3.073	2.395	1.400	2.509
	1.712	0.578	0.441	2.482	1.880	0.919
EVAPOTRANSPIRATION	0.661	0.567	2.436	3.642	5.227	7.298
	3.864	3.154	0.876	1.371	0.861	0.578
SUBSURFACE INFLOW INTO LAYER 3	0.6828	0.6168	0.6828	0.6608	0.6828	0.6608
	0.6828	0.6828	0.6608	0.6828	0.6608	0.6828
LATERAL DRAINAGE COLLECTED FROM LAYER 3	1.2600	1.1380	1.2600	1.2193	1.2600	1.2193
	1.2600	1.2600	1.2193	1.2600	1.2193	1.2600
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.1057	0.0955	0.1057	0.1023	0.1057	0.1023
	0.1057	0.1057	0.1023	0.1057	0.1023	0.1057

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 4	2.690	2.690	2.690	2.690	2.690	2.690
	2.690	2.690	2.690	2.690	2.690	2.690
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 4	0.001	0.002	0.001	0.002	0.001	0.002
	0.001	0.001	0.002	0.001	0.002	0.001

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ANNUAL TOTALS FOR YEAR 29

	INCHES	CU. FEET	PERCENT
PRECIPITATION	68.36	248146.750	100.00
RUNOFF	23.531	85415.812	34.42
EVAPOTRANSPIRATION	30.535	110840.922	44.67
SUBSURFACE INFLOW INTO LAYER 3	8.040000	29185.201	11.76
DRAINAGE COLLECTED FROM LAYER 3	14.8352	53851.801	21.70
PERC./LEAKAGE THROUGH LAYER 4	1.244860	4518.841	1.82
AVG. HEAD ON TOP OF LAYER 4	2.6896		

CHANGE IN WATER STORAGE	14.295	51890.102	20.91
SOIL WATER AT START OF YEAR	860.774	3124611.250	
SOIL WATER AT END OF YEAR	873.464	3170675.500	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	1.605	5825.835	2.35
ANNUAL WATER BUDGET BALANCE	-8.0401	-29185.531	-11.76

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MONTHLY TOTALS (IN INCHES) FOR YEAR 30

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	2.02	1.24	5.86	2.65	2.08	1.82
	3.99	0.38	6.34	6.41	1.89	4.28
RUNOFF	1.473	0.557	1.539	0.254	0.018	0.195
	1.413	0.000	1.818	3.012	0.076	0.813
EVAPOTRANSPIRATION	0.572	0.431	2.378	3.450	2.236	3.430
	2.577	0.380	2.107	1.974	1.168	1.045
SUBSURFACE INFLOW INTO LAYER 3	0.6828	0.6168	0.6828	0.6608	0.6828	0.6608
	0.6828	0.6828	0.6608	0.6828	0.6608	0.6828
LATERAL DRAINAGE COLLECTED FROM LAYER 3	1.2600	1.1380	1.2600	1.2193	1.2600	1.2193
	1.2600	1.2600	1.2193	1.2600	1.2193	1.2600
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.1057	0.0955	0.1057	0.1023	0.1057	0.1023
	0.1057	0.1057	0.1023	0.1057	0.1023	0.1057

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 4	2.690	2.690	2.690	2.690	2.690	2.690
	2.690	2.690	2.690	2.690	2.690	2.690
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 4	0.001	0.002	0.001	0.002	0.001	0.002
	0.001	0.001	0.002	0.001	0.002	0.001

EVAPOTRANSPIRATION	0.395	1.045	2.015	4.138	3.263	5.107
	3.000	1.572	2.158	1.551	0.887	0.774
SUBSURFACE INFLOW INTO LAYER 3	0.6828	0.6168	0.6828	0.6608	0.6828	0.6608
	0.6828	0.6828	0.6608	0.6828	0.6608	0.6828
LATERAL DRAINAGE COLLECTED FROM LAYER 3	1.2600	1.1380	1.2600	1.2193	1.2600	1.2193
	1.2600	1.2600	1.2193	1.2600	1.2193	1.2600
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.1057	0.0955	0.1057	0.1023	0.1057	0.1023
	0.1057	0.1057	0.1023	0.1057	0.1023	0.1057

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 4	2.690	2.690	2.690	2.690	2.690	2.690
	2.690	2.690	2.690	2.690	2.690	2.690
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 4	0.001	0.002	0.001	0.002	0.001	0.002
	0.001	0.001	0.002	0.001	0.002	0.001

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ANNUAL TOTALS FOR YEAR 31

	INCHES	CU. FEET	PERCENT
PRECIPITATION	38.43	139500.906	100.00
RUNOFF	6.751	24506.750	17.57
EVAPOTRANSPIRATION	25.905	94035.906	67.41
SUBSURFACE INFLOW INTO LAYER 3	8.040000	29185.201	20.92
DRAINAGE COLLECTED FROM LAYER 3	14.8352	53851.801	38.60
PERC./LEAKAGE THROUGH LAYER 4	1.244860	4518.841	3.24
AVG. HEAD ON TOP OF LAYER 4	2.6896		
CHANGE IN WATER STORAGE	5.774	20958.223	15.02
SOIL WATER AT START OF YEAR	880.680	3196867.000	
SOIL WATER AT END OF YEAR	886.888	3219401.750	
SNOW WATER AT START OF YEAR	0.434	1576.404	1.13
SNOW WATER AT END OF YEAR	0.000	0.000	0.00

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ANNUAL TOTALS FOR YEAR 30

	INCHES	CU. FEET	PERCENT
PRECIPITATION	38.96	141424.828	100.00
RUNOFF	11.167	40535.691	28.66
EVAPOTRANSPIRATION	21.748	78947.023	55.82
SUBSURFACE INFLOW INTO LAYER 3	8.040000	29185.201	20.64
DRAINAGE COLLECTED FROM LAYER 3	14.8352	53851.801	38.08
PERC./LEAKAGE THROUGH LAYER 4	1.244860	4518.841	3.20
AVG. HEAD ON TOP OF LAYER 4	2.6896		
CHANGE IN WATER STORAGE	6.045	21942.002	15.51
SOIL WATER AT START OF YEAR	873.464	3170675.500	
SOIL WATER AT END OF YEAR	880.680	3196867.000	
SNOW WATER AT START OF YEAR	1.605	5825.835	4.12
SNOW WATER AT END OF YEAR	0.434	1576.404	1.11
ANNUAL WATER BUDGET BALANCE	-8.0400	-29185.334	-20.64

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MONTHLY TOTALS (IN INCHES) FOR YEAR 31

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	1.68	0.64	4.01	4.21	3.90	3.86
	2.56	1.74	2.98	2.88	1.21	8.76
RUNOFF	0.957	0.000	0.269	0.406	0.213	0.363
	0.343	0.151	0.204	0.149	0.072	3.624

ANNUAL WATER BUDGET BALANCE	-8.0401	-29185.422	-20.92

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MONTHLY TOTALS (IN INCHES) FOR YEAR 32

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	0.95	4.60	4.09	0.64	3.91	2.40
	7.38	8.21	4.59	3.00	3.10	4.24
RUNOFF	0.009	2.373	1.180	0.000	1.507	0.365
	3.249	3.365	1.214	0.438	0.073	2.060
EVAPOTRANSPIRATION	0.772	0.645	2.225	1.738	1.967	4.022
	2.565	6.375	2.516	1.238	0.652	0.397
SUBSURFACE INFLOW INTO LAYER 3	0.6828	0.6388	0.6828	0.6608	0.6828	0.6608
	0.6828	0.6828	0.6608	0.6828	0.6608	0.6828
LATERAL DRAINAGE COLLECTED FROM LAYER 3	1.2600	1.1787	1.2600	1.2193	1.2600	1.2193
	1.2600	1.2600	1.2193	1.2600	1.2193	1.2600
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.1057	0.0989	0.1057	0.1023	0.1057	0.1023
	0.1057	0.1057	0.1023	0.1057	0.1023	0.1057

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 4	2.690	2.690	2.690	2.690	2.690	2.690
	2.690	2.690	2.690	2.690	2.690	2.690
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 4	0.001	0.002	0.001	0.002	0.001	0.002
	0.001	0.001	0.002	0.001	0.002	0.001

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ANNUAL TOTALS FOR YEAR 32

	INCHES	CU. FEET	PERCENT

PRECIPITATION	47.11	171009.375	100.00
RUNOFF	15.835	57479.812	33.61
EVAPOTRANSPIRATION	25.113	91159.437	53.31
SUBSURFACE INFLOW INTO LAYER 3	8.062028	29265.160	17.11
DRAINAGE COLLECTED FROM LAYER 3	14.8759	53999.340	31.58
PERC./LEAKAGE THROUGH LAYER 4	1.248270	4531.222	2.65
AVG. HEAD ON TOP OF LAYER 4	2.6896		
CHANGE IN WATER STORAGE	6.163	22369.906	13.08
SOIL WATER AT START OF YEAR	886.888	3219401.750	
SOIL WATER AT END OF YEAR	893.021	3241668.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.029	103.587	0.06
ANNUAL WATER BUDGET BALANCE	-8.0620	-29265.186	-17.11

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MONTHLY TOTALS (IN INCHES) FOR YEAR 33

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	3.42	2.71	4.10	3.03	1.63	4.32
	5.60	3.22	2.02	1.94	2.77	3.04
RUNOFF	0.841	0.309	0.619	0.310	0.037	0.748
	0.947	0.380	0.121	0.351	0.232	1.233
EVAPOTRANSPIRATION	0.870	1.309	2.163	3.657	2.656	4.487
	3.693	4.277	1.167	1.179	0.523	0.539
SUBSURFACE INFLOW INTO LAYER 3	0.6828	0.6168	0.6828	0.6608	0.6828	0.6608
	0.6828	0.6828	0.6608	0.6828	0.6608	0.6828
LATERAL DRAINAGE COLLECTED FROM LAYER 3	1.2600	1.1380	1.2600	1.2193	1.2600	1.2193
	1.2600	1.2600	1.2193	1.2600	1.2193	1.2600
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.1057	0.0955	0.1057	0.1023	0.1057	0.1023
	0.1057	0.1057	0.1023	0.1057	0.1023	0.1057

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 4	2.690	2.690	2.690	2.690	2.690	2.690
	2.690	2.690	2.690	2.690	2.690	2.690
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 4	0.001	0.002	0.001	0.002	0.001	0.002
	0.001	0.001	0.002	0.001	0.002	0.001

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ANNUAL TOTALS FOR YEAR 34

	INCHES	CU. FEET	PERCENT
PRECIPITATION	28.81	104580.328	100.00
RUNOFF	2.542	9229.107	8.82
EVAPOTHANSPIRATION	22.568	81920.195	78.33
SUBSURFACE INFLOW INTO LAYER 3	8.040000	29185.201	27.91
DRAINAGE COLLECTED FROM LAYER 3	14.8352	53851.801	51.49
PERC./LEAKAGE THROUGH LAYER 4	1.244860	4518.841	4.32
AVG. HEAD ON TOP OF LAYER 4	2.6896		
CHANGE IN WATER STORAGE	3.700	13430.822	12.84
SOIL WATER AT START OF YEAR	898.202	3260472.000	
SOIL WATER AT END OF YEAR	901.902	3273902.750	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	-8.0400	-29185.242	-27.91

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MONTHLY TOTALS (IN INCHES) FOR YEAR 35

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	1.87	1.39	4.15	2.02	1.86	5.95
	2.42	5.10	3.84	3.78	1.81	7.26
RUNOFF	0.408	0.277	0.479	0.034	0.033	0.477
	0.088	0.747	1.528	0.650	0.180	3.353
EVAPOTRANSPIRATION	0.602	0.728	2.636	2.925	1.954	6.331
	3.311	3.463	1.557	1.484	0.927	0.440
SUBSURFACE INFLOW INTO LAYER 3	0.6828	0.6168	0.6828	0.6608	0.6828	0.6608
	0.6828	0.6828	0.6608	0.6828	0.6608	0.6828
LATERAL DRAINAGE COLLECTED FROM LAYER 3	1.2600	1.1380	1.2600	1.2193	1.2600	1.2193
	1.2600	1.2600	1.2193	1.2600	1.2193	1.2600
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.1057	0.0955	0.1057	0.1023	0.1057	0.1023
	0.1057	0.1057	0.1023	0.1057	0.1023	0.1057

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 4	2.690 2.690	2.690 2.690	2.690 2.690	2.690 2.690	2.690 2.690	2.690 2.690
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 4	0.001 0.001	0.002 0.001	0.001 0.002	0.002 0.001	0.001 0.002	0.002 0.001

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ANNUAL TOTALS FOR YEAR 35

	INCHES	CU. FEET	PERCENT
PRECIPITATION	41.45	150463.469	100.00
RUNOFF	8.255	29964.439	19.91
EVAPOTRANSPIRATION	26.358	95679.812	63.59
SUBSURFACE INFLOW INTO LAYER 3	8.040000	29185.201	19.40
DRAINAGE COLLECTED FROM LAYER 3	14.8352	53851.801	35.79
PERC./LEAKAGE THROUGH LAYER 4	1.244860	4518.841	3.00
AVG. HEAD ON TOP OF LAYER 4	2.6896		
CHANGE IN WATER STORAGE	6.837	24819.328	16.50
SOIL WATER AT START OF YEAR	901.902	3273902.750	
SOIL WATER AT END OF YEAR	908.739	3298722.250	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	-8.0401	-29185.549	-19.40

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MONTHLY TOTALS (IN INCHES) FOR YEAR 36

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	2.12 2.92	4.54 0.75	4.19 8.39	4.19 1.47	8.03 1.75	5.64 0.61
RUNOFF	0.626 0.394	1.582 0.005	1.161 3.150	0.193 0.038	1.721 0.025	1.022 0.000
EVAPOTRANSPIRATION	1.019 2.638	0.897 0.417	2.732 1.490	4.351 1.782	4.527 1.136	7.213 0.809
SUBSURFACE INFLOW INTO LAYER 3	0.6828 0.6828	0.6388 0.6828	0.6828 0.6608	0.6608 0.6828	0.6828 0.6608	0.6608 0.6828
LATERAL DRAINAGE COLLECTED FROM LAYER 3	1.2600 1.2600	1.1787 1.2600	1.2600 1.2193	1.2193 1.2600	1.2600 1.2193	1.2193 1.2600
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.1057 0.1057	0.0989 0.1057	0.1057 0.1023	0.1023 0.1057	0.1057 0.1023	0.1023 0.1057

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 4	2.690 2.690	2.690 2.690	2.690 2.690	2.690 2.690	2.690 2.690	2.690 2.690
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 4	0.001 0.001	0.002 0.001	0.001 0.002	0.002 0.001	0.001 0.002	0.002 0.001

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ANNUAL TOTALS FOR YEAR 36

	INCHES	CU. FEET	PERCENT
PRECIPITATION	44.60	161897.969	100.00
RUNOFF	9.914	35988.570	22.23
EVAPOTRANSPIRATION	29.011	105308.687	65.05
SUBSURFACE INFLOW INTO LAYER 3	8.062028	29265.160	18.08
DRAINAGE COLLECTED FROM LAYER 3	14.8759	53999.340	33.35
PERC./LEAKAGE THROUGH LAYER 4	1.248270	4531.222	2.80
AVG. HEAD ON TOP OF LAYER 4	2.6896		
CHANGE IN WATER STORAGE	5.675	20600.648	12.72
SOIL WATER AT START OF YEAR	908.739	3298722.250	
SOIL WATER AT END OF YEAR	914.414	3319322.750	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	-8.0621	-29265.346	-18.08

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MONTHLY TOTALS (IN INCHES) FOR YEAR 37

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	7.06 6.60	1.11 4.24	2.48 3.95	2.14 1.63	2.69 1.57	7.65 1.38
RUNOFF	3.601 3.182	0.312 0.987	0.001 0.922	0.055 0.059	0.427 0.082	1.499 0.063
EVAPOTRANSPIRATION	0.778 3.887	0.949 3.555	2.460 1.613	2.764 1.524	2.871 0.761	6.736 0.532
SUBSURFACE INFLOW INTO LAYER 3	0.6828 0.6828	0.6168 0.6828	0.6828 0.6608	0.6608 0.6828	0.6828 0.6608	0.6608 0.6828
LATERAL DRAINAGE COLLECTED FROM LAYER 3	1.2600 1.2600	1.1380 1.2600	1.2600 1.2193	1.2193 1.2600	1.2600 1.2193	1.2193 1.2600
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.1057 0.1057	0.0955 0.1057	0.1057 0.1023	0.1023 0.1057	0.1057 0.1023	0.1023 0.1057

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 4	2.690 2.690	2.690 2.690	2.690 2.690	2.690 2.690	2.690 2.690	2.690 2.690
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 4	0.001 0.001	0.002 0.001	0.001 0.002	0.002 0.001	0.001 0.002	0.002 0.001

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ANNUAL TOTALS FOR YEAR 37

	INCHES	CU. FEET	PERCENT
PRECIPITATION	42.50	154274.984	100.00
RUNOFF	11.191	40625.117	26.33
EVAPOTRANSPIRATION	28.431	103205.461	66.90
SUBSURFACE INFLOW INTO LAYER 3	8.040000	29185.201	18.92
DRAINAGE COLLECTED FROM LAYER 3	14.8352	53851.801	34.91
PERC./LEAKAGE THROUGH LAYER 4	1.244860	4518.841	2.93
AVG. HEAD ON TOP OF LAYER 4	2.6896		
CHANGE IN WATER STORAGE	2.877	10444.447	6.77
SOIL WATER AT START OF YEAR	914.414	3319322.750	
SOIL WATER AT END OF YEAR	917.291	3329767.250	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	-8.0401	-29185.484	-18.92

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MONTHLY TOTALS (IN INCHES) FOR YEAR 38

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	4.44 3.62	2.19 4.51	3.41 2.28	4.62 4.43	2.81 3.12	4.90 1.74
RUNOFF	2.724 0.094	1.260 0.885	1.778 0.140	0.185 1.075	0.230 0.366	0.492 0.046
EVAPOTRANSPIRATION	0.511 3.328	0.460 4.411	1.911 1.171	3.765 1.326	4.311 0.915	4.977 0.762

SUBSURFACE INFLOW INTO LAYER 3	0.6828	0.6168	0.6828	0.6608	0.6828	0.6608
	0.6828	0.6828	0.6608	0.6828	0.6608	0.6828
LATERAL DRAINAGE COLLECTED FROM LAYER 3	1.2600	1.1380	1.2600	1.2193	1.2600	1.2193
	1.2600	1.2600	1.2193	1.2600	1.2193	1.2600
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.1057	0.0955	0.1057	0.1023	0.1057	0.1023
	0.1057	0.1057	0.1023	0.1057	0.1023	0.1057

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 4	2.690	2.690	2.690	2.690	2.690	2.690
	2.690	2.690	2.690	2.690	2.690	2.690
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 4	0.001	0.002	0.001	0.002	0.001	0.002
	0.001	0.001	0.002	0.001	0.002	0.001

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ANNUAL TOTALS FOR YEAR 38

	INCHES	CU. FEET	PERCENT
PRECIPITATION	42.07	152714.141	100.00
RUNOFF	9.274	33664.473	22.04
EVAPOTRANSPIRATION	27.849	101090.656	66.20
SUBSURFACE INFLOW INTO LAYER 3	8.040000	29185.201	19.11
DRAINAGE COLLECTED FROM LAYER 3	14.8352	53851.801	35.26
PERC./LEAKAGE THROUGH LAYER 4	1.244860	4518.841	2.96
AVG. HEAD ON TOP OF LAYER 4	2.6896		
CHANGE IN WATER STORAGE	4.947	17959.018	11.76
SOIL WATER AT START OF YEAR	917.291	3329767.250	
SOIL WATER AT END OF YEAR	922.239	3347726.250	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	-8.0401	-29185.445	-19.11

RUNOFF	18.928	68707.094	32.01
EVAPOTRANSPIRATION	30.460	110568.914	51.51
SUBSURFACE INFLOW INTO LAYER 3	8.040000	29185.201	13.60
DRAINAGE COLLECTED FROM LAYER 3	14.8352	53851.801	25.09
PERC./LEAKAGE THROUGH LAYER 4	1.244860	4518.841	2.11
AVG. HEAD ON TOP OF LAYER 4	2.6896		
CHANGE IN WATER STORAGE	9.743	35365.914	16.48
SOIL WATER AT START OF YEAR	922.239	3347726.250	
SOIL WATER AT END OF YEAR	931.981	3383092.250	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	-8.0401	-29185.428	-13.60

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MONTHLY TOTALS (IN INCHES) FOR YEAR 40

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	3.86	2.74	3.83	3.55	5.78	4.63
	5.26	7.89	3.89	2.25	4.13	1.23
RUNOFF	0.334	0.166	1.171	0.341	0.963	0.809
	1.179	2.258	0.894	0.247	1.208	0.002
EVAPOTRANSPIRATION	1.114	1.458	2.241	3.984	3.294	6.795
	4.231	4.655	2.913	1.174	0.790	0.576
SUBSURFACE INFLOW INTO LAYER 3	0.6828	0.6388	0.6828	0.6608	0.6828	0.6608
	0.6828	0.6828	0.6608	0.6828	0.6608	0.6828
LATERAL DRAINAGE COLLECTED FROM LAYER 3	1.2600	1.1787	1.2600	1.2193	1.2600	1.2193
	1.2600	1.2600	1.2193	1.2600	1.2193	1.2600
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.1057	0.0989	0.1057	0.1023	0.1057	0.1023
	0.1057	0.1057	0.1023	0.1057	0.1023	0.1057

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MONTHLY TOTALS (IN INCHES) FOR YEAR 39

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	0.98	4.73	8.53	3.09	5.72	3.65
	5.57	8.02	7.27	4.94	3.35	3.28
RUNOFF	0.153	0.890	7.276	0.139	1.396	0.797
	0.875	1.887	2.629	2.380	0.277	0.228
EVAPOTRANSPIRATION	0.477	0.285	1.306	3.692	4.297	3.308
	5.808	4.530	3.603	1.374	0.931	0.849
SUBSURFACE INFLOW INTO LAYER 3	0.6828	0.6168	0.6828	0.6608	0.6828	0.6608
	0.6828	0.6828	0.6608	0.6828	0.6608	0.6828
LATERAL DRAINAGE COLLECTED FROM LAYER 3	1.2600	1.1380	1.2600	1.2193	1.2600	1.2193
	1.2600	1.2600	1.2193	1.2600	1.2193	1.2600
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.1057	0.0955	0.1057	0.1023	0.1057	0.1023
	0.1057	0.1057	0.1023	0.1057	0.1023	0.1057

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 4	2.690	2.690	2.690	2.690	2.690	2.690
	2.690	2.690	2.690	2.690	2.690	2.690
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 4	0.001	0.002	0.001	0.002	0.001	0.002
	0.001	0.001	0.002	0.001	0.002	0.001

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ANNUAL TOTALS FOR YEAR 39

	INCHES	CU. FEET	PERCENT
PRECIPITATION	59.13	214641.937	100.00

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 4	2.690	2.690	2.690	2.690	2.690	2.690
	2.690	2.690	2.690	2.690	2.690	2.690
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 4	0.001	0.002	0.001	0.002	0.001	0.002
	0.001	0.001	0.002	0.001	0.002	0.001

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ANNUAL TOTALS FOR YEAR 40

	INCHES	CU. FEET	PERCENT
PRECIPITATION	49.04	178015.187	100.00
RUNOFF	9.571	34743.996	19.52
EVAPOTRANSPIRATION	33.225	120607.758	67.75
SUBSURFACE INFLOW INTO LAYER 3	8.062028	29265.160	16.44
DRAINAGE COLLECTED FROM LAYER 3	14.8759	53999.340	30.33
PERC./LEAKAGE THROUGH LAYER 4	1.248270	4531.222	2.55
AVG. HEAD ON TOP OF LAYER 4	2.6896		
CHANGE IN WATER STORAGE	6.243	22663.297	12.73
SOIL WATER AT START OF YEAR	931.981	3383092.250	
SOIL WATER AT END OF YEAR	938.036	3405069.500	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.189	686.110	0.39
ANNUAL WATER BUDGET BALANCE	-8.0621	-29265.262	-16.44

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AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1 THROUGH 40

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	3.51	2.48	4.54	3.60	3.57	4.75
	4.54	4.67	4.81	3.30	3.09	3.30
STD. DEVIATIONS	2.09	1.27	1.77	1.65	1.84	1.72
	2.19	2.72	2.88	1.80	1.46	2.20
RUNOFF						
TOTALS	1.259	1.294	1.506	0.434	0.513	0.775
	1.163	1.119	1.507	0.867	0.543	0.708
STD. DEVIATIONS	1.192	1.066	1.758	0.681	0.603	0.521
	1.163	1.180	1.607	0.938	0.601	0.993
EVAPOTRANSPIRATION						
TOTALS	0.698	0.717	2.196	3.476	3.250	5.373
	3.514	3.439	2.018	1.435	0.952	0.656
STD. DEVIATIONS	0.241	0.405	0.440	0.663	1.022	1.258
	1.293	1.544	0.812	0.246	0.213	0.162
SUBSURFACE INFLOW INTO LAYER 3						
TOTALS	0.6828	0.6388	0.6828	0.6608	0.6828	0.6608
	0.6828	0.6828	0.6608	0.6828	0.6608	0.6828
LATERAL DRAINAGE COLLECTED FROM LAYER 3						
TOTALS	1.3258	1.1624	1.2647	1.2206	1.2604	1.2194
	1.2600	1.2600	1.2193	1.2600	1.2193	1.2600
STD. DEVIATIONS	0.4165	0.0898	0.0297	0.0083	0.0025	0.0012
	0.0000	0.0000	0.0008	0.0000	0.0009	0.0000
PERCOLATION/LEAKAGE THROUGH LAYER 4						
TOTALS	0.1057	0.0964	0.1057	0.1023	0.1057	0.1023
	0.1057	0.1057	0.1023	0.1057	0.1023	0.1057
STD. DEVIATIONS	0.0000	0.0015	0.0000	0.0001	0.0000	0.0001
	0.0000	0.0000	0.0001	0.0000	0.0001	0.0000

AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)

DAILY AVERAGE HEAD ON TOP OF LAYER 4

AVERAGES	2.8107	2.7227	2.6996	2.6924	2.6904	2.6898
	2.6896	2.6896	2.6896	2.6896	2.6896	2.6896
STD. DEVIATIONS	0.7659	0.2097	0.0635	0.0182	0.0051	0.0011
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1 THROUGH 40

	INCHES		CU. FEET	PERCENT
PRECIPITATION	46.15	(8.949)	167511.8	100.00
RUNOFF	11.689	(5.1277)	42431.09	25.330
EVAPOTRANSPIRATION	27.723	(3.1516)	100633.95	60.076
SUBSURFACE INFLOW INTO LAYER 3	8.06203		29265.162	17.47051
LATERAL DRAINAGE COLLECTED FROM LAYER 3	14.93194	(0.54616)	54202.926	32.35767
PERCOLATION/LEAKAGE THROUGH LAYER 4	1.24573	(0.00069)	4522.000	2.69951
AVERAGE HEAD ON TOP OF LAYER 4	2.704	(0.089)		
CHANGE IN WATER STORAGE	6.648	(2.5993)	24132.45	14.406

PEAK DAILY VALUES FOR YEARS 1 THROUGH 40

	(INCHES)	(CU. FT.)
PRECIPITATION	5.15	18694.500
RUNOFF	4.002	14528.6201
DRAINAGE COLLECTED FROM LAYER 3	0.22009	798.93414
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.003441	12.49175
AVERAGE HEAD ON TOP OF LAYER 4	11.816	
MAXIMUM HEAD ON TOP OF LAYER 4	13.910	
LOCATION OF MAXIMUM HEAD IN LAYER 3 (DISTANCE FROM DRAIN)	39.2 FEET	
SNOW WATER	8.08	29328.5547

MAXIMUM VEG. SOIL WATER (VOL/VOL) 0.3569

MINIMUM VEG. SOIL WATER (VOL/VOL) 0.1285

*** Maximum heads are computed using McEnroe's equations. ***

Reference: Maximum Saturated Depth over Landfill Liner
by Bruce M. McEnroe, University of Kansas
ASCE Journal of Environmental Engineering
Vol. 119, No. 2, March 1993, pp. 262-270.

FINAL WATER STORAGE AT END OF YEAR 40

LAYER	(INCHES)	(VOL/VOL)
1	3.4411	0.2868
2	501.1009	0.1670
3	1.5405	0.1284
4	431.9532	0.4270
SNOW WATER	0.189	

ATTACHMENT G

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**                                                                          **
**                                                                          **
**              HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE               **
**                   HELP MODEL VERSION 3.07  (1 NOVEMBER 1997)             **
**                     DEVELOPED BY ENVIRONMENTAL LABORATORY                **
**                       USAE WATERWAYS EXPERIMENT STATION                  **
**              FOR USEPA RISK REDUCTION ENGINEERING LABORATORY             **
**                                                                          **
**                                                                          **
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PRECIPITATION DATA FILE:      P:\PRJ1\MDENG\HELP3\ME0250\40YEARS.D4
TEMPERATURE DATA FILE:        P:\PRJ1\MDENG\HELP3\ME0250\40YEARS.D7
SOLAR RADIATION DATA FILE:    P:\PRJ1\MDENG\HELP3\ME0250\40YEARS.D13
EVAPOTRANSPIRATION DATA:      P:\PRJ1\MDENG\HELP3\ME0250\40YEARS.D11
SOIL AND DESIGN DATA FILE:    P:\PRJ1\MDENG\HELP3\ME0250\CIL5B3#2.D10
OUTPUT DATA FILE:             P:\PRJ1\MDENG\HELP3\ME0250\CIL5B3#2.OUT


TIME:  8:59     DATE:  3/12/2003


******************************************************************************

     TITLE:  CHERRY ISLAND LANDFILL PHASE V - RUN B3 #2

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     NOTE:  INITIAL MOISTURE CONTENT OF THE LAYERS AND SNOW WATER
              WERE SPECIFIED BY THE USER.


                                  LAYER  1
                                  --------

                     TYPE 1 - VERTICAL PERCOLATION LAYER
                         MATERIAL TEXTURE NUMBER  22
   THICKNESS                    =      12.00   INCHES
   POROSITY                     =       0.4190 VOL/VOL
   FIELD CAPACITY               =       0.3070 VOL/VOL
   WILTING POINT                =       0.1800 VOL/VOL
   INITIAL SOIL WATER CONTENT   =       0.3621 VOL/VOL
   EFFECTIVE SAT. HYD. COND.    =  0.189999992000E-04 CM/SEC
  NOTE:  SATURATED HYDRAULIC CONDUCTIVITY IS MULTIPLIED BY  4.63
           FOR ROOT CHANNELS IN TOP HALF OF EVAPORATIVE ZONE.


                                  LAYER  2
                                  --------

                     TYPE 1 - VERTICAL PERCOLATION LAYER
                         MATERIAL TEXTURE NUMBER   0
   THICKNESS                    =    1920.00   INCHES
   POROSITY                     =       0.6100 VOL/VOL
   FIELD CAPACITY               =       0.2920 VOL/VOL
   WILTING POINT                =       0.0770 VOL/VOL
   INITIAL SOIL WATER CONTENT   =       0.0770 VOL/VOL
   EFFECTIVE SAT. HYD. COND.    =  0.100000005000E-02 CM/SEC


                                  LAYER  3
                                  --------

                     TYPE 1 - VERTICAL PERCOLATION LAYER
                         MATERIAL TEXTURE NUMBER  22
   THICKNESS                    =      12.00   INCHES
   POROSITY                     =       0.4190 VOL/VOL
   FIELD CAPACITY               =       0.3070 VOL/VOL
   WILTING POINT                =       0.1800 VOL/VOL
   INITIAL SOIL WATER CONTENT   =       0.3621 VOL/VOL
   EFFECTIVE SAT. HYD. COND.    =  0.189999992000E-04 CM/SEC


                                  LAYER  4
                                  --------

                     TYPE 2 - LATERAL DRAINAGE LAYER
                         MATERIAL TEXTURE NUMBER   1
   THICKNESS                    =      12.00   INCHES
   POROSITY                     =       0.4170 VOL/VOL
   FIELD CAPACITY               =       0.0450 VOL/VOL
   WILTING POINT                =       0.0180 VOL/VOL
   INITIAL SOIL WATER CONTENT   =       0.0180 VOL/VOL
   EFFECTIVE SAT. HYD. COND.    =  0.999999978000E-02 CM/SEC
   SLOPE                        =       2.00   PERCENT
   DRAINAGE LENGTH              =       75.0   FEET


                                  LAYER  5
                                  --------

                     TYPE 4 - FLEXIBLE MEMBRANE LINER
                         MATERIAL TEXTURE NUMBER  35
   THICKNESS                    =       0.06   INCHES


   POROSITY                     =       0.0000 VOL/VOL
   FIELD CAPACITY               =       0.0000 VOL/VOL
   WILTING POINT                =       0.0000 VOL/VOL
   INITIAL SOIL WATER CONTENT   =       0.0000 VOL/VOL
   EFFECTIVE SAT. HYD. COND.    =  0.199999996000E-12 CM/SEC
   FML PINHOLE DENSITY          =       1.00   HOLES/ACRE
   FML INSTALLATION DEFECTS     =       1.00   HOLES/ACRE
   FML PLACEMENT QUALITY        =  4 - POOR


                                  LAYER  6
                                  --------

                     TYPE 3 - BARRIER SOIL LINER
                         MATERIAL TEXTURE NUMBER  16
   THICKNESS                    =    1011.60   INCHES
   POROSITY                     =       0.4270 VOL/VOL
   FIELD CAPACITY               =       0.4180 VOL/VOL
   WILTING POINT                =       0.3670 VOL/VOL
   INITIAL SOIL WATER CONTENT   =       0.4270 VOL/VOL
   EFFECTIVE SAT. HYD. COND.    =  0.100000001000E-06 CM/SEC


                   GENERAL DESIGN AND EVAPORATIVE ZONE DATA
                   ----------------------------------------

     NOTE:  SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT
              SOIL DATA BASE USING SOIL TEXTURE #22 WITH A
              POOR STAND OF GRASS, A SURFACE SLOPE OF  2.%
              AND A SLOPE LENGTH OF 1200. FEET.

   SCS RUNOFF CURVE NUMBER              =      93.10
   FRACTION OF AREA ALLOWING RUNOFF     =     100.0    PERCENT
   AREA PROJECTED ON HORIZONTAL PLANE   =      1.000   ACRES
   EVAPORATIVE ZONE DEPTH               =      24.0    INCHES
   INITIAL WATER IN EVAPORATIVE ZONE    =      5.269   INCHES
   UPPER LIMIT OF EVAPORATIVE STORAGE   =     12.348   INCHES
   LOWER LIMIT OF EVAPORATIVE STORAGE   =      3.084   INCHES
   INITIAL SNOW WATER                   =      0.000   INCHES
   INITIAL WATER IN LAYER MATERIALS     =    588.700   INCHES
   TOTAL INITIAL WATER                  =    588.700   INCHES
   TOTAL SUBSURFACE INFLOW              =       0.00   INCHES/YEAR


                   EVAPOTRANSPIRATION AND WEATHER DATA
                   -----------------------------------

     NOTE:  EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
              ALBANY                    NEW YORK


   STATION LATITUDE                     =  42.45 DEGREES
   MAXIMUM LEAF AREA INDEX              =   3.50
   START OF GROWING SEASON (JULIAN DATE) =   123
   END OF GROWING SEASON (JULIAN DATE)  =   282
   EVAPORATIVE ZONE DEPTH               =  24.0  INCHES
   AVERAGE ANNUAL WIND SPEED            =   8.90 MPH
   AVERAGE 1ST QUARTER RELATIVE HUMIDITY =  68.00 %
   AVERAGE 2ND QUARTER RELATIVE HUMIDITY =  66.00 %
   AVERAGE 3RD QUARTER RELATIVE HUMIDITY =  74.00 %
   AVERAGE 4TH QUARTER RELATIVE HUMIDITY =  74.00 %


     NOTE:  PRECIPITATION DATA FOR     CHERRY ISLAND LF
              WAS ENTERED BY THE USER.


     NOTE:  TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING
              COEFFICIENTS FOR    WILMINGTON          DELAWARE

              NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

   JAN/JUL   FEB/AUG   MAR/SEP   APR/OCT   MAY/NOV   JUN/DEC
   -------   -------   -------   -------   -------   -------
    31.20     33.20     41.80     52.40     62.20     71.20
    76.00     74.80     67.80     56.30     45.60     35.50


     NOTE:  SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
              COEFFICIENTS FOR    WILMINGTON          DELAWARE
              AND STATION LATITUDE  =  39.80 DEGREES


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                   MONTHLY TOTALS (IN INCHES) FOR YEAR    1
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                        JAN/JUL  FEB/AUG  MAR/SEP  APR/OCT  MAY/NOV  JUN/DEC
                        -------  -------  -------  -------  -------  -------

PRECIPITATION            1.87     1.39     4.15     2.02     1.86     5.95
                         2.42     5.10     3.84     3.78     1.81     7.26

RUNOFF                   0.095    0.001    0.577    0.031    0.038    0.439
                         0.088    0.761    1.492    0.644    0.157    1.816

EVAPOTRANSPIRATION       1.092    1.466    2.155    2.935    1.981    6.301
                         3.152    3.498    1.588    1.479    1.192    0.865

LATERAL DRAINAGE COLLECTED  0.1674  0.1156  0.0388  0.0108  0.0032  0.0009
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FROM LAYER 4	0.0003	0.0001	0.0000	0.0000	0.0000	0.0000
PERCOLATION/LEAKAGE THROUGH LAYER 6	0.0001 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 5	0.357 0.001	0.273 0.000	0.083 0.000	0.024 0.000	0.007 0.000	0.002 0.000
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 5	0.208 0.000	0.091 0.000	0.030 0.000	0.008 0.000	0.003 0.000	0.001 0.000

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ANNUAL TOTALS FOR YEAR 1

	INCHES	CU. FEET	PERCENT
PRECIPITATION	41.45	150463.469	100.00
RUNOFF	6.139	22283.998	14.81
EVAPOTRANSPIRATION	27.705	100567.484	66.84
DRAINAGE COLLECTED FROM LAYER 4	0.3371	1223.552	0.81
PERC./LEAKAGE THROUGH LAYER 6	0.000133	0.484	0.00
AVG. HEAD ON TOP OF LAYER 5	0.0622		
CHANGE IN WATER STORAGE	7.269	26387.955	17.54
SOIL WATER AT START OF YEAR	588.700	2136979.500	
SOIL WATER AT END OF YEAR	595.969	2163367.500	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.004	0.00

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CHANGE IN WATER STORAGE	5.686	20641.637	12.75
SOIL WATER AT START OF YEAR	595.969	2163367.500	
SOIL WATER AT END OF YEAR	601.655	2184009.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	-0.097	0.00

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MONTHLY TOTALS (IN INCHES) FOR YEAR 3

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	7.06 6.60	1.11 4.24	2.48 3.95	2.14 1.63	2.69 1.57	7.65 1.38
RUNOFF	2.786 3.181	0.003 0.979	0.009 0.920	0.057 0.053	0.477 0.088	1.445 0.106
EVAPOTRANSPIRATION	0.690 4.128	1.503 3.663	2.295 1.846	2.863 1.435	2.854 0.689	6.305 0.427
LATERAL DRAINAGE COLLECTED FROM LAYER 4	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000
PERCOLATION/LEAKAGE THROUGH LAYER 6	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 5	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 5	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000

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MONTHLY TOTALS (IN INCHES) FOR YEAR 2

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	2.12 2.92	4.54 0.75	4.19 7.04	4.19 2.82	7.87 1.75	5.80 0.61
RUNOFF	0.337 0.383	1.022 0.005	3.785 2.549	0.176 0.665	1.729 0.023	1.012 0.000
EVAPOTRANSPIRATION	0.723 3.485	0.498 0.390	1.731 1.435	3.957 1.916	4.502 1.297	6.707 0.587
LATERAL DRAINAGE COLLECTED FROM LAYER 4	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000
PERCOLATION/LEAKAGE THROUGH LAYER 6	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 5	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 5	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000

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ANNUAL TOTALS FOR YEAR 2

	INCHES	CU. FEET	PERCENT
PRECIPITATION	44.60	161897.969	100.00
RUNOFF	11.685	42417.039	26.20
EVAPOTRANSPIRATION	27.228	98839.391	61.05
DRAINAGE COLLECTED FROM LAYER 4	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 6	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 5	0.0000		

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ANNUAL TOTALS FOR YEAR 3

	INCHES	CU. FEET	PERCENT
PRECIPITATION	42.50	154274.984	100.00
RUNOFF	10.104	36679.020	23.78
EVAPOTRANSPIRATION	28.697	104170.680	67.52
DRAINAGE COLLECTED FROM LAYER 4	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 6	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 5	0.0000		
CHANGE IN WATER STORAGE	3.698	13425.176	8.70
SOIL WATER AT START OF YEAR	601.655	2184009.000	
SOIL WATER AT END OF YEAR	605.340	2197382.750	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.014	51.515	0.03
ANNUAL WATER BUDGET BALANCE	0.0000	0.112	0.00

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MONTHLY TOTALS (IN INCHES) FOR YEAR 4

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	4.44 3.62	2.19 4.51	3.41 2.34	4.62 4.37	2.81 3.12	4.90 1.74
RUNOFF	2.726 0.094	1.113 0.882	0.788 0.138	0.220 1.072	0.263 0.380	0.505 0.039
EVAPOTRANSPIRATION	0.369 3.467	0.669 4.122	1.921 1.283	3.518 1.332	4.263 0.841	5.143 0.712
LATERAL DRAINAGE COLLECTED	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

FROM LAYER 4	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
PERCOLATION/LEAKAGE THROUGH LAYER 6	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 5	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 5	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000

ANNUAL TOTALS FOR YEAR 4

	INCHES	CU. FEET	PERCENT
PRECIPITATION	42.07	152714.141	100.00
RUNOFF	8.221	29843.949	19.54
EVAPOTRANSPIRATION	27.640	100332.555	65.70
DRAINAGE COLLECTED FROM LAYER 4	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 6	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 5	0.0000		
CHANGE IN WATER STORAGE	6.209	22537.615	14.76
SOIL WATER AT START OF YEAR	605.340	2197382.750	
SOIL WATER AT END OF YEAR	611.562	2219972.000	
SNOW WATER AT START OF YEAR	0.014	51.515	0.03
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.023	0.00

MONTHLY TOTALS (IN INCHES) FOR YEAR 5

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	0.98 5.57	4.73 8.02	8.53 7.27	3.09 4.94	5.72 3.35	3.65 3.28
RUNOFF	0.133 0.850	2.760 1.906	2.590 2.660	0.131 2.396	1.365 0.334	0.799 0.216
EVAPOTRANSPIRATION	0.596 5.703	0.573 4.535	2.376 3.263	3.493 1.387	4.680 1.287	3.663 0.835
LATERAL DRAINAGE COLLECTED FROM LAYER 4	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000
PERCOLATION/LEAKAGE THROUGH LAYER 6	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 5	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 5	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000

ANNUAL TOTALS FOR YEAR 5

	INCHES	CU. FEET	PERCENT
PRECIPITATION	59.13	214641.937	100.00
RUNOFF	16.140	58589.238	27.30
EVAPOTRANSPIRATION	32.391	117580.430	54.78
DRAINAGE COLLECTED FROM LAYER 4	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 6	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 5	0.0000		
CHANGE IN WATER STORAGE	10.598	38472.152	17.92
SOIL WATER AT START OF YEAR	611.562	2219972.000	
SOIL WATER AT END OF YEAR	622.161	2258444.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.111	0.00

MONTHLY TOTALS (IN INCHES) FOR YEAR 6

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	3.86 5.26	2.45 7.83	4.12 3.95	3.55 2.25	4.92 4.13	5.49 1.23
RUNOFF	0.327 1.177	2.079 2.261	0.743 0.880	0.340 0.252	0.839 1.202	0.945 0.108
EVAPOTRANSPIRATION	0.695 4.321	0.997 4.933	2.723 2.883	3.955 1.023	3.285 0.824	6.703 0.511
LATERAL DRAINAGE COLLECTED FROM LAYER 4	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000
PERCOLATION/LEAKAGE THROUGH LAYER 6	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 5	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 5	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000

ANNUAL TOTALS FOR YEAR 6

	INCHES	CU. FEET	PERCENT
PRECIPITATION	49.04	178015.187	100.00
RUNOFF	11.153	40483.594	22.74
EVAPOTRANSPIRATION	32.855	119262.039	67.00
DRAINAGE COLLECTED FROM LAYER 4	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 6	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 5	0.0000		
CHANGE IN WATER STORAGE	5.033	18269.641	10.26
SOIL WATER AT START OF YEAR	622.161	2258444.000	
SOIL WATER AT END OF YEAR	627.194	2276713.750	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	-0.087	0.00

MONTHLY TOTALS (IN INCHES) FOR YEAR 7

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	4.59 1.55	1.40 5.61	5.75 5.53	4.02 1.83	1.74 7.03	2.86 4.38
RUNOFF	1.944 0.009	0.802 1.265	1.245 1.701	0.269 0.438	0.031 2.049	0.610 1.403
EVAPOTRANSPIRATION	0.766 1.548	0.316 4.181	1.594 1.916	3.708 1.522	3.106 1.198	3.802 0.814
LATERAL DRAINAGE COLLECTED	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

FROM LAYER 4	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
PERCOLATION/LEAKAGE THROUGH LAYER 6	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 5	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 5	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000

ANNUAL TOTALS FOR YEAR 7

	INCHES	CU. FEET	PERCENT
PRECIPITATION	46.29	168032.703	100.00
RUNOFF	11.764	42704.168	25.41
EVAPOTRANSPIRATION	24.471	88829.359	52.86
DRAINAGE COLLECTED FROM LAYER 4	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 6	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 5	0.0000		
CHANGE IN WATER STORAGE	10.055	36499.180	21.72
SOIL WATER AT START OF YEAR	627.194	2276713.750	
SOIL WATER AT END OF YEAR	637.249	2313212.750	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	-0.003	0.00

MONTHLY TOTALS (IN INCHES) FOR YEAR 8

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	5.72 1.89	2.50 4.41	3.55 1.64	6.62 3.14	2.47 2.70	3.30 3.30
RUNOFF	1.759 0.179	0.688 0.857	0.446 0.138	1.820 0.599	0.029 0.654	0.442 0.559
EVAPOTRANSPIRATION	1.216 1.539	1.661 3.809	2.692 1.536	4.385 1.138	3.188 0.871	4.667 0.460
LATERAL DRAINAGE COLLECTED FROM LAYER 4	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000
PERCOLATION/LEAKAGE THROUGH LAYER 6	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 5	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 5	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000

ANNUAL TOTALS FOR YEAR 8

	INCHES	CU. FEET	PERCENT
PRECIPITATION	41.24	149701.187	100.00
RUNOFF	8.169	29654.473	19.81
EVAPOTRANSPIRATION	27.161	98594.859	65.86
DRAINAGE COLLECTED FROM LAYER 4	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 6	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 5	0.0000		
CHANGE IN WATER STORAGE	5.910	21451.873	14.33
SOIL WATER AT START OF YEAR	637.249	2313212.750	
SOIL WATER AT END OF YEAR	643.158	2334664.750	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	-0.010	0.00

MONTHLY TOTALS (IN INCHES) FOR YEAR 9

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	4.63 5.22	2.81 6.98	2.61 10.80	4.64 0.60	3.92 4.39	5.10 3.09
RUNOFF	2.828 1.666	2.240 2.141	0.612 4.366	0.613 0.018	0.132 0.420	0.846 0.651
EVAPOTRANSPIRATION	0.399 3.647	0.192 4.345	1.613 3.169	3.944 1.601	4.339 1.170	5.133 0.623
LATERAL DRAINAGE COLLECTED FROM LAYER 4	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000
PERCOLATION/LEAKAGE THROUGH LAYER 6	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 5	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 5	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000

ANNUAL TOTALS FOR YEAR 9

	INCHES	CU. FEET	PERCENT
PRECIPITATION	54.79	198887.719	100.00
RUNOFF	16.532	60010.840	30.17
EVAPOTRANSPIRATION	30.175	109536.453	55.07
DRAINAGE COLLECTED FROM LAYER 4	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 6	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 5	0.0000		
CHANGE IN WATER STORAGE	8.083	29340.297	14.75
SOIL WATER AT START OF YEAR	643.158	2334664.750	
SOIL WATER AT END OF YEAR	650.945	2362929.250	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.296	1075.748	0.54
ANNUAL WATER BUDGET BALANCE	0.0000	0.129	0.00

MONTHLY TOTALS (IN INCHES) FOR YEAR 10

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	3.98 6.20	2.12 5.67	4.68 11.97	3.52 7.03	3.38 2.02	4.46 2.41
RUNOFF	2.512 2.408	1.409 1.455	1.382 6.389	0.471 2.106	0.110 0.061	0.557 0.167
EVAPOTRANSPIRATION	0.475 3.085	0.417 3.928	2.738 2.535	3.000 1.719	3.158 1.062	6.169 0.583
LATERAL DRAINAGE COLLECTED	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

FROM LAYER 4	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
PERCOLATION/LEAKAGE THROUGH LAYER 6	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 5	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 5	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000

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ANNUAL TOTALS FOR YEAR 10

	INCHES	CU. FEET	PERCENT
PRECIPITATION	57.44	208507.234	100.00
RUNOFF	19.027	69066.852	33.12
EVAPOTRANSPIRATION	28.870	104798.945	50.26
DRAINAGE COLLECTED FROM LAYER 4	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 6	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 5	0.0000		
CHANGE IN WATER STORAGE	9.543	34641.555	16.61
SOIL WATER AT START OF YEAR	650.945	2362929.250	
SOIL WATER AT END OF YEAR	660.784	2398646.500	
SNOW WATER AT START OF YEAR	0.296	1075.748	0.52
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	-0.115	0.00

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CHANGE IN WATER STORAGE	3.605	13086.079	7.98
SOIL WATER AT START OF YEAR	660.784	2398646.500	
SOIL WATER AT END OF YEAR	664.389	2411732.750	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.038	0.00

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MONTHLY TOTALS (IN INCHES) FOR YEAR 12

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	8.05 5.35	2.10 3.72	8.59 2.36	9.03 6.26	4.39 5.12	8.03 5.83
RUNOFF	0.436 1.712	3.049 0.574	8.575 0.455	3.208 2.480	0.547 1.866	2.506 1.370
EVAPOTRANSPIRATION	0.693 3.646	0.450 3.146	1.951 0.754	4.034 1.114	5.292 1.104	7.422 0.809
LATERAL DRAINAGE COLLECTED FROM LAYER 4	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000
PERCOLATION/LEAKAGE THROUGH LAYER 6	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 5	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 5	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000

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MONTHLY TOTALS (IN INCHES) FOR YEAR 11

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	3.93 10.86	3.22 3.62	3.86 1.46	2.79 1.67	1.90 2.93	6.67 2.27
RUNOFF	2.682 3.871	1.434 0.526	0.499 0.217	0.307 0.159	0.093 0.498	0.986 0.353
EVAPOTRANSPIRATION	0.152 6.811	0.758 4.078	2.953 0.705	3.862 1.234	2.045 0.764	6.084 0.503
LATERAL DRAINAGE COLLECTED FROM LAYER 4	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000
PERCOLATION/LEAKAGE THROUGH LAYER 6	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 5	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 5	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000

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ANNUAL TOTALS FOR YEAR 11

	INCHES	CU. FEET	PERCENT
PRECIPITATION	45.18	164003.359	100.00
RUNOFF	11.625	42199.598	25.73
EVAPOTRANSPIRATION	29.950	108717.641	66.29
DRAINAGE COLLECTED FROM LAYER 4	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 6	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 5	0.0000		

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ANNUAL TOTALS FOR YEAR 12

	INCHES	CU. FEET	PERCENT
PRECIPITATION	68.83	249852.844	100.00
RUNOFF	26.778	97205.555	38.91
EVAPOTRANSPIRATION	30.414	110404.172	44.19
DRAINAGE COLLECTED FROM LAYER 4	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 6	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 5	0.0000		
CHANGE IN WATER STORAGE	11.637	42243.137	16.91
SOIL WATER AT START OF YEAR	664.389	2411732.750	
SOIL WATER AT END OF YEAR	673.985	2446564.500	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	2.042	7411.400	2.97
ANNUAL WATER BUDGET BALANCE	0.0000	-0.007	0.00

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MONTHLY TOTALS (IN INCHES) FOR YEAR 13

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	2.02 3.99	1.24 0.38	5.86 6.34	2.65 6.41	2.08 1.89	1.82 4.28
RUNOFF	0.692 1.401	0.523 0.000	1.699 1.821	0.262 3.027	0.019 0.095	0.193 0.857
EVAPOTRANSPIRATION	0.550 2.589	0.240 0.380	2.354 2.126	3.218 1.840	2.230 1.181	3.507 0.768
LATERAL DRAINAGE COLLECTED	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

FROM LAYER 4	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
PERCOLATION/LEAKAGE THROUGH LAYER 6	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 5	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 5	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000

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ANNUAL TOTALS FOR YEAR 13

	INCHES	CU. FEET	PERCENT
PRECIPITATION	38.96	141424.828	100.00
RUNOFF	10.589	38439.430	27.18
EVAPOTRANSPIRATION	20.982	76165.945	53.86
DRAINAGE COLLECTED FROM LAYER 4	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 6	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 5	0.0000		
CHANGE IN WATER STORAGE	7.388	26819.449	18.96
SOIL WATER AT START OF YEAR	673.985	2446564.500	
SOIL WATER AT END OF YEAR	682.696	2478186.750	
SNOW WATER AT START OF YEAR	2.042	7411.400	5.24
SNOW WATER AT END OF YEAR	0.719	2608.595	1.84
ANNUAL WATER BUDGET BALANCE	0.0000	-0.003	0.00

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MONTHLY TOTALS (IN INCHES) FOR YEAR 14

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	1.68 2.56	0.64 1.74	4.01 2.98	4.21 2.88	3.90 1.21	3.86 8.76
RUNOFF	0.046 0.344	0.630 0.150	0.512 0.205	0.384 0.143	0.213 0.076	0.364 3.412
EVAPOTRANSPIRATION	0.658 2.987	0.321 1.493	2.773 2.264	4.338 1.616	3.226 0.762	5.094 0.617
LATERAL DRAINAGE COLLECTED FROM LAYER 4	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000
PERCOLATION/LEAKAGE THROUGH LAYER 6	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 5	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 5	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000

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ANNUAL TOTALS FOR YEAR 14

	INCHES	CU. FEET	PERCENT
PRECIPITATION	38.43	139500.906	100.00
RUNOFF	6.480	23520.609	16.86
EVAPOTRANSPIRATION	26.150	94923.398	68.05
DRAINAGE COLLECTED FROM LAYER 4	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 6	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 5	0.0000		
CHANGE IN WATER STORAGE	5.801	21056.867	15.09
SOIL WATER AT START OF YEAR	682.696	2478186.750	
SOIL WATER AT END OF YEAR	687.673	2496253.250	
SNOW WATER AT START OF YEAR	0.719	2608.595	1.87
SNOW WATER AT END OF YEAR	1.542	5598.767	4.01
ANNUAL WATER BUDGET BALANCE	0.0000	0.026	0.00

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MONTHLY TOTALS (IN INCHES) FOR YEAR 15

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	0.95 2.68	4.60 12.91	4.04 4.59	0.69 3.00	3.91 3.10	2.40 4.24
RUNOFF	0.756 0.227	3.549 6.362	1.093 1.216	0.000 0.451	1.501 0.612	0.364 0.196
EVAPOTRANSPIRATION	0.627 2.454	0.524 5.616	2.292 2.975	1.757 1.405	1.861 0.777	4.181 0.460
LATERAL DRAINAGE COLLECTED FROM LAYER 4	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000
PERCOLATION/LEAKAGE THROUGH LAYER 6	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 5	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 5	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000

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ANNUAL TOTALS FOR YEAR 15

	INCHES	CU. FEET	PERCENT
PRECIPITATION	47.11	171009.375	100.00
RUNOFF	16.327	59265.539	34.66
EVAPOTRANSPIRATION	24.929	90491.781	52.92
DRAINAGE COLLECTED FROM LAYER 4	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 6	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 5	0.0000		
CHANGE IN WATER STORAGE	5.855	21251.996	12.43
SOIL WATER AT START OF YEAR	687.673	2496253.250	
SOIL WATER AT END OF YEAR	692.918	2515293.250	
SNOW WATER AT START OF YEAR	1.542	5598.767	3.27
SNOW WATER AT END OF YEAR	2.152	7810.766	4.57
ANNUAL WATER BUDGET BALANCE	0.0000	0.054	0.00

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MONTHLY TOTALS (IN INCHES) FOR YEAR 16

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	3.42 5.56	2.71 3.22	4.10 3.06	3.22 0.90	1.44 2.77	4.36 3.04
RUNOFF	1.533 0.959	1.711 0.399	0.993 0.334	0.297 0.132	0.037 0.283	0.7 0.2
EVAPOTRANSPIRATION	0.649 3.578	0.356 4.229	2.176 1.231	4.061 1.112	2.249 0.715	4.714 0.488
LATERAL DRAINAGE COLLECTED	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

FROM LAYER 4	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
PERCOLATION/LEAKAGE THROUGH LAYER 6	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 5	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 5	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000

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ANNUAL TOTALS FOR YEAR 16

	INCHES	CU. FEET	PERCENT
PRECIPITATION	37.80	137213.984	100.00
RUNOFF	7.659	27802.449	20.26
EVAPOTRANSPIRATION	25.558	92773.930	67.61
DRAINAGE COLLECTED FROM LAYER 4	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 6	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 5	0.0000		
CHANGE IN WATER STORAGE	4.583	16637.453	12.13
SOIL WATER AT START OF YEAR	692.918	2515293.250	
SOIL WATER AT END OF YEAR	699.653	2539741.500	
SNOW WATER AT START OF YEAR	2.152	7810.766	5.69
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.151	0.00

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MONTHLY TOTALS (IN INCHES) FOR YEAR 17

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	0.66 2.67	1.49 1.56	3.09 3.30	2.64 2.64	1.65 5.00	2.73 1.38
RUNOFF	0.000 0.235	0.472 0.004	0.473 0.189	0.018 0.380	0.022 1.105	0.232 0.018
EVAPOTRANSPIRATION	0.680 2.301	0.382 1.426	2.418 2.747	2.419 1.613	2.109 0.920	4.551 0.645
LATERAL DRAINAGE COLLECTED FROM LAYER 4	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000
PERCOLATION/LEAKAGE THROUGH LAYER 6	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 5	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 5	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000

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ANNUAL TOTALS FOR YEAR 17

	INCHES	CU. FEET	PERCENT
PRECIPITATION	28.81	104580.328	100.00
RUNOFF	3.148	11425.474	10.93
EVAPOTRANSPIRATION	22.210	80621.289	77.09
DRAINAGE COLLECTED FROM LAYER 4	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 6	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 5	0.0000		
CHANGE IN WATER STORAGE	3.453	12533.515	11.98
SOIL WATER AT START OF YEAR	699.653	2539741.500	
SOIL WATER AT END OF YEAR	703.106	2552275.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.052	0.00

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MONTHLY TOTALS (IN INCHES) FOR YEAR 18

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	1.87 2.42	1.39 5.10	4.15 3.84	2.02 3.78	1.86 1.81	5.95 7.26
RUNOFF	0.106 0.088	0.139 0.738	2.006 1.507	0.028 0.657	0.034 0.164	0.471 2.034
EVAPOTRANSPIRATION	0.967 3.337	0.595 3.493	1.893 1.579	2.788 1.463	1.925 1.101	6.364 0.655
LATERAL DRAINAGE COLLECTED FROM LAYER 4	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000
PERCOLATION/LEAKAGE THROUGH LAYER 6	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 5	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 5	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000

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ANNUAL TOTALS FOR YEAR 18

	INCHES	CU. FEET	PERCENT
PRECIPITATION	41.45	150463.469	100.00
RUNOFF	7.971	28933.273	19.23
EVAPOTRANSPIRATION	26.160	94962.250	63.11
DRAINAGE COLLECTED FROM LAYER 4	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 6	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 5	0.0000		
CHANGE IN WATER STORAGE	7.319	26568.082	17.66
SOIL WATER AT START OF YEAR	703.106	2552275.000	
SOIL WATER AT END OF YEAR	710.425	2578843.250	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	-0.133	0.00

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MONTHLY TOTALS (IN INCHES) FOR YEAR 19

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	2.12 2.92	4.54 0.75	4.19 7.04	4.19 2.82	7.87 1.75	5.80 0.61
RUNOFF	0.403 0.388	1.156 0.005	2.459 2.515	0.190 0.661	1.733 0.030	1.001 0.000
EVAPOTRANSPIRATION	0.807 3.334	0.664 0.357	1.740 1.542	4.066 1.781	4.564 1.228	6.615 0.749
LATERAL DRAINAGE COLLECTED	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

FROM LAYER 4	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
PERCOLATION/LEAKAGE THROUGH LAYER 6	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 5	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 5	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000

ANNUAL TOTALS FOR YEAR 19

	INCHES	CU. FEET	PERCENT
PRECIPITATION	44.60	161897.969	100.00
RUNOFF	10.540	38260.137	23.63
EVAPOTRANSPIRATION	27.447	99633.500	61.54
DRAINAGE COLLECTED FROM LAYER 4	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 6	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 5	0.0000		
CHANGE IN WATER STORAGE	6.613	24004.217	14.83
SOIL WATER AT START OF YEAR	710.425	2578843.250	
SOIL WATER AT END OF YEAR	717.038	2602847.250	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.114	0.00

MONTHLY TOTALS (IN INCHES) FOR YEAR 20

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	7.06 6.60	1.11 4.40	2.48 3.85	2.14 1.57	2.69 1.57	7.65 1.38
RUNOFF	4.385 3.148	0.002 0.977	0.491 0.921	0.062 0.061	0.448 0.100	1.478 0.064
EVAPOTRANSPIRATION	0.546 4.041	1.403 3.489	0.939 1.649	2.937 1.429	2.861 0.595	6.820 0.578
LATERAL DRAINAGE COLLECTED FROM LAYER 4	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000
PERCOLATION/LEAKAGE THROUGH LAYER 6	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 5	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 5	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000

ANNUAL TOTALS FOR YEAR 20

	INCHES	CU. FEET	PERCENT
PRECIPITATION	42.50	154274.984	100.00
RUNOFF	12.138	44061.629	28.56
EVAPOTRANSPIRATION	27.290	99064.391	64.21
DRAINAGE COLLECTED FROM LAYER 4	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 6	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 5	0.0000		
CHANGE IN WATER STORAGE	3.071	11149.223	7.23
SOIL WATER AT START OF YEAR	717.038	2602847.250	
SOIL WATER AT END OF YEAR	720.109	2613996.500	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	-0.0001	-0.260	0.00

MONTHLY TOTALS (IN INCHES) FOR YEAR 21

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	4.44 3.62	2.19 4.51	3.41 2.28	4.62 4.43	2.81 3.12	4.90 1.74
RUNOFF	0.717 0.094	1.766 0.881	1.049 0.139	0.201 1.064	0.233 0.378	0.500 0.036
EVAPOTRANSPIRATION	0.946 3.593	0.399 4.305	2.172 1.252	3.447 1.438	4.393 0.903	4.896 0.740
LATERAL DRAINAGE COLLECTED FROM LAYER 4	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000
PERCOLATION/LEAKAGE THROUGH LAYER 6	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 5	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 5	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000

ANNUAL TOTALS FOR YEAR 21

	INCHES	CU. FEET	PERCENT
PRECIPITATION	42.07	152714.141	100.00
RUNOFF	7.059	25623.549	16.78
EVAPOTRANSPIRATION	28.485	103399.289	67.71
DRAINAGE COLLECTED FROM LAYER 4	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 6	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 5	0.0000		
CHANGE IN WATER STORAGE	6.526	23691.156	15.51
SOIL WATER AT START OF YEAR	720.109	2613996.500	
SOIL WATER AT END OF YEAR	726.636	2637687.750	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.144	0.00

MONTHLY TOTALS (IN INCHES) FOR YEAR 22

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	0.98 5.57	4.73 8.02	8.53 7.27	3.09 4.94	5.72 3.35	3.65 3.28
RUNOFF	0.010 0.872	3.089 1.915	3.430 2.550	0.125 2.397	1.363 0.335	0.797 0.067
EVAPOTRANSPIRATION	0.897 5.705	0.432 4.526	2.231 3.523	3.806 1.450	4.535 1.151	3.308 0.582
LATERAL DRAINAGE COLLECTED	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

FROM LAYER 4	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
PERCOLATION/LEAKAGE THROUGH LAYER 6	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 5	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 5	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000

ANNUAL TOTALS FOR YEAR 22

	INCHES	CU. FEET	PERCENT
PRECIPITATION	59.13	214641.937	100.00
RUNOFF	16.949	61524.535	28.66
EVAPOTRANSPIRATION	32.146	116689.578	54.36
DRAINAGE COLLECTED FROM LAYER 4	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 6	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 5	0.0000		
CHANGE IN WATER STORAGE	10.035	36427.848	16.97
SOIL WATER AT START OF YEAR	726.636	2637687.750	
SOIL WATER AT END OF YEAR	736.250	2672588.500	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.421	1526.985	0.71
ANNUAL WATER BUDGET BALANCE	0.0000	-0.031	0.00

MONTHLY TOTALS (IN INCHES) FOR YEAR 23

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	3.86 5.26	2.45 7.83	4.12 3.95	3.55 2.25	4.92 4.13	5.49 1.23
RUNOFF	2.816 1.198	0.321 2.258	0.736 0.875	0.361 0.247	0.816 1.193	0.942 0.108
EVAPOTRANSPIRATION	0.505 4.306	1.229 4.987	2.797 3.249	3.775 1.196	3.254 0.788	6.675 0.525
LATERAL DRAINAGE COLLECTED FROM LAYER 4	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000
PERCOLATION/LEAKAGE THROUGH LAYER 6	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 5	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 5	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000

ANNUAL TOTALS FOR YEAR 23

	INCHES	CU. FEET	PERCENT
PRECIPITATION	49.04	178015.187	100.00
RUNOFF	11.871	43092.879	24.21
EVAPOTRANSPIRATION	33.288	120834.461	67.88
DRAINAGE COLLECTED FROM LAYER 4	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 6	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 5	0.0000		
CHANGE IN WATER STORAGE	3.881	14087.730	7.91
SOIL WATER AT START OF YEAR	736.250	2672588.500	
SOIL WATER AT END OF YEAR	740.552	2688203.250	
SNOW WATER AT START OF YEAR	0.421	1526.985	0.86
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.114	0.00

MONTHLY TOTALS (IN INCHES) FOR YEAR 24

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	4.59 2.29	1.40 5.56	6.05 4.84	3.72 1.83	1.78 7.03	2.82 4.79
RUNOFF	0.202 0.069	1.845 1.252	2.226 1.659	0.225 0.439	0.031 2.086	0.610 1.367
EVAPOTRANSPIRATION	0.678 1.649	0.437 4.152	2.229 1.881	3.449 1.511	2.855 1.167	3.817 0.788
LATERAL DRAINAGE COLLECTED FROM LAYER 4	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000
PERCOLATION/LEAKAGE THROUGH LAYER 6	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 5	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 5	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000

ANNUAL TOTALS FOR YEAR 24

	INCHES	CU. FEET	PERCENT
PRECIPITATION	46.70	169521.000	100.00
RUNOFF	12.009	43591.117	25.71
EVAPOTRANSPIRATION	24.611	89338.828	52.70
DRAINAGE COLLECTED FROM LAYER 4	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 6	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 5	0.0000		
CHANGE IN WATER STORAGE	10.080	36591.125	21.59
SOIL WATER AT START OF YEAR	740.552	2688203.250	
SOIL WATER AT END OF YEAR	750.632	2724794.500	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	-0.073	0.00

MONTHLY TOTALS (IN INCHES) FOR YEAR 25

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	5.72 1.71	2.50 4.59	3.55 1.64	6.62 3.14	2.37 2.70	3.40 3.09
RUNOFF	1.819 0.179	1.641 0.854	0.505 0.138	1.880 0.599	0.032 0.668	0.443 0.339
EVAPOTRANSPIRATION	0.865 1.388	0.283 3.860	2.307 1.744	4.292 0.929	2.959 0.899	4.702 0.586
LATERAL DRAINAGE COLLECTED	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

FROM LAYER 4	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
PERCOLATION/LEAKAGE THROUGH LAYER 6	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 5	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 5	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000

ANNUAL TOTALS FOR YEAR 25

	INCHES	CU. FEET	PERCENT
PRECIPITATION	41.03	148938.891	100.00
RUNOFF	9.099	33030.348	22.18
EVAPOTRANSPIRATION	24.813	90072.211	60.48
DRAINAGE COLLECTED FROM LAYER 4	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 6	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 5	0.0000		
CHANGE IN WATER STORAGE	7.117	25836.412	17.35
SOIL WATER AT START OF YEAR	750.632	2724794.500	
SOIL WATER AT END OF YEAR	757.232	2748753.250	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.517	1877.615	1.26
ANNUAL WATER BUDGET BALANCE	0.0000	-0.077	0.00

MONTHLY TOTALS (IN INCHES) FOR YEAR 26

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	4.63 5.22	2.81 6.98	2.61 10.80	4.64 0.60	3.92 4.39	5.10 3.09
RUNOFF	2.142 1.759	3.506 2.133	0.064 4.406	0.546 0.017	0.137 0.731	0.818 0.221
EVAPOTRANSPIRATION	0.385 3.486	1.056 4.364	2.618 3.031	4.154 1.492	4.082 1.274	5.127 0.807
LATERAL DRAINAGE COLLECTED FROM LAYER 4	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000
PERCOLATION/LEAKAGE THROUGH LAYER 6	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 5	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 5	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000

ANNUAL TOTALS FOR YEAR 26

	INCHES	CU. FEET	PERCENT
PRECIPITATION	54.79	198887.719	100.00
RUNOFF	16.481	59826.156	30.08
EVAPOTRANSPIRATION	31.876	115708.234	58.18
DRAINAGE COLLECTED FROM LAYER 4	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 6	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 5	0.0000		
CHANGE IN WATER STORAGE	6.433	23353.367	11.74
SOIL WATER AT START OF YEAR	757.232	2748753.250	
SOIL WATER AT END OF YEAR	764.183	2773984.250	
SNOW WATER AT START OF YEAR	0.517	1877.615	0.94
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	-0.044	0.00

MONTHLY TOTALS (IN INCHES) FOR YEAR 27

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	3.98 6.20	2.12 5.67	4.68 11.97	3.52 7.03	3.38 2.02	4.46 2.41
RUNOFF	0.783 2.394	1.355 1.452	1.713 6.423	0.478 2.116	0.106 0.014	0.565 0.169
EVAPOTRANSPIRATION	1.265 3.092	0.466 4.101	1.852 2.385	3.244 1.759	3.132 1.118	6.218 1.073
LATERAL DRAINAGE COLLECTED FROM LAYER 4	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000
PERCOLATION/LEAKAGE THROUGH LAYER 6	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 5	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 5	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000

ANNUAL TOTALS FOR YEAR 27

	INCHES	CU. FEET	PERCENT
PRECIPITATION	57.44	208507.234	100.00
RUNOFF	17.569	63776.891	30.59
EVAPOTRANSPIRATION	29.705	107827.906	51.71
DRAINAGE COLLECTED FROM LAYER 4	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 6	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 5	0.0000		
CHANGE IN WATER STORAGE	10.166	36902.195	17.70
SOIL WATER AT START OF YEAR	764.183	2773984.250	
SOIL WATER AT END OF YEAR	774.349	2810886.500	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0001	0.249	0.00

MONTHLY TOTALS (IN INCHES) FOR YEAR 28

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	3.93 10.86	3.22 3.65	4.40 1.43	2.25 1.67	2.75 2.93	5.82 2.27
RUNOFF	1.362 3.824	2.258 0.531	0.894 0.217	0.353 0.158	0.184 0.496	0.891 0.080
EVAPOTRANSPIRATION	0.716 7.000	0.607 3.898	1.475 0.815	2.857 1.164	2.071 0.617	6.234 0.531
LATERAL DRAINAGE COLLECTED	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

FROM LAYER 4	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
PERCOLATION/LEAKAGE THROUGH LAYER 6	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 5	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 5	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000

ANNUAL TOTALS FOR YEAR 28

	INCHES	CU. FEET	PERCENT
PRECIPITATION	45.18	164003.359	100.00
RUNOFF	11.248	40828.543	24.89
EVAPOTRANSPIRATION	27.986	101587.562	61.94
DRAINAGE COLLECTED FROM LAYER 4	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 6	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 5	0.0000		
CHANGE IN WATER STORAGE	5.947	21587.244	13.16
SOIL WATER AT START OF YEAR	774.349	2810886.500	
SOIL WATER AT END OF YEAR	780.296	2832473.750	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.010	0.00

MONTHLY TOTALS (IN INCHES) FOR YEAR 29

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	8.05 5.35	2.10 3.72	8.59 2.36	7.13 6.26	6.01 5.12	8.31 5.36
RUNOFF	2.880 1.712	3.263 0.578	3.073 0.441	2.395 2.482	1.398 1.880	2.508 0.906
EVAPOTRANSPIRATION	0.661 3.921	0.567 3.155	2.436 0.874	3.642 1.368	5.227 0.860	7.283 0.578
LATERAL DRAINAGE COLLECTED FROM LAYER 4	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000
PERCOLATION/LEAKAGE THROUGH LAYER 6	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 5	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 5	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000

ANNUAL TOTALS FOR YEAR 29

	INCHES	CU. FEET	PERCENT
PRECIPITATION	68.36	248146.750	100.00
RUNOFF	23.515	85359.914	34.40
EVAPOTRANSPIRATION	30.572	110976.586	44.72
DRAINAGE COLLECTED FROM LAYER 4	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 6	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 5	0.0000		
CHANGE IN WATER STORAGE	14.273	51810.562	20.88
SOIL WATER AT START OF YEAR	780.296	2832473.750	
SOIL WATER AT END OF YEAR	792.964	2878458.500	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	1.605	5825.835	2.35
ANNUAL WATER BUDGET BALANCE	-0.0001	-0.310	0.00

MONTHLY TOTALS (IN INCHES) FOR YEAR 30

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	2.02 3.99	1.24 0.38	5.86 6.34	2.65 6.41	2.08 1.89	1.82 4.28
RUNOFF	1.473 1.413	0.557 0.000	1.539 1.818	0.254 3.011	0.018 0.077	0.195 0.815
EVAPOTRANSPIRATION	0.572 2.577	0.431 0.380	2.378 2.108	3.450 1.974	2.236 1.168	3.431 1.045
LATERAL DRAINAGE COLLECTED FROM LAYER 4	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000
PERCOLATION/LEAKAGE THROUGH LAYER 6	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 5	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 5	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000

ANNUAL TOTALS FOR YEAR 30

	INCHES	CU. FEET	PERCENT
PRECIPITATION	38.96	141424.828	100.00
RUNOFF	11.170	40546.988	28.67
EVAPOTRANSPIRATION	21.750	78952.133	55.83
DRAINAGE COLLECTED FROM LAYER 4	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 6	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 5	0.0000		
CHANGE IN WATER STORAGE	6.040	21925.607	15.50
SOIL WATER AT START OF YEAR	792.964	2878458.500	
SOIL WATER AT END OF YEAR	800.174	2904633.500	
SNOW WATER AT START OF YEAR	1.605	5825.835	4.12
SNOW WATER AT END OF YEAR	0.434	1576.404	1.11
ANNUAL WATER BUDGET BALANCE	0.0000	0.095	0.00

MONTHLY TOTALS (IN INCHES) FOR YEAR 31

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	1.68 2.56	0.64 1.74	4.01 2.98	4.21 2.88	3.90 1.21	3.86 8.76
RUNOFF	0.957 0.343	0.000 0.151	0.266 0.204	0.406 0.149	0.213 0.072	0.363 3.624
EVAPOTRANSPIRATION	0.395 3.004	1.045 1.572	2.015 2.158	4.138 1.552	3.263 0.886	5.108 0.774
LATERAL DRAINAGE COLLECTED	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

FROM LAYER 4	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
PERCOLATION/LEAKAGE THROUGH LAYER 6	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 5	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 5	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000

ANNUAL TOTALS FOR YEAR 31

	INCHES	CU. FEET	PERCENT
PRECIPITATION	38.43	139500.906	100.00
RUNOFF	6.749	24498.703	17.56
EVAPOTRANSPIRATION	25.910	94054.211	67.42
DRAINAGE COLLECTED FROM LAYER 4	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 6	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 5	0.0000		
CHANGE IN WATER STORAGE	5.771	20948.031	15.02
SOIL WATER AT START OF YEAR	800.174	2904633.500	
SOIL WATER AT END OF YEAR	806.380	2927157.750	
SNOW WATER AT START OF YEAR	0.434	1576.404	1.13
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	-0.045	0.00

MONTHLY TOTALS (IN INCHES) FOR YEAR 32

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	0.95 7.38	4.60 8.21	4.09 4.59	0.64 3.00	3.91 3.10	2.40 4.24
RUNOFF	0.009 3.249	2.373 3.365	1.180 1.214	0.000 0.438	1.508 0.073	0.365 2.060
EVAPOTRANSPIRATION	0.771 2.565	0.645 6.372	2.224 2.524	1.744 1.237	1.967 0.652	4.028 0.397
LATERAL DRAINAGE COLLECTED FROM LAYER 4	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000
PERCOLATION/LEAKAGE THROUGH LAYER 6	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 5	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 5	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000

ANNUAL TOTALS FOR YEAR 32

	INCHES	CU. FEET	PERCENT
PRECIPITATION	47.11	171009.375	100.00
RUNOFF	15.835	57481.516	33.61
EVAPOTRANSPIRATION	25.127	91209.945	53.34
DRAINAGE COLLECTED FROM LAYER 4	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 6	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 5	0.0000		
CHANGE IN WATER STORAGE	6.148	22317.619	13.05
SOIL WATER AT START OF YEAR	806.380	2927157.750	
SOIL WATER AT END OF YEAR	812.499	2949372.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.029	103.587	0.06
ANNUAL WATER BUDGET BALANCE	0.0001	0.289	0.00

MONTHLY TOTALS (IN INCHES) FOR YEAR 33

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	3.42 5.60	2.71 3.22	4.10 2.02	3.03 1.94	1.63 2.77	4.32 3.04
RUNOFF	0.841 0.947	0.312 0.380	0.620 0.121	0.311 0.352	0.037 0.231	0.748 1.234
EVAPOTRANSPIRATION	0.870 3.693	1.309 4.277	2.163 1.166	3.656 1.174	2.657 0.521	4.484 0.539
LATERAL DRAINAGE COLLECTED FROM LAYER 4	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000
PERCOLATION/LEAKAGE THROUGH LAYER 6	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 5	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 5	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000

ANNUAL TOTALS FOR YEAR 33

	INCHES	CU. FEET	PERCENT
PRECIPITATION	37.80	137213.984	100.00
RUNOFF	6.132	22260.344	16.22
EVAPOTRANSPIRATION	26.509	96227.945	70.13
DRAINAGE COLLECTED FROM LAYER 4	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 6	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 5	0.0000		
CHANGE IN WATER STORAGE	5.159	18725.709	13.65
SOIL WATER AT START OF YEAR	812.499	2949372.000	
SOIL WATER AT END OF YEAR	817.686	2968201.250	
SNOW WATER AT START OF YEAR	0.029	103.587	0.08
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	-0.012	0.00

MONTHLY TOTALS (IN INCHES) FOR YEAR 34

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	0.66 2.67	1.49 1.56	3.09 3.30	2.64 2.64	1.65 5.00	2.73 1.38
RUNOFF	0.014 0.235	0.223 0.004	0.099 0.188	0.011 0.386	0.022 1.132	0.22[illegible] 0.003
EVAPOTRANSPIRATION	0.534 2.258	0.994 1.468	2.314 2.652	2.656 1.303	2.411 1.036	4.332 0.610
LATERAL DRAINAGE COLLECTED	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

FROM LAYER 4	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
PERCOLATION/LEAKAGE THROUGH LAYER 6	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 5	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 5	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000

ANNUAL TOTALS FOR YEAR 34

	INCHES	CU. FEET	PERCENT
PRECIPITATION	28.81	104580.328	100.00
RUNOFF	2.541	9224.780	8.82
EVAPOTRANSPIRATION	22.569	81926.859	78.34
DRAINAGE COLLECTED FROM LAYER 4	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 6	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 5	0.0000		
CHANGE IN WATER STORAGE	3.699	13428.607	12.84
SOIL WATER AT START OF YEAR	817.686	2968201.250	
SOIL WATER AT END OF YEAR	821.386	2981629.750	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.075	0.00

MONTHLY TOTALS (IN INCHES) FOR YEAR 35

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	1.87 2.42	1.39 5.10	4.15 3.84	2.02 3.78	1.86 1.81	5.95 7.26
RUNOFF	0.408 0.088	0.278 0.747	0.479 1.528	0.034 0.650	0.033 0.180	0.477 3.354
EVAPOTRANSPIRATION	0.602 3.313	0.729 3.463	2.636 1.558	2.925 1.485	1.954 0.928	6.313 0.440
LATERAL DRAINAGE COLLECTED FROM LAYER 4	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000
PERCOLATION/LEAKAGE THROUGH LAYER 6	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 5	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 5	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000

ANNUAL TOTALS FOR YEAR 35

	INCHES	CU. FEET	PERCENT
PRECIPITATION	41.45	150463.469	100.00
RUNOFF	8.256	29967.852	19.92
EVAPOTRANSPIRATION	26.345	95631.766	63.56
DRAINAGE COLLECTED FROM LAYER 4	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 6	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 5	0.0000		
CHANGE IN WATER STORAGE	6.850	24864.082	16.52
SOIL WATER AT START OF YEAR	821.386	2981629.750	
SOIL WATER AT END OF YEAR	828.235	3006494.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	-0.0001	-0.225	0.00

MONTHLY TOTALS (IN INCHES) FOR YEAR 36

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	2.12 2.92	4.54 0.75	4.19 8.39	4.19 1.47	8.03 1.75	5.64 0.61
RUNOFF	0.626 0.394	1.574 0.005	1.161 3.150	0.193 0.038	1.721 0.025	1.022 0.000
EVAPOTRANSPIRATION	1.019 2.636	0.897 0.417	2.733 1.490	4.351 1.783	4.527 1.136	7.213 0.809
LATERAL DRAINAGE COLLECTED FROM LAYER 4	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000
PERCOLATION/LEAKAGE THROUGH LAYER 6	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 5	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 5	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000

ANNUAL TOTALS FOR YEAR 36

	INCHES	CU. FEET	PERCENT
PRECIPITATION	44.60	161897.969	100.00
RUNOFF	9.907	35960.906	22.21
EVAPOTRANSPIRATION	29.011	105308.906	65.05
DRAINAGE COLLECTED FROM LAYER 4	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 6	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 5	0.0000		
CHANGE IN WATER STORAGE	5.683	20628.121	12.74
SOIL WATER AT START OF YEAR	828.235	3006494.000	
SOIL WATER AT END OF YEAR	833.918	3027122.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.035	0.00

MONTHLY TOTALS (IN INCHES) FOR YEAR 37

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	7.06 6.60	1.11 4.24	2.48 3.95	2.14 1.63	2.69 1.57	7.65 1.38
RUNOFF	3.601 3.182	0.312 0.987	0.001 0.922	0.055 0.059	0.427 0.082	1.498 0.064
EVAPOTRANSPIRATION	0.778 3.887	0.949 3.555	2.460 1.612	2.764 1.521	2.871 0.760	6.744 0.532
LATERAL DRAINAGE COLLECTED	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

FROM LAYER 4	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
PERCOLATION/LEAKAGE THROUGH LAYER 6	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 5	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 5	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000

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ANNUAL TOTALS FOR YEAR 37

	INCHES	CU. FEET	PERCENT
PRECIPITATION	42.50	154274.984	100.00
RUNOFF	11.191	40625.023	26.33
EVAPOTRANSPIRATION	28.434	103215.148	66.90
DRAINAGE COLLECTED FROM LAYER 4	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 6	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 5	0.0000		
CHANGE IN WATER STORAGE	2.875	10434.699	6.76
SOIL WATER AT START OF YEAR	833.918	3027122.000	
SOIL WATER AT END OF YEAR	836.792	3037556.750	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.114	0.00

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MONTHLY TOTALS (IN INCHES) FOR YEAR 38

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	4.44 3.62	2.19 4.51	3.41 2.28	4.62 4.43	2.81 3.12	4.90 1.74
RUNOFF	2.723 0.094	1.260 0.885	1.778 0.140	0.185 1.075	0.230 0.366	0.492 0.046
EVAPOTRANSPIRATION	0.511 3.328	0.460 4.411	1.910 1.171	3.765 1.325	4.311 0.914	4.985 0.762
LATERAL DRAINAGE COLLECTED FROM LAYER 4	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000
PERCOLATION/LEAKAGE THROUGH LAYER 6	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 5	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 5	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000

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ANNUAL TOTALS FOR YEAR 38

	INCHES	CU. FEET	PERCENT
PRECIPITATION	42.07	152714.141	100.00
RUNOFF	9.274	33663.895	22.04
EVAPOTRANSPIRATION	27.854	101110.258	66.21
DRAINAGE COLLECTED FROM LAYER 4	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 6	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 5	0.0000		
CHANGE IN WATER STORAGE	4.942	17939.963	11.75
SOIL WATER AT START OF YEAR	836.792	3037556.750	
SOIL WATER AT END OF YEAR	841.735	3055496.750	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.028	0.00

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MONTHLY TOTALS (IN INCHES) FOR YEAR 39

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	0.98 5.57	4.73 8.02	8.53 7.27	3.09 4.94	5.72 3.35	3.65 3.28
RUNOFF	0.153 0.875	0.890 1.886	7.275 2.629	0.139 2.385	1.396 0.277	0.797 0.228
EVAPOTRANSPIRATION	0.477 5.804	0.285 4.532	1.306 3.602	3.692 1.373	4.297 0.930	3.368 0.849
LATERAL DRAINAGE COLLECTED FROM LAYER 4	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000
PERCOLATION/LEAKAGE THROUGH LAYER 6	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 5	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 5	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000

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ANNUAL TOTALS FOR YEAR 39

	INCHES	CU. FEET	PERCENT
PRECIPITATION	59.13	214641.937	100.00
RUNOFF	18.931	68717.930	32.02
EVAPOTRANSPIRATION	30.514	110764.156	51.60
DRAINAGE COLLECTED FROM LAYER 4	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 6	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 5	0.0000		
CHANGE IN WATER STORAGE	9.686	35159.863	16.38
SOIL WATER AT START OF YEAR	841.735	3055496.750	
SOIL WATER AT END OF YEAR	851.421	3090656.500	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	-0.021	0.00

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MONTHLY TOTALS (IN INCHES) FOR YEAR 40

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	3.86 5.26	2.74 7.89	3.83 3.89	3.55 2.25	5.78 4.13	4.63 1.23
RUNOFF	0.334 1.178	0.167 2.258	1.170 0.894	0.341 0.247	0.964 1.208	0.81 0.00
EVAPOTRANSPIRATION	1.114 4.231	1.458 4.656	2.241 2.912	3.983 1.172	3.294 0.789	6.857 0.575
LATERAL DRAINAGE COLLECTED	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

FROM LAYER 4	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
PERCOLATION/LEAKAGE THROUGH LAYER 6	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 5	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 5	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000

ANNUAL TOTALS FOR YEAR 40

	INCHES	CU. FEET	PERCENT
PRECIPITATION	49.04	178015.187	100.00
RUNOFF	9.572	34747.184	19.52
EVAPOTRANSPIRATION	33.281	120808.945	67.86
DRAINAGE COLLECTED FROM LAYER 4	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 6	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 5	0.0000		
CHANGE IN WATER STORAGE	6.187	22459.020	12.62
SOIL WATER AT START OF YEAR	851.421	3090656.500	
SOIL WATER AT END OF YEAR	857.419	3112429.500	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.189	686.110	0.39
ANNUAL WATER BUDGET BALANCE	0.0000	0.043	0.00

AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1 THROUGH 40

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	3.51 4.54	2.48 4.67	4.54 4.81	3.60 3.30	3.57 3.09	4.75 3.30
STD. DEVIATIONS	2.09 2.19	1.27 2.72	1.77 2.88	1.65 1.80	1.84 1.46	1.72 2.20
RUNOFF						
TOTALS	1.259 1.163	1.294 1.119	1.506 1.507	0.434 0.868	0.513 0.543	0.775 0.708
STD. DEVIATIONS	1.192 1.163	1.066 1.180	1.758 1.607	0.681 0.938	0.603 0.601	0.521 0.993
EVAPOTRANSPIRATION						
TOTALS	0.698 3.515	0.717 3.439	2.196 2.018	3.476 1.434	3.250 0.952	5.377 0.656
STD. DEVIATIONS	0.241 1.293	0.405 1.544	0.440 0.812	0.663 0.246	1.022 0.213	1.257 0.162
LATERAL DRAINAGE COLLECTED FROM LAYER 4						
TOTALS	0.0042 0.0000	0.0029 0.0000	0.0010 0.0000	0.0003 0.0000	0.0001 0.0000	0.0000 0.0000
STD. DEVIATIONS	0.0265 0.0000	0.0183 0.0000	0.0061 0.0000	0.0017 0.0000	0.0005 0.0000	0.0001 0.0000
PERCOLATION/LEAKAGE THROUGH LAYER 6						
TOTALS	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000
STD. DEVIATIONS	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000

AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)

DAILY AVERAGE HEAD ON TOP OF LAYER 5						
AVERAGES	0.0089	0.0068	0.0021	0.0006	0.0002	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0565 0.0001	0.0432 0.0000	0.0131 0.0000	0.0038 0.0000	0.0011 0.0000	0.0003 0.0000

AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1 THROUGH 40

	INCHES	CU. FEET	PERCENT
PRECIPITATION	46.15 (8.949)	167511.8	100.00
RUNOFF	11.689 (5.1270)	42429.90	25.330
EVAPOTRANSPIRATION	27.727 (3.1556)	100647.88	60.084
LATERAL DRAINAGE COLLECTED FROM LAYER 4	0.00843 (0.05329)	30.589	0.01826
PERCOLATION/LEAKAGE THROUGH LAYER 6	0.00000 (0.00002)	0.012	0.00001
AVERAGE HEAD ON TOP OF LAYER 5	0.002 (0.010)		
CHANGE IN WATER STORAGE	6.723 (2.5651)	24403.40	14.568

PEAK DAILY VALUES FOR YEARS 1 THROUGH 40

	(INCHES)	(CU. FT.)
PRECIPITATION	5.15	18694.500
RUNOFF	4.002	14528.6201
DRAINAGE COLLECTED FROM LAYER 4	0.00827	30.00776
PERCOLATION/LEAKAGE THROUGH LAYER 6	0.000003	0.01091
AVERAGE HEAD ON TOP OF LAYER 5	0.547	
MAXIMUM HEAD ON TOP OF LAYER 5	0.959	
LOCATION OF MAXIMUM HEAD IN LAYER 4 (DISTANCE FROM DRAIN)	9.2 FEET	
SNOW WATER	8.08	29328.5547

MAXIMUM VEG. SOIL WATER (VOL/VOL) 0.3569

MINIMUM VEG. SOIL WATER (VOL/VOL) 0.1285

*** Maximum heads are computed using McEnroe's equations. ***

Reference: Maximum Saturated Depth over Landfill Liner
by Bruce M. McEnroe, University of Kansas
ASCE Journal of Environmental Engineering
Vol. 119, No. 2, March 1993, pp. 262-270.

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FINAL WATER STORAGE AT END OF YEAR 40

LAYER	(INCHES)	(VOL/VOL)
1	3.4418	0.2868
2	417.7996	0.2176
3	3.6840	0.3070
4	0.5400	0.0450
5	0.0000	0.0000
6	431.9532	0.4270
SNOW WATER	0.189	

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**              HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE               **
**                HELP MODEL VERSION 3.07  (1 NOVEMBER 1997)                **
**                 DEVELOPED BY ENVIRONMENTAL LABORATORY                    **
**                   USAE WATERWAYS EXPERIMENT STATION                      **
**             FOR USEPA RISK REDUCTION ENGINEERING LABORATORY              **
**                                                                          **
**                                                                          **
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PRECIPITATION DATA FILE:      P:\PRJ1\MDENG\HELP3\ME0250\40YEARS.D4
TEMPERATURE DATA FILE:        P:\PRJ1\MDENG\HELP3\ME0250\40YEARS.D7
SOLAR RADIATION DATA FILE:    P:\PRJ1\MDENG\HELP3\ME0250\40YEARS.D13
EVAPOTRANSPIRATION DATA:      P:\PRJ1\MDENG\HELP3\ME0250\40YEARS.D11
SOIL AND DESIGN DATA FILE:    P:\PRJ1\MDENG\HELP3\ME0250\CIL5B3S2.D10
OUTPUT DATA FILE:             P:\PRJ1\MDENG\HELP3\ME0250\CIL5B3S2.OUT


TIME:  14:56      DATE:   2/26/2003


******************************************************************************

     TITLE:  CHERRY ISLAND LANDFILL PHASE V - RUN B3 SIDE SLOPES

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     NOTE:  INITIAL MOISTURE CONTENT OF THE LAYERS AND SNOW WATER
            WERE SPECIFIED BY THE USER.


                                   LAYER  1
                                   --------

                 TYPE 1 - VERTICAL PERCOLATION LAYER
                     MATERIAL TEXTURE NUMBER  22
       THICKNESS                    =     12.00   INCHES
       POROSITY                     =      0.4190 VOL/VOL
       FIELD CAPACITY               =      0.3070 VOL/VOL
       WILTING POINT                =      0.1800 VOL/VOL
       INITIAL SOIL WATER CONTENT   =      0.3621 VOL/VOL
       EFFECTIVE SAT. HYD. COND.    =  0.189999992000E-04 CM/SEC
     NOTE:  SATURATED HYDRAULIC CONDUCTIVITY IS MULTIPLIED BY  4.63
            FOR ROOT CHANNELS IN TOP HALF OF EVAPORATIVE ZONE.


                 TYPE 3 - BARRIER SOIL LINER
                     MATERIAL TEXTURE NUMBER  16
       THICKNESS                    =   1011.60   INCHES
       POROSITY                     =      0.4270 VOL/VOL
       FIELD CAPACITY               =      0.4180 VOL/VOL
       WILTING POINT                =      0.3670 VOL/VOL
       INITIAL SOIL WATER CONTENT   =      0.4270 VOL/VOL
       EFFECTIVE SAT. HYD. COND.    =  0.100000001000E-06 CM/SEC


                 GENERAL DESIGN AND EVAPORATIVE ZONE DATA
                 ----------------------------------------

     NOTE:  SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT
            SOIL DATA BASE USING SOIL TEXTURE #22 WITH A
            POOR STAND OF GRASS, A SURFACE SLOPE OF  2.%
            AND A SLOPE LENGTH OF 1200. FEET.

     SCS RUNOFF CURVE NUMBER              =     93.10
     FRACTION OF AREA ALLOWING RUNOFF     =    100.0    PERCENT
     AREA PROJECTED ON HORIZONTAL PLANE   =      1.000  ACRES
     EVAPORATIVE ZONE DEPTH               =     24.0    INCHES
     INITIAL WATER IN EVAPORATIVE ZONE    =      5.269  INCHES
     UPPER LIMIT OF EVAPORATIVE STORAGE   =     12.348  INCHES
     LOWER LIMIT OF EVAPORATIVE STORAGE   =      3.084  INCHES
     INITIAL SNOW WATER                   =      0.000  INCHES
     INITIAL WATER IN LAYER MATERIALS     =    592.829  INCHES
     TOTAL INITIAL WATER                  =    592.829  INCHES
     TOTAL SUBSURFACE INFLOW              =      0.00   INCHES/YEAR


                 EVAPOTRANSPIRATION AND WEATHER DATA
                 -----------------------------------

     NOTE:  EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
            ALBANY                    NEW YORK

         STATION LATITUDE                      =  42.45 DEGREES
         MAXIMUM LEAF AREA INDEX               =   3.50
         START OF GROWING SEASON (JULIAN DATE) =    123
         END OF GROWING SEASON (JULIAN DATE)   =    282
         EVAPORATIVE ZONE DEPTH                =  24.0  INCHES
         AVERAGE ANNUAL WIND SPEED             =   8.90 MPH
         AVERAGE 1ST QUARTER RELATIVE HUMIDITY =  68.00 %
         AVERAGE 2ND QUARTER RELATIVE HUMIDITY =  66.00 %
         AVERAGE 3RD QUARTER RELATIVE HUMIDITY =  74.00 %
         AVERAGE 4TH QUARTER RELATIVE HUMIDITY =  74.00 %

     NOTE:  PRECIPITATION DATA FOR      CHERRY ISLAND LF
            WAS ENTERED BY THE USER.


                                   LAYER  2
                                   --------

                 TYPE 1 - VERTICAL PERCOLATION LAYER
                     MATERIAL TEXTURE NUMBER   0
       THICKNESS                    =   1920.00   INCHES
       POROSITY                     =      0.6100 VOL/VOL
       FIELD CAPACITY               =      0.2920 VOL/VOL
       WILTING POINT                =      0.0770 VOL/VOL
       INITIAL SOIL WATER CONTENT   =      0.0770 VOL/VOL
       EFFECTIVE SAT. HYD. COND.    =  0.100000005000E-02 CM/SEC


                                   LAYER  3
                                   --------

                 TYPE 2 - LATERAL DRAINAGE LAYER
                     MATERIAL TEXTURE NUMBER  22
       THICKNESS                    =     24.00   INCHES
       POROSITY                     =      0.4190 VOL/VOL
       FIELD CAPACITY               =      0.3070 VOL/VOL
       WILTING POINT                =      0.1800 VOL/VOL
       INITIAL SOIL WATER CONTENT   =      0.3621 VOL/VOL
       EFFECTIVE SAT. HYD. COND.    =  0.189999992000E-04 CM/SEC
       SLOPE                        =     50.00   PERCENT
       DRAINAGE LENGTH              =     75.0    FEET


                                   LAYER  4
                                   --------

                 TYPE 4 - FLEXIBLE MEMBRANE LINER
                     MATERIAL TEXTURE NUMBER  35
       THICKNESS                    =      0.06   INCHES
       POROSITY                     =      0.0000 VOL/VOL
       FIELD CAPACITY               =      0.0000 VOL/VOL
       WILTING POINT                =      0.0000 VOL/VOL
       INITIAL SOIL WATER CONTENT   =      0.0000 VOL/VOL
       EFFECTIVE SAT. HYD. COND.    =  0.199999996000E-12 CM/SEC
       FML PINHOLE DENSITY          =      1.00   HOLES/ACRE
       FML INSTALLATION DEFECTS     =      1.00   HOLES/ACRE
       FML PLACEMENT QUALITY        =  4 - POOR


                                   LAYER  5
                                   --------


     NOTE:  TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING
            COEFFICIENTS FOR    WILMINGTON          DELAWARE

          NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

       JAN/JUL    FEB/AUG    MAR/SEP    APR/OCT    MAY/NOV    JUN/DEC
       -------    -------    -------    -------    -------    -------
       31.20      33.20      41.80      52.40      62.20      71.20
       76.00      74.80      67.80      56.30      45.60      35.50

     NOTE:  SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
            COEFFICIENTS FOR    WILMINGTON          DELAWARE
              AND STATION LATITUDE  =  39.80 DEGREES


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                 MONTHLY TOTALS (IN INCHES) FOR YEAR    1
------------------------------------------------------------------------------
                          JAN/JUL  FEB/AUG  MAR/SEP  APR/OCT  MAY/NOV  JUN/DEC
                          -------  -------  -------  -------  -------  -------
PRECIPITATION              1.07     1.39     4.15     2.02     1.86     5.95
                           2.42     5.10     3.84     3.78     1.81     7.26

RUNOFF                     0.095    0.001    0.577    0.031    0.038    0.439
                           0.088    0.761    1.492    0.644    0.157    1.816

EVAPOTRANSPIRATION         1.092    1.466    2.155    2.935    1.981    6.301
                           3.152    3.498    1.588    1.479    1.192    0.865

LATERAL DRAINAGE COLLECTED 0.1707   0.1539   0.1463   0.1209   0.1068   0.0882
  FROM LAYER  3            0.0779   0.0663   0.0548   0.0484   0.0400   0.0353

PERCOLATION/LEAKAGE THROUGH 0.0012  0.0011   0.0011   0.0009   0.0008   0.0007
  LAYER  5                 0.0006   0.0005   0.0004   0.0004   0.0003   0.0003

------------------------------------------------------------------------------
                 MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)
------------------------------------------------------------------------------

AVERAGE DAILY HEAD ON      9.586    9.569    8.217    7.018    5.994    5.119
  TOP OF LAYER  4          4.372    3.725    3.181    2.716    2.320    1.981

STD. DEVIATION OF DAILY    1.103    0.407    0.386    0.319    0.282    0.233
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HEAD ON TOP OF LAYER 4	0.206	0.175	0.145	0.128	0.106	0.093

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ANNUAL TOTALS FOR YEAR 1

	INCHES	CU. FEET	PERCENT
PRECIPITATION	41.45	150463.469	100.00
RUNOFF	6.139	22283.998	14.81
EVAPOTRANSPIRATION	27.705	100567.484	66.84
DRAINAGE COLLECTED FROM LAYER 3	1.1096	4027.711	2.68
PERC./LEAKAGE THROUGH LAYER 5	0.008413	30.539	0.02
AVG. HEAD ON TOP OF LAYER 4	5.3166		
CHANGE IN WATER STORAGE	6.489	23554.012	15.65
SOIL WATER AT START OF YEAR	592.829	2151968.250	
SOIL WATER AT END OF YEAR	599.317	2175522.250	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	-0.0001	-0.267	0.00

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MONTHLY TOTALS (IN INCHES) FOR YEAR 2

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	2.12	4.54	4.19	4.19	7.87	5.80
	2.92	0.75	7.04	2.82	1.75	0.61
RUNOFF	0.337	1.022	3.785	0.176	1.729	1.012
	0.383	0.005	2.549	0.665	0.023	0.000
EVAPOTRANSPIRATION	0.723	0.498	1.731	3.957	4.502	6.707
	3.485	0.390	1.435	1.916	1.297	0.587
LATERAL DRAINAGE COLLECTED FROM LAYER 3	0.0301	0.0233	0.0221	0.0183	0.0161	0.0133
	0.0118	0.0100	0.0083	0.0073	0.0060	0.0053
PERCOLATION/LEAKAGE THROUGH LAYER 5	0.0003	0.0002	0.0002	0.0002	0.0001	0.0001
	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 4	1.687	1.448	1.243	1.062	0.906	0.774
	0.661	0.563	0.481	0.410	0.350	0.299
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 4	0.079	0.062	0.059	0.048	0.043	0.035
	0.031	0.027	0.022	0.019	0.016	0.014

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ANNUAL TOTALS FOR YEAR 2

	INCHES	CU. FEET	PERCENT
PRECIPITATION	44.60	161897.969	100.00
RUNOFF	11.685	42417.039	26.20
EVAPOTRANSPIRATION	27.228	98839.391	61.05
DRAINAGE COLLECTED FROM LAYER 3	0.1720	624.386	0.39
PERC./LEAKAGE THROUGH LAYER 5	0.001562	5.671	0.00
AVG. HEAD ON TOP OF LAYER 4	0.8237		
CHANGE IN WATER STORAGE	5.513	20011.527	12.36
SOIL WATER AT START OF YEAR	599.317	2175522.250	
SOIL WATER AT END OF YEAR	604.830	2195533.750	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	-0.044	0.00

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MONTHLY TOTALS (IN INCHES) FOR YEAR 3

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	7.06	1.11	2.48	2.14	2.69	7.65
	6.60	4.24	3.95	1.63	1.57	1.38
RUNOFF	2.786	0.003	0.009	0.057	0.477	1.445
	3.181	0.979	0.920	0.053	0.088	0.106
EVAPOTRANSPIRATION	0.690	1.503	2.295	2.863	2.854	6.305
	4.128	3.663	1.846	1.435	0.689	0.427
LATERAL DRAINAGE COLLECTED FROM LAYER 3	0.0045	0.0035	0.0033	0.0028	0.0024	0.0020
	0.0018	0.0015	0.0012	0.0011	0.0009	0.0008
PERCOLATION/LEAKAGE THROUGH LAYER 5	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 4	0.255	0.218	0.188	0.160	0.137	0.117
	0.100	0.085	0.072	0.062	0.053	0.045
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 4	0.012	0.009	0.009	0.007	0.006	0.005
	0.005	0.004	0.003	0.003	0.002	0.002

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ANNUAL TOTALS FOR YEAR 3

	INCHES	CU. FEET	PERCENT
PRECIPITATION	42.50	154274.984	100.00
RUNOFF	10.104	36679.020	23.78
EVAPOTRANSPIRATION	28.697	104170.680	67.52
DRAINAGE COLLECTED FROM LAYER 3	0.0259	94.130	0.06
PERC./LEAKAGE THROUGH LAYER 5	0.000284	1.029	0.00
AVG. HEAD ON TOP OF LAYER 4	0.1242		
CHANGE IN WATER STORAGE	3.672	13330.127	8.64
SOIL WATER AT START OF YEAR	604.830	2195533.750	
SOIL WATER AT END OF YEAR	608.488	2208812.500	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.014	51.515	0.03
ANNUAL WATER BUDGET BALANCE	0.0000	0.000	0.00

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MONTHLY TOTALS (IN INCHES) FOR YEAR 4

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	4.44	2.19	3.41	4.62	2.81	4.90
	3.62	4.51	2.34	4.37	3.12	1.74
RUNOFF	2.726	1.113	0.788	0.220	0.263	0.505
	0.094	0.882	0.138	1.072	0.380	0.039
EVAPOTRANSPIRATION	0.369	0.669	1.921	3.518	4.263	5.143
	3.467	4.122	1.283	1.332	0.841	0.712
LATERAL DRAINAGE COLLECTED FROM LAYER 3	0.0007	0.0005	0.0005	0.0004	0.0004	0.0003
	0.0003	0.0002	0.0002	0.0002	0.0001	0.0001
PERCOLATION/LEAKAGE THROUGH LAYER 5	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 4	0.038	0.033	0.028	0.024	0.020	0.017
	0.015	0.013	0.011	0.009	0.008	0.007
STD. DEVIATION OF DAILY	0.002	0.001	0.001	0.001	0.001	0.001

HEAD ON TOP OF LAYER 4	0.001	0.001	0.000	0.000	0.000	0.000

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ANNUAL TOTALS FOR YEAR 4

	INCHES	CU. FEET	PERCENT
PRECIPITATION	42.07	152714.141	100.00
RUNOFF	8.221	29843.949	19.54
EVAPOTRANSPIRATION	27.640	100332.555	65.70
DRAINAGE COLLECTED FROM LAYER 3	0.0039	14.146	0.01
PERC./LEAKAGE THROUGH LAYER 5	0.000053	0.193	0.00
AVG. HEAD ON TOP OF LAYER 4	0.0186		
CHANGE IN WATER STORAGE	6.205	22523.213	14.75
SOIL WATER AT START OF YEAR	608.488	2208812.500	
SOIL WATER AT END OF YEAR	614.707	2231387.250	
SNOW WATER AT START OF YEAR	0.014	51.515	0.03
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.086	0.00

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MONTHLY TOTALS (IN INCHES) FOR YEAR 5

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	0.98	4.73	8.53	3.09	5.72	3.65
	5.57	8.02	7.27	4.94	3.35	3.28
RUNOFF	0.133	2.760	2.590	0.131	1.365	0.799
	0.850	1.906	2.660	2.396	0.334	0.216
EVAPOTRANSPIRATION	0.596	0.573	2.376	3.493	4.680	3.663
	5.703	4.535	3.263	1.387	1.287	0.835
LATERAL DRAINAGE COLLECTED FROM LAYER 3	0.0001	0.0001	0.0001	0.0001	0.0001	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
PERCOLATION/LEAKAGE THROUGH LAYER 5	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 4	0.006	0.005	0.004	0.004	0.003	0.003
	0.002	0.002	0.002	0.001	0.001	0.001
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 4	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000

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ANNUAL TOTALS FOR YEAR 5

	INCHES	CU. FEET	PERCENT
PRECIPITATION	59.13	214641.937	100.00
RUNOFF	16.140	58589.238	27.30
EVAPOTRANSPIRATION	32.391	117580.430	54.78
DRAINAGE COLLECTED FROM LAYER 3	0.0006	2.095	0.00
PERC./LEAKAGE THROUGH LAYER 5	0.000012	0.042	0.00
AVG. HEAD ON TOP OF LAYER 4	0.0028		
CHANGE IN WATER STORAGE	10.598	38470.156	17.92
SOIL WATER AT START OF YEAR	614.707	2231387.250	
SOIL WATER AT END OF YEAR	625.305	2269857.250	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	-0.032	0.00

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MONTHLY TOTALS (IN INCHES) FOR YEAR 6

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	3.86	2.45	4.12	3.55	4.92	5.49
	5.26	7.83	3.95	2.25	4.13	1.23
RUNOFF	0.327	2.079	0.743	0.340	0.839	0.945
	1.177	2.261	0.880	0.252	1.202	0.108
EVAPOTRANSPIRATION	0.695	0.997	2.723	3.955	3.285	6.703
	4.321	4.933	2.883	1.023	0.824	0.511
LATERAL DRAINAGE COLLECTED FROM LAYER 3	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
PERCOLATION/LEAKAGE THROUGH LAYER 5	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 4	0.001	0.001	0.001	0.001	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 4	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000

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ANNUAL TOTALS FOR YEAR 6

	INCHES	CU. FEET	PERCENT
PRECIPITATION	49.04	178015.187	100.00
RUNOFF	11.153	40483.594	22.74
EVAPOTRANSPIRATION	32.855	119262.039	67.00
DRAINAGE COLLECTED FROM LAYER 3	0.0001	0.304	0.00
PERC./LEAKAGE THROUGH LAYER 5	0.000004	0.015	0.00
AVG. HEAD ON TOP OF LAYER 4	0.0004		
CHANGE IN WATER STORAGE	5.033	18269.197	10.26
SOIL WATER AT START OF YEAR	625.305	2269857.250	
SOIL WATER AT END OF YEAR	630.338	2288126.500	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.038	0.00

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MONTHLY TOTALS (IN INCHES) FOR YEAR 7

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	4.59	1.40	5.75	4.02	1.74	2.86
	1.55	5.61	5.53	1.83	7.03	4.38
RUNOFF	1.944	0.802	1.245	0.269	0.031	0.610
	0.009	1.265	1.701	0.438	2.049	1.403
EVAPOTRANSPIRATION	0.766	0.316	1.594	3.708	3.106	3.802
	1.548	4.181	1.916	1.522	1.198	0.814
LATERAL DRAINAGE COLLECTED FROM LAYER 3	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
PERCOLATION/LEAKAGE THROUGH LAYER 5	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 4	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000
STD. DEVIATION OF DAILY	0.000	0.000	0.000	0.000	0.000	0.000

HEAD ON TOP OF LAYER 4	0.000	0.000	0.000	0.000	0.000	0.000

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ANNUAL TOTALS FOR YEAR 7

	INCHES	CU. FEET	PERCENT
PRECIPITATION	46.29	168032.703	100.00
RUNOFF	11.764	42704.168	25.41
EVAPOTRANSPIRATION	24.471	88829.359	52.86
DRAINAGE COLLECTED FROM LAYER 3	0.0000	0.037	0.00
PERC./LEAKAGE THROUGH LAYER 5	0.000003	0.010	0.00
AVG. HEAD ON TOP OF LAYER 4	0.0000		
CHANGE IN WATER STORAGE	10.055	36499.180	21.72
SOIL WATER AT START OF YEAR	630.338	2288126.500	
SOIL WATER AT END OF YEAR	640.393	2324625.750	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	-0.051	0.00

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MONTHLY TOTALS (IN INCHES) FOR YEAR 8

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	5.72	2.50	3.55	6.62	2.47	3.30
	1.89	4.41	1.64	3.14	2.70	3.30
RUNOFF	1.759	0.688	0.446	1.820	0.029	0.442
	0.179	0.857	0.138	0.599	0.654	0.559
EVAPOTRANSPIRATION	1.216	1.661	2.692	4.385	3.188	4.667
	1.539	3.809	1.536	1.138	0.871	0.460
LATERAL DRAINAGE COLLECTED FROM LAYER 3	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
PERCOLATION/LEAKAGE THROUGH LAYER 5	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 4	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 4	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000

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ANNUAL TOTALS FOR YEAR 8

	INCHES	CU. FEET	PERCENT
PRECIPITATION	41.24	149701.187	100.00
RUNOFF	8.169	29654.473	19.81
EVAPOTRANSPIRATION	27.161	98594.859	65.86
DRAINAGE COLLECTED FROM LAYER 3	0.0000	0.001	0.00
PERC./LEAKAGE THROUGH LAYER 5	0.000001	0.003	0.00
AVG. HEAD ON TOP OF LAYER 4	0.0000		
CHANGE IN WATER STORAGE	5.910	21451.873	14.33
SOIL WATER AT START OF YEAR	640.393	2324625.750	
SOIL WATER AT END OF YEAR	646.302	2346077.500	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	-0.014	0.00

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MONTHLY TOTALS (IN INCHES) FOR YEAR 9

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	4.63	2.81	2.61	4.64	3.92	5.10
	5.22	6.98	10.80	0.60	4.39	3.09
RUNOFF	2.828	2.240	0.612	0.613	0.132	0.846
	1.666	2.141	4.366	0.018	0.420	0.651
EVAPOTRANSPIRATION	0.399	0.192	1.613	3.944	4.339	5.133
	3.647	4.345	3.169	1.601	1.170	0.623
LATERAL DRAINAGE COLLECTED FROM LAYER 3	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
PERCOLATION/LEAKAGE THROUGH LAYER 5	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 4	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 4	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000

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ANNUAL TOTALS FOR YEAR 9

	INCHES	CU. FEET	PERCENT
PRECIPITATION	54.79	198887.719	100.00
RUNOFF	16.532	60010.840	30.17
EVAPOTRANSPIRATION	30.175	109536.453	55.07
DRAINAGE COLLECTED FROM LAYER 3	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 5	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 4	0.0000		
CHANGE IN WATER STORAGE	8.083	29340.297	14.75
SOIL WATER AT START OF YEAR	646.302	2346077.500	
SOIL WATER AT END OF YEAR	654.089	2374342.250	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.296	1075.748	0.54
ANNUAL WATER BUDGET BALANCE	0.0000	0.129	0.00

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MONTHLY TOTALS (IN INCHES) FOR YEAR 10

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	3.98	2.12	4.68	3.52	3.38	4.46
	6.20	5.67	11.97	7.03	2.02	2.41
RUNOFF	2.512	1.409	1.382	0.471	0.110	0.557
	2.408	1.455	6.389	2.106	0.061	0.167
EVAPOTRANSPIRATION	0.475	0.417	2.738	3.000	3.158	6.169
	3.085	3.928	2.535	1.719	1.062	0.583
LATERAL DRAINAGE COLLECTED FROM LAYER 3	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
PERCOLATION/LEAKAGE THROUGH LAYER 5	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 4	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000
STD. DEVIATION OF DAILY	0.000	0.000	0.000	0.000	0.000	0.000

HEAD ON TOP OF LAYER 4	0.000	0.000	0.000	0.000	0.000	0.000

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ANNUAL TOTALS FOR YEAR 10

	INCHES	CU. FEET	PERCENT
PRECIPITATION	57.44	208507.234	100.00
RUNOFF	19.027	69066.852	33.12
EVAPOTRANSPIRATION	28.870	104798.945	50.26
DRAINAGE COLLECTED FROM LAYER 3	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 5	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 4	0.0000		
CHANGE IN WATER STORAGE	9.543	34641.332	16.61
SOIL WATER AT START OF YEAR	654.089	2374342.250	
SOIL WATER AT END OF YEAR	663.928	2410059.250	
SNOW WATER AT START OF YEAR	0.296	1075.748	0.52
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.106	0.00

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MONTHLY TOTALS (IN INCHES) FOR YEAR 11

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	3.93	3.22	3.86	2.79	1.90	6.67
	10.86	3.62	1.46	1.67	2.93	2.27
RUNOFF	2.682	1.434	0.499	0.307	0.093	0.986
	3.871	0.526	0.217	0.159	0.498	0.353
EVAPOTRANSPIRATION	0.152	0.758	2.953	3.862	2.045	6.084
	6.811	4.078	0.705	1.234	0.764	0.503
LATERAL DRAINAGE COLLECTED FROM LAYER 3	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
PERCOLATION/LEAKAGE THROUGH LAYER 5	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 4	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 4	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000

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MONTHLY TOTALS (IN INCHES) FOR YEAR 12

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	8.05	2.10	8.59	9.03	4.39	8.03
	5.35	3.72	2.36	6.26	5.12	5.83
RUNOFF	0.436	3.049	8.575	3.208	0.547	2.506
	1.712	0.574	0.455	2.480	1.866	1.370
EVAPOTRANSPIRATION	0.693	0.450	1.951	4.034	5.292	7.422
	3.646	3.146	0.754	1.114	1.104	0.809
LATERAL DRAINAGE COLLECTED FROM LAYER 3	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
PERCOLATION/LEAKAGE THROUGH LAYER 5	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 4	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 4	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000

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ANNUAL TOTALS FOR YEAR 12

	INCHES	CU. FEET	PERCENT
PRECIPITATION	68.83	249852.844	100.00
RUNOFF	26.778	97205.555	38.91
EVAPOTRANSPIRATION	30.414	110404.172	44.19
DRAINAGE COLLECTED FROM LAYER 3	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 5	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 4	0.0000		
CHANGE IN WATER STORAGE	11.637	42243.137	16.91
SOIL WATER AT START OF YEAR	667.533	2423145.250	
SOIL WATER AT END OF YEAR	677.129	2457977.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	2.042	7411.400	2.97
ANNUAL WATER BUDGET BALANCE	0.0000	-0.007	0.00

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MONTHLY TOTALS (IN INCHES) FOR YEAR 13

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	2.02	1.24	5.86	2.65	2.08	1.82
	3.99	0.38	6.34	6.41	1.89	4.28
RUNOFF	0.692	0.523	1.699	0.262	0.019	0.193
	1.401	0.000	1.821	3.027	0.095	0.857
EVAPOTRANSPIRATION	0.550	0.240	2.354	3.218	2.230	3.507
	2.589	0.380	2.126	1.840	1.181	0.768
LATERAL DRAINAGE COLLECTED FROM LAYER 3	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
PERCOLATION/LEAKAGE THROUGH LAYER 5	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 4	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000
STD. DEVIATION OF DAILY	0.000	0.000	0.000	0.000	0.000	0.000

HEAD ON TOP OF LAYER 4	0.000	0.000	0.000	0.000	0.000	0.000

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ANNUAL TOTALS FOR YEAR 13

	INCHES	CU. FEET	PERCENT
PRECIPITATION	38.96	141424.828	100.00
RUNOFF	10.589	38439.430	27.18
EVAPOTRANSPIRATION	20.982	76165.945	53.86
DRAINAGE COLLECTED FROM LAYER 3	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 5	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 4	0.0000		
CHANGE IN WATER STORAGE	7.388	26819.449	18.96
SOIL WATER AT START OF YEAR	677.129	2457977.000	
SOIL WATER AT END OF YEAR	685.840	2489599.250	
SNOW WATER AT START OF YEAR	2.042	7411.400	5.24
SNOW WATER AT END OF YEAR	0.719	2608.595	1.84
ANNUAL WATER BUDGET BALANCE	0.0000	-0.003	0.00

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MONTHLY TOTALS (IN INCHES) FOR YEAR 14

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	1.68	0.64	4.01	4.21	3.90	3.86
	2.56	1.74	2.98	2.88	1.21	8.76
RUNOFF	0.046	0.630	0.512	0.384	0.213	0.364
	0.344	0.150	0.205	0.143	0.076	3.412
EVAPOTRANSPIRATION	0.658	0.321	2.773	4.338	3.226	5.094
	2.987	1.493	2.264	1.616	0.762	0.617
LATERAL DRAINAGE COLLECTED FROM LAYER 3	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
PERCOLATION/LEAKAGE THROUGH LAYER 5	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 4	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 4	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000

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ANNUAL TOTALS FOR YEAR 14

	INCHES	CU. FEET	PERCENT
PRECIPITATION	38.43	139500.906	100.00
RUNOFF	6.480	23520.609	16.86
EVAPOTRANSPIRATION	26.150	94923.398	68.05
DRAINAGE COLLECTED FROM LAYER 3	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 5	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 4	0.0000		
CHANGE IN WATER STORAGE	5.801	21056.867	15.09
SOIL WATER AT START OF YEAR	685.840	2489599.250	
SOIL WATER AT END OF YEAR	690.817	2507666.000	
SNOW WATER AT START OF YEAR	0.719	2608.595	1.87
SNOW WATER AT END OF YEAR	1.542	5598.767	4.01
ANNUAL WATER BUDGET BALANCE	0.0000	0.026	0.00

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MONTHLY TOTALS (IN INCHES) FOR YEAR 15

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	0.95	4.60	4.04	0.69	3.91	2.40
	2.68	12.91	4.59	3.00	3.10	4.24
RUNOFF	0.756	3.549	1.093	0.000	1.501	0.364
	0.227	6.362	1.216	0.451	0.612	0.196
EVAPOTRANSPIRATION	0.627	0.524	2.292	1.757	1.861	4.181
	2.454	5.616	2.975	1.405	0.777	0.460
LATERAL DRAINAGE COLLECTED FROM LAYER 3	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
PERCOLATION/LEAKAGE THROUGH LAYER 5	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 4	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 4	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000

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ANNUAL TOTALS FOR YEAR 15

	INCHES	CU. FEET	PERCENT
PRECIPITATION	47.11	171009.375	100.00
RUNOFF	16.327	59265.539	34.66
EVAPOTRANSPIRATION	24.929	90491.781	52.92
DRAINAGE COLLECTED FROM LAYER 3	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 5	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 4	0.0000		
CHANGE IN WATER STORAGE	5.855	21251.996	12.43
SOIL WATER AT START OF YEAR	690.817	2507666.000	
SOIL WATER AT END OF YEAR	696.062	2526706.000	
SNOW WATER AT START OF YEAR	1.542	5598.767	3.27
SNOW WATER AT END OF YEAR	2.152	7810.766	4.57
ANNUAL WATER BUDGET BALANCE	0.0000	0.054	0.00

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MONTHLY TOTALS (IN INCHES) FOR YEAR 16

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	3.42	2.71	4.10	3.22	1.44	4.36
	5.56	3.22	3.06	0.90	2.77	3.04
RUNOFF	1.533	1.711	0.993	0.297	0.037	0.750
	0.959	0.399	0.334	0.132	0.283	0.231
EVAPOTRANSPIRATION	0.649	0.356	2.176	4.061	2.249	4.714
	3.578	4.229	1.231	1.112	0.715	0.488
LATERAL DRAINAGE COLLECTED FROM LAYER 3	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
PERCOLATION/LEAKAGE THROUGH LAYER 5	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 4	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000
STD. DEVIATION OF DAILY	0.000	0.000	0.000	0.000	0.000	0.000

HEAD ON TOP OF LAYER 4	0.000	0.000	0.000	0.000	0.000	0.000

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ANNUAL TOTALS FOR YEAR 16

	INCHES	CU. FEET	PERCENT
PRECIPITATION	37.80	137213.984	100.00
RUNOFF	7.659	27802.449	20.26
EVAPOTRANSPIRATION	25.558	92773.930	67.61
DRAINAGE COLLECTED FROM LAYER 3	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 5	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 4	0.0000		
CHANGE IN WATER STORAGE	4.583	16637.676	12.13
SOIL WATER AT START OF YEAR	696.062	2526706.000	
SOIL WATER AT END OF YEAR	702.797	2551154.500	
SNOW WATER AT START OF YEAR	2.152	7810.766	5.69
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	-0.070	0.00

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MONTHLY TOTALS (IN INCHES) FOR YEAR 17

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	0.66	1.49	3.09	2.64	1.65	2.73
	2.67	1.56	3.30	2.64	5.00	1.38
RUNOFF	0.000	0.472	0.473	0.018	0.022	0.232
	0.235	0.004	0.189	0.380	1.105	0.018
EVAPOTRANSPIRATION	0.680	0.382	2.418	2.419	2.109	4.551
	2.301	1.426	2.747	1.613	0.920	0.645
LATERAL DRAINAGE COLLECTED FROM LAYER 3	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
PERCOLATION/LEAKAGE THROUGH LAYER 5	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 4	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 4	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000

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ANNUAL TOTALS FOR YEAR 17

	INCHES	CU. FEET	PERCENT
PRECIPITATION	28.81	104580.328	100.00
RUNOFF	3.148	11425.474	10.93
EVAPOTRANSPIRATION	22.210	80621.289	77.09
DRAINAGE COLLECTED FROM LAYER 3	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 5	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 4	0.0000		
CHANGE IN WATER STORAGE	3.453	12533.515	11.98
SOIL WATER AT START OF YEAR	702.797	2551154.500	
SOIL WATER AT END OF YEAR	706.250	2563688.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.052	0.00

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MONTHLY TOTALS (IN INCHES) FOR YEAR 18

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	1.87	1.39	4.15	2.02	1.86	5.95
	2.42	5.10	3.84	3.78	1.81	7.26
RUNOFF	0.106	0.139	2.006	0.028	0.034	0.471
	0.088	0.738	1.507	0.657	0.164	2.034
EVAPOTRANSPIRATION	0.967	0.595	1.893	2.788	1.925	6.364
	3.337	3.493	1.579	1.463	1.101	0.655
LATERAL DRAINAGE COLLECTED FROM LAYER 3	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
PERCOLATION/LEAKAGE THROUGH LAYER 5	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 4	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 4	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000

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ANNUAL TOTALS FOR YEAR 18

	INCHES	CU. FEET	PERCENT
PRECIPITATION	41.45	150463.469	100.00
RUNOFF	7.971	28933.273	19.23
EVAPOTRANSPIRATION	26.160	94962.250	63.11
DRAINAGE COLLECTED FROM LAYER 3	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 5	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 4	0.0000		
CHANGE IN WATER STORAGE	7.319	26567.859	17.66
SOIL WATER AT START OF YEAR	706.250	2563688.000	
SOIL WATER AT END OF YEAR	713.569	2590255.750	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.088	0.00

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MONTHLY TOTALS (IN INCHES) FOR YEAR 19

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	2.12	4.54	4.19	4.19	7.87	5.80
	2.92	0.75	7.04	2.82	1.75	0.61
RUNOFF	0.403	1.156	2.459	0.190	1.733	1.001
	0.388	0.005	2.515	0.661	0.030	0.000
EVAPOTRANSPIRATION	0.807	0.664	1.740	4.066	4.564	6.615
	3.334	0.357	1.542	1.781	1.228	0.749
LATERAL DRAINAGE COLLECTED FROM LAYER 3	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
PERCOLATION/LEAKAGE THROUGH LAYER 5	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 4	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000
STD. DEVIATION OF DAILY	0.000	0.000	0.000	0.000	0.000	0.000

HEAD ON TOP OF LAYER 4	0.000	0.000	0.000	0.000	0.000	0.000

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ANNUAL TOTALS FOR YEAR 19

	INCHES	CU. FEET	PERCENT
PRECIPITATION	44.60	161897.969	100.00
RUNOFF	10.540	38260.137	23.63
EVAPOTRANSPIRATION	27.447	99633.500	61.54
DRAINAGE COLLECTED FROM LAYER 3	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 5	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 4	0.0000		
CHANGE IN WATER STORAGE	6.613	24004.437	14.83
SOIL WATER AT START OF YEAR	713.569	2590255.750	
SOIL WATER AT END OF YEAR	720.182	2614260.250	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	-0.107	0.00

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MONTHLY TOTALS (IN INCHES) FOR YEAR 20

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	7.06	1.11	2.48	2.14	2.69	7.65
	6.60	4.40	3.85	1.57	1.57	1.38
RUNOFF	4.385	0.002	0.491	0.062	0.448	1.478
	3.148	0.977	0.921	0.061	0.100	0.064
EVAPOTRANSPIRATION	0.546	1.403	0.939	2.937	2.861	6.820
	4.041	3.489	1.649	1.429	0.595	0.578
LATERAL DRAINAGE COLLECTED FROM LAYER 3	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
PERCOLATION/LEAKAGE THROUGH LAYER 5	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 4	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 4	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000

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ANNUAL TOTALS FOR YEAR 20

	INCHES	CU. FEET	PERCENT
PRECIPITATION	42.50	154274.984	100.00
RUNOFF	12.138	44061.629	28.56
EVAPOTRANSPIRATION	27.290	99064.391	64.21
DRAINAGE COLLECTED FROM LAYER 3	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 5	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 4	0.0000		
CRANGE IN WATER STORAGE	3.071	11148.779	7.23
SOIL WATER AT START OF YEAR	720.182	2614260.250	
SOIL WATER AT END OF YEAR	723.253	2625409.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0001	0.183	0.00

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MONTHLY TOTALS (IN INCHES) FOR YEAR 21

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	4.44	2.19	3.41	4.62	2.81	4.90
	3.62	4.51	2.28	4.43	3.12	1.74
RUNOFF	0.717	1.766	1.049	0.201	0.233	0.500
	0.094	0.881	0.139	1.064	0.378	0.036
EVAPOTRANSPIRATION	0.946	0.399	2.172	3.447	4.393	4.896
	3.593	4.305	1.252	1.438	0.903	0.740
LATERAL DRAINAGE COLLECTED FROM LAYER 3	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
PERCOLATION/LEAKAGE THROUGH LAYER 5	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 4	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 4	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000

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ANNUAL TOTALS FOR YEAR 21

	INCHES	CU. FEET	PERCENT
PRECIPITATION	42.07	152714.141	100.00
RUNOFF	7.059	25623.549	16.78
EVAPOTRANSPIRATION	28.485	103399.289	67.71
DRAINAGE COLLECTED FROM LAYER 3	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 5	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 4	0.0000		
CHANGE IN WATER STORAGE	6.527	23691.377	15.51
SOIL WATER AT START OF YEAR	723.253	2625409.000	
SOIL WATER AT END OF YEAR	729.780	2649100.500	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	-0.078	0.00

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MONTHLY TOTALS (IN INCHES) FOR YEAR 22

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	0.98	4.73	8.53	3.09	5.72	3.65
	5.57	8.02	7.27	4.94	3.35	3.28
RUNOFF	0.010	3.089	3.430	0.125	1.363	0.797
	0.872	1.915	2.550	2.397	0.335	0.067
EVAPOTRANSPIRATION	0.897	0.432	2.231	3.806	4.535	3.308
	5.705	4.526	3.523	1.450	1.151	0.582
LATERAL DRAINAGE COLLECTED FROM LAYER 3	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
PERCOLATION/LEAKAGE THROUGH LAYER 5	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 4	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000
STD. DEVIATION OF DAILY	0.000	0.000	0.000	0.000	0.000	0.000

HEAD ON TOP OF LAYER 4	0.000	0.000	0.000	0.000	0.000	0.000

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ANNUAL TOTALS FOR YEAR 22

	INCHES	CU. FEET	PERCENT
PRECIPITATION	59.13	214641.937	100.00
RUNOFF	16.949	61524.535	28.66
EVAPOTRANSPIRATION	32.146	116689.578	54.36
DRAINAGE COLLECTED FROM LAYER 3	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 5	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 4	0.0000		
CHANGE IN WATER STORAGE	10.035	36427.848	16.97
SOIL WATER AT START OF YEAR	729.780	2649100.500	
SOIL WATER AT END OF YEAR	739.394	2684001.250	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.421	1526.985	0.71
ANNUAL WATER BUDGET BALANCE	0.0000	-0.031	0.00

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MONTHLY TOTALS (IN INCHES) FOR YEAR 23

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	3.86	2.45	4.12	3.55	4.92	5.49
	5.26	7.83	3.95	2.25	4.13	1.23
RUNOFF	2.816	0.321	0.736	0.361	0.816	0.942
	1.198	2.258	0.875	0.247	1.193	0.108
EVAPOTRANSPIRATION	0.505	1.229	2.797	3.775	3.254	6.675
	4.306	4.987	3.249	1.196	0.788	0.525
LATERAL DRAINAGE COLLECTED	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
FROM LAYER 3	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
PERCOLATION/LEAKAGE THROUGH	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
LAYER 5	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON	0.000	0.000	0.000	0.000	0.000	0.000
TOP OF LAYER 4	0.000	0.000	0.000	0.000	0.000	0.000
STD. DEVIATION OF DAILY	0.000	0.000	0.000	0.000	0.000	0.000
HEAD ON TOP OF LAYER 4	0.000	0.000	0.000	0.000	0.000	0.000

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ANNUAL TOTALS FOR YEAR 23

	INCHES	CU. FEET	PERCENT
PRECIPITATION	49.04	178015.187	100.00
RUNOFF	11.871	43092.879	24.21
EVAPOTRANSPIRATION	33.288	120834.461	67.88
DRAINAGE COLLECTED FROM LAYER 3	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 5	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 4	0.0000		
CHANGE IN WATER STORAGE	3.881	14087.952	7.91
SOIL WATER AT START OF YEAR	739.394	2684001.250	
SOIL WATER AT END OF YEAR	743.696	2699616.250	
SNOW WATER AT START OF YEAR	0.421	1526.985	0.86
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	-0.107	0.00

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MONTHLY TOTALS (IN INCHES) FOR YEAR 24

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	4.59	1.40	6.05	3.72	1.78	2.82
	2.29	5.56	4.84	1.83	7.03	4.79
RUNOFF	0.202	1.845	2.226	0.225	0.031	0.610
	0.069	1.252	1.659	0.439	2.086	1.367
EVAPOTRANSPIRATION	0.678	0.437	2.229	3.449	2.855	3.817
	1.649	4.152	1.881	1.511	1.167	0.788
LATERAL DRAINAGE COLLECTED	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
FROM LAYER 3	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
PERCOLATION/LEAKAGE THROUGH	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
LAYER 5	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON	0.000	0.000	0.000	0.000	0.000	0.000
TOP OF LAYER 4	0.000	0.000	0.000	0.000	0.000	0.000
STD. DEVIATION OF DAILY	0.000	0.000	0.000	0.000	0.000	0.000
HEAD ON TOP OF LAYER 4	0.000	0.000	0.000	0.000	0.000	0.000

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ANNUAL TOTALS FOR YEAR 24

	INCHES	CU. FEET	PERCENT
PRECIPITATION	46.70	169521.000	100.00
RUNOFF	12.009	43591.117	25.71
EVAPOTRANSPIRATION	24.611	89338.828	52.70
DRAINAGE COLLECTED FROM LAYER 3	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 5	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 4	0.0000		
CHANGE IN WATER STORAGE	10.080	36590.906	21.58
SOIL WATER AT START OF YEAR	743.696	2699616.250	
SOIL WATER AT END OF YEAR	753.776	2736207.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.149	0.00

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MONTHLY TOTALS (IN INCHES) FOR YEAR 25

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	5.72	2.50	3.55	6.62	2.37	3.40
	1.71	4.59	1.64	3.14	2.70	3.09
RUNOFF	1.819	1.641	0.505	1.880	0.032	0.443
	0.179	0.854	0.138	0.599	0.668	0.339
EVAPOTRANSPIRATION	0.865	0.283	2.307	4.292	2.959	4.702
	1.388	3.860	1.744	0.929	0.899	0.586
LATERAL DRAINAGE COLLECTED	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
FROM LAYER 3	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
PERCOLATION/LEAKAGE THROUGH	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
LAYER 5	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON	0.000	0.000	0.000	0.000	0.000	0.000
TOP OF LAYER 4	0.000	0.000	0.000	0.000	0.000	0.000
STD. DEVIATION OF DAILY	0.000	0.000	0.000	0.000	0.000	0.000

HEAD ON TOP OF LAYER 4	0.000	0.000	0.000	0.000	0.000	0.000

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ANNUAL TOTALS FOR YEAR 25

	INCHES	CU. FEET	PERCENT
PRECIPITATION	41.03	148938.891	100.00
RUNOFF	9.099	33030.348	22.18
EVAPOTRANSPIRATION	24.813	90072.211	60.48
DRAINAGE COLLECTED FROM LAYER 3	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 5	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 4	0.0000		
CHANGE IN WATER STORAGE	7.117	25836.189	17.35
SOIL WATER AT START OF YEAR	753.776	2736207.000	
SOIL WATER AT END OF YEAR	760.376	2760165.750	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.517	1877.615	1.26
ANNUAL WATER BUDGET BALANCE	0.0000	0.145	0.00

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MONTHLY TOTALS (IN INCHES) FOR YEAR 26

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	4.63	2.81	2.61	4.64	3.92	5.10
	5.22	6.98	10.80	0.60	4.39	3.09
RUNOFF	2.142	3.506	0.064	0.546	0.137	0.818
	1.759	2.133	4.406	0.017	0.731	0.221
EVAPOTRANSPIRATION	0.385	1.056	2.618	4.154	4.082	5.127
	3.486	4.364	3.031	1.492	1.274	0.807
LATERAL DRAINAGE COLLECTED FROM LAYER 3	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
PERCOLATION/LEAKAGE THROUGH LAYER 5	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 4	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 4	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000

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ANNUAL TOTALS FOR YEAR 26

	INCHES	CU. FEET	PERCENT
PRECIPITATION	54.79	198887.719	100.00
RUNOFF	16.481	59826.156	30.08
EVAPOTRANSPIRATION	31.876	115708.234	58.18
DRAINAGE COLLECTED FROM LAYER 3	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 5	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 4	0.0000		
CHANGE IN WATER STORAGE	6.433	23353.367	11.74
SOIL WATER AT START OF YEAR	760.376	2760165.750	
SOIL WATER AT END OF YEAR	767.327	2785396.750	
SNOW WATER AT START OF YEAR	0.517	1877.615	0.94
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	-0.044	0.00

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MONTHLY TOTALS (IN INCHES) FOR YEAR 27

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	3.98	2.12	4.68	3.52	3.38	4.46
	6.20	5.67	11.97	7.03	2.02	2.41
RUNOFF	0.783	1.355	1.713	0.478	0.106	0.565
	2.394	1.452	6.423	2.116	0.014	0.169
EVAPOTRANSPIRATION	1.265	0.466	1.852	3.244	3.132	6.218
	3.092	4.101	2.385	1.759	1.118	1.073
LATERAL DRAINAGE COLLECTED FROM LAYER 3	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
PERCOLATION/LEAKAGE THROUGH LAYER 5	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 4	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 4	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000

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ANNUAL TOTALS FOR YEAR 27

	INCHES	CU. FEET	PERCENT
PRECIPITATION	57.44	208507.234	100.00
RUNOFF	17.569	63776.891	30.59
EVAPOTRANSPIRATION	29.705	107827.906	51.71
DRAINAGE COLLECTED FROM LAYER 3	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 5	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 4	0.0000		
CHANGE IN WATER STORAGE	10.166	36902.637	17.70
SOIL WATER AT START OF YEAR	767.327	2785396.750	
SOIL WATER AT END OF YEAR	777.493	2822299.250	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	-0.0001	-0.194	0.00

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MONTHLY TOTALS (IN INCHES) FOR YEAR 28

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	3.93	3.22	4.40	2.25	2.75	5.82
	10.86	3.65	1.43	1.67	2.93	2.27
RUNOFF	1.362	2.258	0.894	0.353	0.184	0.891
	3.824	0.531	0.217	0.158	0.496	0.080
EVAPOTRANSPIRATION	0.716	0.607	1.475	2.857	2.071	6.234
	7.000	3.898	0.815	1.164	0.617	0.531
LATERAL DRAINAGE COLLECTED FROM LAYER 3	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
PERCOLATION/LEAKAGE THROUGH LAYER 5	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 4	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000
STD. DEVIATION OF DAILY	0.000	0.000	0.000	0.000	0.000	0.000

HEAD ON TOP OF LAYER 4	0.000	0.000	0.000	0.000	0.000	0.000

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ANNUAL TOTALS FOR YEAR 28

	INCHES	CU. FEET	PERCENT
PRECIPITATION	45.18	164003.359	100.00
RUNOFF	11.248	40828.543	24.89
EVAPOTRANSPIRATION	27.986	101587.562	61.94
DRAINAGE COLLECTED FROM LAYER 3	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 5	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 4	0.0000		
CHANGE IN WATER STORAGE	5.947	21587.244	13.16
SOIL WATER AT START OF YEAR	777.493	2822299.250	
SOIL WATER AT END OF YEAR	783.440	2843886.500	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.010	0.00

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MONTHLY TOTALS (IN INCHES) FOR YEAR 29

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	8.05	2.10	8.59	7.13	6.01	8.31
	5.35	3.72	2.36	6.26	5.12	5.36
RUNOFF	2.880	3.263	3.073	2.395	1.398	2.508
	1.712	0.578	0.441	2.482	1.880	0.906
EVAPOTRANSPIRATION	0.661	0.567	2.436	3.642	5.227	7.283
	3.921	3.155	0.874	1.368	0.860	0.578
LATERAL DRAINAGE COLLECTED FROM LAYER 3	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
PERCOLATION/LEAKAGE THROUGH LAYER 5	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 4	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 4	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000

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ANNUAL TOTALS FOR YEAR 29

	INCHES	CU. FEET	PERCENT
PRECIPITATION	68.36	248146.750	100.00
RUNOFF	23.515	85359.914	34.40
EVAPOTRANSPIRATION	30.572	110976.586	44.72
DRAINAGE COLLECTED FROM LAYER 3	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 5	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 4	0.0000		
CHANGE IN WATER STORAGE	14.273	51810.121	20.88
SOIL WATER AT START OF YEAR	783.440	2843886.500	
SOIL WATER AT END OF YEAR	796.108	2889870.750	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	1.605	5825.835	2.35
ANNUAL WATER BUDGET BALANCE	0.0000	0.133	0.00

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MONTHLY TOTALS (IN INCHES) FOR YEAR 30

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	2.02	1.24	5.86	2.65	2.08	1.82
	3.99	0.38	6.34	6.41	1.89	4.28
RUNOFF	1.473	0.557	1.539	0.254	0.018	0.195
	1.413	0.000	1.818	3.011	0.077	0.815
EVAPOTRANSPIRATION	0.572	0.431	2.378	3.450	2.236	3.431
	2.577	0.380	2.108	1.974	1.168	1.045
LATERAL DRAINAGE COLLECTED FROM LAYER 3	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
PERCOLATION/LEAKAGE THROUGH LAYER 5	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 4	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 4	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000

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ANNUAL TOTALS FOR YEAR 30

	INCHES	CU. FEET	PERCENT
PRECIPITATION	38.96	141424.828	100.00
RUNOFF	11.170	40546.988	28.67
EVAPOTRANSPIRATION	21.750	78952.133	55.83
DRAINAGE COLLECTED FROM LAYER 3	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 5	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 4	0.0000		
CHANGE IN WATER STORAGE	6.040	21925.828	15.50
SOIL WATER AT START OF YEAR	796.108	2889870.750	
SOIL WATER AT END OF YEAR	803.318	2916046.000	
SNOW WATER AT START OF YEAR	1.605	5825.835	4.12
SNOW WATER AT END OF YEAR	0.434	1576.404	1.11
ANNUAL WATER BUDGET BALANCE	0.0000	-0.126	0.00

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MONTHLY TOTALS (IN INCHES) FOR YEAR 31

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	1.68	0.64	4.01	4.21	3.90	3.86
	2.56	1.74	2.98	2.88	1.21	8.76
RUNOFF	0.957	0.000	0.266	0.406	0.213	0.363
	0.343	0.151	0.204	0.149	0.072	3.624
EVAPOTRANSPIRATION	0.395	1.045	2.015	4.138	3.263	5.108
	3.004	1.572	2.158	1.552	0.886	0.774
LATERAL DRAINAGE COLLECTED FROM LAYER 3	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
PERCOLATION/LEAKAGE THROUGH LAYER 5	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 4	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000
STD. DEVIATION OF DAILY	0.000	0.000	0.000	0.000	0.000	0.000

HEAD ON TOP OF LAYER 4	0.000	0.000	0.000	0.000	0.000	0.000

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ANNUAL TOTALS FOR YEAR 31

	INCHES	CU. FEET	PERCENT
PRECIPITATION	38.43	139500.906	100.00
RUNOFF	6.749	24498.703	17.56
EVAPOTRANSPIRATION	25.910	94054.211	67.42
DRAINAGE COLLECTED FROM LAYER 3	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 5	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 4	0.0000		
CHANGE IN WATER STORAGE	5.771	20948.031	15.02
SOIL WATER AT START OF YEAR	803.318	2916046.000	
SOIL WATER AT END OF YEAR	809.524	2938570.500	
SNOW WATER AT START OF YEAR	0.434	1576.404	1.13
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	-0.045	0.00

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MONTHLY TOTALS (IN INCHES) FOR YEAR 32

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	0.95	4.60	4.09	0.64	3.91	2.40
	7.38	8.21	4.59	3.00	3.10	4.24
RUNOFF	0.009	2.373	1.180	0.000	1.508	0.365
	3.249	3.365	1.214	0.438	0.073	2.060
EVAPOTRANSPIRATION	0.771	0.645	2.224	1.744	1.967	4.028
	2.565	6.372	2.524	1.237	0.652	0.397
LATERAL DRAINAGE COLLECTED	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
FROM LAYER 3	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
PERCOLATION/LEAKAGE THROUGH	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
LAYER 5	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON	0.000	0.000	0.000	0.000	0.000	0.000
TOP OF LAYER 4	0.000	0.000	0.000	0.000	0.000	0.000
STD. DEVIATION OF DAILY	0.000	0.000	0.000	0.000	0.000	0.000
HEAD ON TOP OF LAYER 4	0.000	0.000	0.000	0.000	0.000	0.000

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ANNUAL TOTALS FOR YEAR 32

	INCHES	CU. FEET	PERCENT
PRECIPITATION	47.11	171009.375	100.00
RUNOFF	15.835	57481.516	33.61
EVAPOTRANSPIRATION	25.127	91209.945	53.34
DRAINAGE COLLECTED FROM LAYER 3	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 5	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 4	0.0000		
CHANGE IN WATER STORAGE	6.148	22317.840	13.05
SOIL WATER AT START OF YEAR	809.524	2938570.500	
SOIL WATER AT END OF YEAR	815.643	2960784.750	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.029	103.587	0.06
ANNUAL WATER BUDGET BALANCE	0.0000	0.067	0.00

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MONTHLY TOTALS (IN INCHES) FOR YEAR 33

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	3.42	2.71	4.10	3.03	1.63	4.32
	5.60	3.22	2.02	1.94	2.77	3.04
RUNOFF	0.841	0.312	0.620	0.311	0.037	0.748
	0.947	0.380	0.121	0.352	0.231	1.234
EVAPOTRANSPIRATION	0.870	1.309	2.163	3.656	2.657	4.484
	3.693	4.277	1.166	1.174	0.521	0.539
LATERAL DRAINAGE COLLECTED	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
FROM LAYER 3	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
PERCOLATION/LEAKAGE THROUGH	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
LAYER 5	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON	0.000	0.000	0.000	0.000	0.000	0.000
TOP OF LAYER 4	0.000	0.000	0.000	0.000	0.000	0.000
STD. DEVIATION OF DAILY	0.000	0.000	0.000	0.000	0.000	0.000
HEAD ON TOP OF LAYER 4	0.000	0.000	0.000	0.000	0.000	0.000

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ANNUAL TOTALS FOR YEAR 33

	INCHES	CU. FEET	PERCENT
PRECIPITATION	37.80	137213.984	100.00
RUNOFF	6.132	22260.344	16.22
EVAPOTRANSPIRATION	26.509	96227.945	70.13
DRAINAGE COLLECTED FROM LAYER 3	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 5	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 4	0.0000		
CHANGE IN WATER STORAGE	5.159	18725.709	13.65
SOIL WATER AT START OF YEAR	815.643	2960784.750	
SOIL WATER AT END OF YEAR	820.830	2979614.000	
SNOW WATER AT START OF YEAR	0.029	103.587	0.08
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	-0.012	0.00

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MONTHLY TOTALS (IN INCHES) FOR YEAR 34

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	0.66	1.49	3.09	2.64	1.65	2.73
	2.67	1.56	3.30	2.64	5.00	1.38
RUNOFF	0.014	0.223	0.099	0.011	0.022	0.223
	0.235	0.004	0.188	0.386	1.132	0.003
EVAPOTRANSPIRATION	0.534	0.994	2.314	2.656	2.411	4.332
	2.258	1.468	2.652	1.303	1.036	0.610
LATERAL DRAINAGE COLLECTED	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
FROM LAYER 3	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
PERCOLATION/LEAKAGE THROUGH	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
LAYER 5	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON	0.000	0.000	0.000	0.000	0.000	0.000
TOP OF LAYER 4	0.000	0.000	0.000	0.000	0.000	0.000
STD. DEVIATION OF DAILY	0.000	0.000	0.000	0.000	0.000	0.000

HEAD ON TOP OF LAYER 4	0.000	0.000	0.000	0.000	0.000	0.000

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ANNUAL TOTALS FOR YEAR 34

	INCHES	CU. FEET	PERCENT
PRECIPITATION	28.81	104580.328	100.00
RUNOFF	2.541	9224.780	8.82
EVAPOTRANSPIRATION	22.569	81926.859	78.34
DRAINAGE COLLECTED FROM LAYER 3	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 5	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 4	0.0000		
CHANGE IN WATER STORAGE	3.699	13428.607	12.84
SOIL WATER AT START OF YEAR	820.830	2979614.000	
SOIL WATER AT END OF YEAR	824.530	2993042.750	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.075	0.00

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MONTHLY TOTALS (IN INCHES) FOR YEAR 35

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	1.87	1.39	4.15	2.02	1.86	5.95
	2.42	5.10	3.84	3.78	1.81	7.26
RUNOFF	0.408	0.278	0.479	0.034	0.033	0.477
	0.088	0.747	1.528	0.650	0.180	3.354
EVAPOTRANSPIRATION	0.602	0.729	2.636	2.925	1.954	6.313
	3.313	3.463	1.558	1.485	0.928	0.440
LATERAL DRAINAGE COLLECTED FROM LAYER 3	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
PERCOLATION/LEAKAGE THROUGH LAYER 5	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 4	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 4	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000

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MONTHLY TOTALS (IN INCHES) FOR YEAR 36

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	2.12	4.54	4.19	4.19	8.03	5.64
	2.92	0.75	8.39	1.47	1.75	0.61
RUNOFF	0.626	1.574	1.161	0.193	1.721	1.022
	0.394	0.005	3.150	0.038	0.025	0.000
EVAPOTRANSPIRATION	1.019	0.897	2.733	4.351	4.527	7.213
	2.636	0.417	1.490	1.783	1.136	0.809
LATERAL DRAINAGE COLLECTED FROM LAYER 3	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
PERCOLATION/LEAKAGE THROUGH LAYER 5	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 4	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 4	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000

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ANNUAL TOTALS FOR YEAR 36

	INCHES	CU. FEET	PERCENT
PRECIPITATION	44.60	161897.969	100.00
RUNOFF	9.907	35960.906	22.21
EVAPOTRANSPIRATION	29.011	105308.906	65.05
DRAINAGE COLLECTED FROM LAYER 3	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 5	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 4	0.0000		
CHANGE IN WATER STORAGE	5.683	20628.121	12.74
SOIL WATER AT START OF YEAR	831.379	3017906.500	
SOIL WATER AT END OF YEAR	837.062	3038534.750	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.035	0.00

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MONTHLY TOTALS (IN INCHES) FOR YEAR 37

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	7.06	1.11	2.48	2.14	2.69	7.65
	6.60	4.24	3.95	1.63	1.57	1.38
RUNOFF	3.601	0.312	0.001	0.055	0.427	1.498
	3.182	0.987	0.922	0.059	0.082	0.064
EVAPOTRANSPIRATION	0.778	0.949	2.460	2.764	2.871	6.744
	3.887	3.555	1.612	1.521	0.760	0.532
LATERAL DRAINAGE COLLECTED FROM LAYER 3	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
PERCOLATION/LEAKAGE THROUGH LAYER 5	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 4	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000
STD. DEVIATION OF DAILY	0.000	0.000	0.000	0.000	0.000	0.000

HEAD ON TOP OF LAYER 4	0.000	0.000	0.000	0.000	0.000	0.000

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ANNUAL TOTALS FOR YEAR 37

	INCHES	CU. FEET	PERCENT
PRECIPITATION	42.50	154274.984	100.00
RUNOFF	11.191	40625.023	26.33
EVAPOTRANSPIRATION	28.434	103215.148	66.90
DRAINAGE COLLECTED FROM LAYER 3	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 5	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 4	0.0000		
CHANGE IN WATER STORAGE	2.875	10434.921	6.76
SOIL WATER AT START OF YEAR	837.062	3038534.750	
SOIL WATER AT END OF YEAR	839.937	3048969.500	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	-0.107	0.00

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MONTHLY TOTALS (IN INCHES) FOR YEAR 38

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	4.44	2.19	3.41	4.62	2.81	4.90
	3.62	4.51	2.28	4.43	3.12	1.74
RUNOFF	2.723	1.260	1.778	0.185	0.230	0.492
	0.094	0.885	0.140	1.075	0.366	0.046
EVAPOTRANSPIRATION	0.511	0.460	1.910	3.765	4.311	4.985
	3.328	4.411	1.171	1.325	0.914	0.762
LATERAL DRAINAGE COLLECTED FROM LAYER 3	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
PERCOLATION/LEAKAGE THROUGH LAYER 5	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 4	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 4	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000

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ANNUAL TOTALS FOR YEAR 38

	INCHES	CU. FEET	PERCENT
PRECIPITATION	42.07	152714.141	100.00
RUNOFF	9.274	33663.895	22.04
EVAPOTRANSPIRATION	27.854	101110.258	66.21
DRAINAGE COLLECTED FROM LAYER 3	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 5	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 4	0.0000		
CHANGE IN WATER STORAGE	4.942	17939.963	11.75
SOIL WATER AT START OF YEAR	839.937	3048969.500	
SOIL WATER AT END OF YEAR	844.879	3066909.500	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.028	0.00

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MONTHLY TOTALS (IN INCHES) FOR YEAR 39

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	0.98	4.73	8.53	3.09	5.72	3.65
	5.57	8.02	7.27	4.94	3.35	3.28
RUNOFF	0.153	0.890	7.275	0.139	1.396	0.797
	0.875	1.886	2.629	2.385	0.277	0.228
EVAPOTRANSPIRATION	0.477	0.285	1.306	3.692	4.297	3.368
	5.804	4.532	3.602	1.373	0.930	0.849
LATERAL DRAINAGE COLLECTED FROM LAYER 3	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
PERCOLATION/LEAKAGE THROUGH LAYER 5	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 4	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 4	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000

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ANNUAL TOTALS FOR YEAR 39

	INCHES	CU. FEET	PERCENT
PRECIPITATION	59.13	214641.937	100.00
RUNOFF	18.931	68717.930	32.02
EVAPOTRANSPIRATION	30.514	110764.156	51.60
DRAINAGE COLLECTED FROM LAYER 3	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 5	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 4	0.0000		
CHANGE IN WATER STORAGE	9.686	35159.645	16.38
SOIL WATER AT START OF YEAR	844.879	3066909.500	
SOIL WATER AT END OF YEAR	854.565	3102069.250	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0001	0.201	0.00

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MONTHLY TOTALS (IN INCHES) FOR YEAR 40

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	3.86	2.74	3.83	3.55	5.78	4.63
	5.26	7.89	3.89	2.25	4.13	1.23
RUNOFF	0.334	0.167	1.170	0.341	0.964	0.810
	1.178	2.258	0.894	0.247	1.208	0.002
EVAPOTRANSPIRATION	1.114	1.458	2.241	3.983	3.294	6.857
	4.231	4.656	2.912	1.172	0.789	0.575
LATERAL DRAINAGE COLLECTED FROM LAYER 3	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
PERCOLATION/LEAKAGE THROUGH LAYER 5	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 4	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000
STD. DEVIATION OF DAILY	0.000	0.000	0.000	0.000	0.000	0.000

HEAD ON TOP OF LAYER 4	0.000	0.000	0.000	0.000	0.000	0.000

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ANNUAL TOTALS FOR YEAR 40

	INCHES	CU. FEET	PERCENT
PRECIPITATION	49.04	178015.187	100.00
RUNOFF	9.572	34747.184	19.52
EVAPOTRANSPIRATION	33.281	120808.945	67.86
DRAINAGE COLLECTED FROM LAYER 3	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 5	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 4	0.0000		
CHANGE IN WATER STORAGE	6.187	22459.242	12.62
SOIL WATER AT START OF YEAR	854.565	3102069.250	
SOIL WATER AT END OF YEAR	860.563	3123842.250	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.189	686.110	0.39
ANNUAL WATER BUDGET BALANCE	0.0000	-0.178	0.00

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AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1 THROUGH 40

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	3.51	2.48	4.54	3.60	3.57	4.75
	4.54	4.67	4.81	3.30	3.09	3.30
STD. DEVIATIONS	2.09	1.27	1.77	1.65	1.84	1.72
	2.19	2.72	2.88	1.80	1.46	2.20
RUNOFF						
TOTALS	1.259	1.294	1.506	0.434	0.513	0.775
	1.163	1.119	1.507	0.868	0.543	0.708
STD. DEVIATIONS	1.192	1.066	1.758	0.681	0.603	0.521
	1.163	1.180	1.607	0.938	0.601	0.993
EVAPOTRANSPIRATION						
TOTALS	0.698	0.717	2.196	3.476	3.250	5.377
	3.515	3.439	2.018	1.434	0.952	0.656
STD. DEVIATIONS	0.241	0.405	0.440	0.663	1.022	1.257
	1.293	1.544	0.812	0.246	0.213	0.162
LATERAL DRAINAGE COLLECTED FROM LAYER 3						
TOTALS	0.0052	0.0045	0.0043	0.0036	0.0031	0.0026
	0.0023	0.0020	0.0016	0.0014	0.0012	0.0010
STD. DEVIATIONS	0.0273	0.0245	0.0233	0.0193	0.0170	0.0140
	0.0124	0.0106	0.0087	0.0077	0.0064	0.0056
PERCOLATION/LEAKAGE THROUGH LAYER 5						
TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0002	0.0002	0.0002	0.0001	0.0001	0.0001
	0.0001	0.0001	0.0001	0.0001	0.0001	0.0000

AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)

DAILY AVERAGE HEAD ON TOP OF LAYER 4						
AVERAGES	0.2893	0.2819	0.2420	0.2067	0.1765	0.1508
	0.1288	0.1097	0.0937	0.0800	0.0683	0.0583
STD. DEVIATIONS	1.5314	1.5236	1.3084	1.1174	0.9544	0.8151
	0.6962	0.5930	0.5064	0.4325	0.3693	0.3154

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AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1 THROUGH 40

	INCHES	CU. FEET	PERCENT
PRECIPITATION	46.15 (8.949)	167511.8	100.00
RUNOFF	11.689 (5.1270)	42429.90	25.330
EVAPOTRANSPIRATION	27.727 (3.1556)	100647.88	60.084
LATERAL DRAINAGE COLLECTED FROM LAYER 3	0.03280 (0.17675)	119.070	0.07108
PERCOLATION/LEAKAGE THROUGH LAYER 5	0.00026 (0.00135)	0.938	0.00056
AVERAGE HEAD ON TOP OF LAYER 4	0.157 (0.847)		
CHANGE IN WATER STORAGE	6.698 (2.5665)	24314.00	14.515

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PEAK DAILY VALUES FOR YEARS 1 THROUGH 40

	(INCHES)	(CU. FT.)
PRECIPITATION	5.15	18694.500
RUNOFF	4.002	14528.6201
DRAINAGE COLLECTED FROM LAYER 3	0.00603	21.90517
PERCOLATION/LEAKAGE THROUGH LAYER 5	0.000043	0.15712
AVERAGE HEAD ON TOP OF LAYER 4	10.504	
MAXIMUM HEAD ON TOP OF LAYER 4	18.970	
LOCATION OF MAXIMUM HEAD IN LAYER 3 (DISTANCE FROM DRAIN)	0.0 FEET	
SNOW WATER	8.08	29328.5547

MAXIMUM VEG. SOIL WATER (VOL/VOL) 0.3569

MINIMUM VEG. SOIL WATER (VOL/VOL) 0.1285

*** Maximum heads are computed using McEnroe's equations. ***

Reference: Maximum Saturated Depth over Landfill Liner
by Bruce M. McEnroe, University of Kansas
ASCE Journal of Environmental Engineering
Vol. 119, No. 2, March 1993, pp. 262-270.

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FINAL WATER STORAGE AT END OF YEAR 40

LAYER	(INCHES)	(VOL/VOL)
1	3.4418	0.2868
2	417.7996	0.2176
3	7.3680	0.3070
4	0.0000	0.0000
5	431.9532	0.4270
SNOW WATER	0.189	

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**                                                                          **
**                                                                          **
**              HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE               **
**                HELP MODEL VERSION 3.07  (1 NOVEMBER 1997)                **
**                  DEVELOPED BY ENVIRONMENTAL LABORATORY                   **
**                     USAE WATERWAYS EXPERIMENT STATION                    **
**              FOR USEPA RISK REDUCTION ENGINEERING LABORATORY             **
**                                                                          **
**                                                                          **
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PRECIPITATION DATA FILE:     P:\PRJ1\MDENG\HELP3\ME0250\40YEARS.D4
TEMPERATURE DATA FILE:       P:\PRJ1\MDENG\HELP3\ME0250\40YEARS.D7
SOLAR RADIATION DATA FILE:   P:\PRJ1\MDENG\HELP3\ME0250\40YEARS.D13
EVAPOTRANSPIRATION DATA:     P:\PRJ1\MDENG\HELP3\ME0250\40YEARS.D11
SOIL AND DESIGN DATA FILE:   P:\PRJ1\MDENG\HELP3\ME0250\CIL5B3.D10
OUTPUT DATA FILE:            P:\PRJ1\MDENG\HELP3\ME0250\CIL5B3.OUT


TIME:  15:10     DATE:   2/26/2003


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    TITLE:  CHERRY ISLAND LANDFILL PHASE V - RUN B3

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    NOTE:  INITIAL MOISTURE CONTENT OF THE LAYERS AND SNOW WATER
           WERE SPECIFIED BY THE USER.


                                LAYER  1
                                --------

                TYPE 1 - VERTICAL PERCOLATION LAYER
                    MATERIAL TEXTURE NUMBER  22
    THICKNESS                  =    12.00   INCHES
    POROSITY                   =     0.4190 VOL/VOL
    FIELD CAPACITY             =     0.3070 VOL/VOL
    WILTING POINT              =     0.1800 VOL/VOL
    INITIAL SOIL WATER CONTENT =     0.3621 VOL/VOL
    EFFECTIVE SAT. HYD. COND.  = 0.189999992000E-04 CM/SEC
  NOTE:  SATURATED HYDRAULIC CONDUCTIVITY IS MULTIPLIED BY  4.63
           FOR ROOT CHANNELS IN TOP HALF OF EVAPORATIVE ZONE.


                                LAYER  2
                                --------

                TYPE 1 - VERTICAL PERCOLATION LAYER
                    MATERIAL TEXTURE NUMBER   0
    THICKNESS                  =  1920.00   INCHES
    POROSITY                   =     0.6100 VOL/VOL
    FIELD CAPACITY             =     0.2920 VOL/VOL
    WILTING POINT              =     0.0770 VOL/VOL
    INITIAL SOIL WATER CONTENT =     0.0770 VOL/VOL
    EFFECTIVE SAT. HYD. COND.  = 0.100000005000E-02 CM/SEC


                                LAYER  3
                                --------

                TYPE 1 - VERTICAL PERCOLATION LAYER
                    MATERIAL TEXTURE NUMBER  22
    THICKNESS                  =    24.00   INCHES
    POROSITY                   =     0.4190 VOL/VOL
    FIELD CAPACITY             =     0.3070 VOL/VOL
    WILTING POINT              =     0.1800 VOL/VOL
    INITIAL SOIL WATER CONTENT =     0.3621 VOL/VOL
    EFFECTIVE SAT. HYD. COND.  = 0.189999992000E-04 CM/SEC


                                LAYER  4
                                --------

                TYPE 2 - LATERAL DRAINAGE LAYER
                    MATERIAL TEXTURE NUMBER  20
    THICKNESS                  =     0.20   INCHES
    POROSITY                   =     0.8500 VOL/VOL
    FIELD CAPACITY             =     0.0100 VOL/VOL
    WILTING POINT              =     0.0050 VOL/VOL
    INITIAL SOIL WATER CONTENT =     0.0050 VOL/VOL
    EFFECTIVE SAT. HYD. COND.  =  10.0000000000     CM/SEC
    SLOPE                      =     2.00   PERCENT
    DRAINAGE LENGTH            =    75.0    FEET


                                LAYER  5
                                --------

                TYPE 4 - FLEXIBLE MEMBRANE LINER
                    MATERIAL TEXTURE NUMBER  35
    THICKNESS                  =     0.06   INCHES


    POROSITY                   =     0.0000 VOL/VOL
    FIELD CAPACITY             =     0.0000 VOL/VOL
    WILTING POINT              =     0.0000 VOL/VOL
    INITIAL SOIL WATER CONTENT =     0.0000 VOL/VOL
    EFFECTIVE SAT. HYD. COND.  = 0.199999996000E-12 CM/SEC
    FML PINHOLE DENSITY        =     1.00   HOLES/ACRE
    FML INSTALLATION DEFECTS   =     1.00   HOLES/ACRE
    FML PLACEMENT QUALITY      = 4 - POOR


                                LAYER  6
                                --------

                TYPE 3 - BARRIER SOIL LINER
                    MATERIAL TEXTURE NUMBER  16
    THICKNESS                  =  1011.60   INCHES
    POROSITY                   =     0.4270 VOL/VOL
    FIELD CAPACITY             =     0.4180 VOL/VOL
    WILTING POINT              =     0.3670 VOL/VOL
    INITIAL SOIL WATER CONTENT =     0.4270 VOL/VOL
    EFFECTIVE SAT. HYD. COND.  = 0.100000001000E-06 CM/SEC


            GENERAL DESIGN AND EVAPORATIVE ZONE DATA
            ----------------------------------------

  NOTE:  SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT
           SOIL DATA BASE USING SOIL TEXTURE #22 WITH A
           POOR STAND OF GRASS, A SURFACE SLOPE OF  2.%
           AND A SLOPE LENGTH OF 1200. FEET.

  SCS RUNOFF CURVE NUMBER            =    93.10
  FRACTION OF AREA ALLOWING RUNOFF   =   100.0    PERCENT
  AREA PROJECTED ON HORIZONTAL PLANE =     1.000  ACRES
  EVAPORATIVE ZONE DEPTH             =    24.0    INCHES
  INITIAL WATER IN EVAPORATIVE ZONE  =     5.269  INCHES
  UPPER LIMIT OF EVAPORATIVE STORAGE =    12.348  INCHES
  LOWER LIMIT OF EVAPORATIVE STORAGE =     3.084  INCHES
  INITIAL SNOW WATER                 =     0.000  INCHES
  INITIAL WATER IN LAYER MATERIALS   =   592.830  INCHES
  TOTAL INITIAL WATER                =   592.830  INCHES
  TOTAL SUBSURFACE INFLOW            =     0.00   INCHES/YEAR


            EVAPOTRANSPIRATION AND WEATHER DATA
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  NOTE:  EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
           ALBANY                  NEW YORK


  STATION LATITUDE                      =  42.45 DEGREES
  MAXIMUM LEAF AREA INDEX               =   3.50
  START OF GROWING SEASON (JULIAN DATE) =   123
  END OF GROWING SEASON (JULIAN DATE)   =   282
  EVAPORATIVE ZONE DEPTH                =  24.0  INCHES
  AVERAGE ANNUAL WIND SPEED             =   8.90 MPH
  AVERAGE 1ST QUARTER RELATIVE HUMIDITY =  68.00 %
  AVERAGE 2ND QUARTER RELATIVE HUMIDITY =  66.00 %
  AVERAGE 3RD QUARTER RELATIVE HUMIDITY =  74.00 %
  AVERAGE 4TH QUARTER RELATIVE HUMIDITY =  74.00 %


  NOTE:  PRECIPITATION DATA FOR     CHERRY ISLAND LF
           WAS ENTERED BY THE USER.


  NOTE:  TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING
           COEFFICIENTS FOR    WILMINGTON          DELAWARE

        NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

  JAN/JUL   FEB/AUG   MAR/SEP   APR/OCT   MAY/NOV   JUN/DEC
  -------   -------   -------   -------   -------   -------
   31.20     33.20     41.80     52.40     62.20     71.20
   76.00     74.80     67.80     56.30     45.60     35.50


  NOTE:  SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
           COEFFICIENTS FOR    WILMINGTON          DELAWARE
             AND STATION LATITUDE  =  39.80 DEGREES


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                MONTHLY TOTALS (IN INCHES) FOR YEAR    1
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                          JAN/JUL FEB/AUG MAR/SEP APR/OCT MAY/NOV JUN/DEC
                          ------- ------- ------- ------- ------- -------

PRECIPITATION              1.87    1.39    4.15    2.02    1.86    5.95
                           2.42    5.10    3.84    3.78    1.81    7.26

RUNOFF                     0.107   0.002   0.626   0.034   0.040   0.459
                           0.088   0.769   1.502   0.677   0.159   1.960

EVAPOTRANSPIRATION         1.084   1.457   2.146   2.921   2.166   6.151
                           3.121   3.498   1.576   1.475   1.180   0.863

LATERAL DRAINAGE COLLECTED 1.1533  0.1681  0.0000  0.0000  0.0000  0.0000
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FROM LAYER 4	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
PERCOLATION/LEAKAGE THROUGH LAYER 6	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 5	0.002 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 5	0.001 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000

ANNUAL TOTALS FOR YEAR 1

	INCHES	CU. FEET	PERCENT
PRECIPITATION	41.45	150463.469	100.00
RUNOFF	6.422	23310.625	15.49
EVAPOTRANSPIRATION	27.639	100329.984	66.68
DRAINAGE COLLECTED FROM LAYER 4	1.3214	4796.679	3.19
PERC./LEAKAGE THROUGH LAYER 6	0.000001	0.004	0.00
AVG. HEAD ON TOP OF LAYER 5	0.0002		
CHANGE IN WATER STORAGE	6.068	22026.150	14.64
SOIL WATER AT START OF YEAR	592.830	2151972.000	
SOIL WATER AT END OF YEAR	598.898	2173998.250	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.031	0.00

CHANGE IN WATER STORAGE	5.024	18236.186	11.26
SOIL WATER AT START OF YEAR	598.898	2173998.250	
SOIL WATER AT END OF YEAR	603.921	2192234.500	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	-0.066	0.00

MONTHLY TOTALS (IN INCHES) FOR YEAR 3

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	7.06 6.60	1.11 4.24	2.48 3.95	2.14 1.63	2.69 1.57	7.65 1.38
RUNOFF	2.906 3.188	0.004 1.003	0.012 0.920	0.058 0.056	0.487 0.094	1.495 0.110
EVAPOTRANSPIRATION	0.690 4.218	1.502 3.642	2.294 1.841	2.862 1.424	2.855 0.683	6.288 0.424
LATERAL DRAINAGE COLLECTED FROM LAYER 4	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000
PERCOLATION/LEAKAGE THROUGH LAYER 6	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 5	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 5	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000

MONTHLY TOTALS (IN INCHES) FOR YEAR 2

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	2.12 2.92	4.54 0.75	4.19 7.04	4.19 2.82	7.87 1.75	5.80 0.61
RUNOFF	0.349 0.405	1.040 0.005	3.911 2.655	0.192 0.760	1.889 0.030	1.095 0.000
EVAPOTRANSPIRATION	0.721 3.507	0.498 0.390	1.729 1.474	3.962 1.907	4.499 1.295	6.676 0.586
LATERAL DRAINAGE COLLECTED FROM LAYER 4	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000
PERCOLATION/LEAKAGE THROUGH LAYER 6	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 5	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 5	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000

ANNUAL TOTALS FOR YEAR 2

	INCHES	CU. FEET	PERCENT
PRECIPITATION	44.60	161897.969	100.00
RUNOFF	12.332	44763.621	27.65
EVAPOTRANSPIRATION	27.245	98898.227	61.09
DRAINAGE COLLECTED FROM LAYER 4	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 6	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 5	0.0000		

ANNUAL TOTALS FOR YEAR 3

	INCHES	CU. FEET	PERCENT
PRECIPITATION	42.50	154274.984	100.00
RUNOFF	10.332	37506.566	24.31
EVAPOTRANSPIRATION	28.723	104265.477	67.58
DRAINAGE COLLECTED FROM LAYER 4	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 6	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 5	0.0000		
CHANGE IN WATER STORAGE	3.444	12503.053	8.10
SOIL WATER AT START OF YEAR	603.921	2192234.500	
SOIL WATER AT END OF YEAR	607.352	2204686.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.014	51.515	0.03
ANNUAL WATER BUDGET BALANCE	0.0000	-0.113	0.00

MONTHLY TOTALS (IN INCHES) FOR YEAR 4

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	4.44 3.62	2.19 4.51	3.41 2.34	4.62 4.37	2.81 3.12	4.90 1.74
RUNOFF	2.734 0.097	1.209 0.889	0.881 0.144	0.240 1.098	0.277 0.476	0.502 0.043
EVAPOTRANSPIRATION	0.369 3.492	0.668 4.072	1.918 1.263	3.514 1.330	4.261 0.824	5.222 0.704
LATERAL DRAINAGE COLLECTED	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

FROM LAYER 4	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
PERCOLATION/LEAKAGE THROUGH LAYER 6	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 5	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 5	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000

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ANNUAL TOTALS FOR YEAR 4

	INCHES	CU. FEET	PERCENT
PRECIPITATION	42.07	152714.141	100.00
RUNOFF	8.589	31176.941	20.42
EVAPOTRANSPIRATION	27.636	100317.078	65.69
DRAINAGE COLLECTED FROM LAYER 4	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 6	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 5	0.0000		
CHANGE IN WATER STORAGE	5.846	21220.012	13.90
SOIL WATER AT START OF YEAR	607.352	2204686.000	
SOIL WATER AT END OF YEAR	613.211	2225957.500	
SNOW WATER AT START OF YEAR	0.014	51.515	0.03
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.110	0.00

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MONTHLY TOTALS (IN INCHES) FOR YEAR 5

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	0.98 5.57	4.73 8.02	8.53 7.27	3.09 4.94	5.72 3.35	3.65 3.28
RUNOFF	0.139 0.926	2.888 1.917	2.733 2.670	0.164 2.412	1.513 0.396	0.798 0.248
EVAPOTRANSPIRATION	0.592 5.632	0.572 4.475	2.367 3.262	3.484 1.394	4.648 1.290	3.568 0.836
LATERAL DRAINAGE COLLECTED FROM LAYER 4	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000
PERCOLATION/LEAKAGE THROUGH LAYER 6	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 5	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 5	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000

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ANNUAL TOTALS FOR YEAR 5

	INCHES	CU. FEET	PERCENT
PRECIPITATION	59.13	214641.937	100.00
RUNOFF	16.805	61002.512	28.42
EVAPOTRANSPIRATION	32.121	116598.203	54.32
DRAINAGE COLLECTED FROM LAYER 4	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 6	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 5	0.0000		
CHANGE IN WATER STORAGE	10.204	37041.332	17.26
SOIL WATER AT START OF YEAR	613.211	2225957.500	
SOIL WATER AT END OF YEAR	623.416	2262998.750	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	-0.111	0.00

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MONTHLY TOTALS (IN INCHES) FOR YEAR 6

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	3.86 5.26	2.45 7.83	4.12 3.95	3.55 2.25	4.92 4.13	5.49 1.23
RUNOFF	0.337 1.202	2.131 2.277	0.831 0.903	0.332 0.258	0.926 1.220	1.015 0.116
EVAPOTRANSPIRATION	0.696 4.268	0.998 4.899	2.725 2.887	3.961 1.023	3.285 0.826	6.651 0.504
LATERAL DRAINAGE COLLECTED FROM LAYER 4	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000
PERCOLATION/LEAKAGE THROUGH LAYER 6	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 5	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 5	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000

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ANNUAL TOTALS FOR YEAR 6

	INCHES	CU. FEET	PERCENT
PRECIPITATION	49.04	178015.187	100.00
RUNOFF	11.548	41920.902	23.55
EVAPOTRANSPIRATION	32.723	118785.016	66.73
DRAINAGE COLLECTED FROM LAYER 4	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 6	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 5	0.0000		
CHANGE IN WATER STORAGE	4.768	17309.189	9.72
SOIL WATER AT START OF YEAR	623.416	2262998.750	
SOIL WATER AT END OF YEAR	628.184	2280308.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.083	0.00

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MONTHLY TOTALS (IN INCHES) FOR YEAR 7

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	4.59 1.55	1.40 5.61	5.75 5.53	4.02 1.83	1.74 7.03	2.86 4.38
RUNOFF	1.965 0.009	0.799 1.268	1.543 1.706	0.290 0.529	0.033 2.198	0.642 1.456
EVAPOTRANSPIRATION	0.765 1.549	0.316 4.117	1.591 1.958	3.702 1.489	3.104 1.180	3.810 0.805
LATERAL DRAINAGE COLLECTED	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

FROM LAYER 4	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
PERCOLATION/LEAKAGE THROUGH LAYER 6	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 5	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 5	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000

ANNUAL TOTALS FOR YEAR 7

	INCHES	CU. FEET	PERCENT
PRECIPITATION	46.29	168032.703	100.00
RUNOFF	12.439	45152.523	26.87
EVAPOTRANSPIRATION	24.385	88516.664	52.68
DRAINAGE COLLECTED FROM LAYER 4	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 6	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 5	0.0000		
CHANGE IN WATER STORAGE	9.467	34363.586	20.45
SOIL WATER AT START OF YEAR	628.184	2280308.000	
SOIL WATER AT END OF YEAR	637.651	2314671.500	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	-0.073	0.00

MONTHLY TOTALS (IN INCHES) FOR YEAR 8

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	5.72 1.89	2.50 4.41	3.55 1.64	6.62 3.14	2.47 2.70	3.30 3.30
RUNOFF	1.992 0.179	0.696 0.858	0.456 0.137	1.930 0.679	0.033 0.653	0.445 0.584
EVAPOTRANSPIRATION	1.208 1.541	1.653 3.745	2.678 1.598	4.372 1.131	3.184 0.860	4.684 0.456
LATERAL DRAINAGE COLLECTED FROM LAYER 4	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000
PERCOLATION/LEAKAGE THROUGH LAYER 6	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 5	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 5	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000

ANNUAL TOTALS FOR YEAR 8

	INCHES	CU. FEET	PERCENT
PRECIPITATION	41.24	149701.187	100.00
RUNOFF	8.641	31366.971	20.95
EVAPOTRANSPIRATION	27.111	98413.570	65.74
DRAINAGE COLLECTED FROM LAYER 4	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 6	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 5	0.0000		
CHANGE IN WATER STORAGE	5.488	19920.467	13.31
SOIL WATER AT START OF YEAR	637.651	2314671.500	
SOIL WATER AT END OF YEAR	643.138	2334592.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0001	0.187	0.00

MONTHLY TOTALS (IN INCHES) FOR YEAR 9

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	4.63 5.22	2.81 6.98	2.61 10.80	4.64 0.60	3.92 4.39	5.10 3.09
RUNOFF	2.941 1.804	2.276 2.184	0.648 4.744	0.667 0.018	0.157 0.420	0.869 0.703
EVAPOTRANSPIRATION	0.404 3.494	0.193 4.329	1.605 3.118	3.917 1.606	4.236 1.169	5.245 0.623
LATERAL DRAINAGE COLLECTED FROM LAYER 4	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000
PERCOLATION/LEAKAGE THROUGH LAYER 6	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 5	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 5	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000

ANNUAL TOTALS FOR YEAR 9

	INCHES	CU. FEET	PERCENT
PRECIPITATION	54.79	198887.719	100.00
RUNOFF	17.430	63270.391	31.81
EVAPOTRANSPIRATION	29.938	108675.531	54.64
DRAINAGE COLLECTED FROM LAYER 4	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 6	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 5	0.0000		
CHANGE IN WATER STORAGE	7.422	26941.713	13.55
SOIL WATER AT START OF YEAR	643.138	2334592.000	
SOIL WATER AT END OF YEAR	650.264	2360458.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.296	1075.748	0.54
ANNUAL WATER BUDGET BALANCE	0.0000	0.088	0.00

MONTHLY TOTALS (IN INCHES) FOR YEAR 10

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	3.98 6.20	2.12 5.67	4.68 11.97	3.52 7.03	3.38 2.02	4.46 2.41
RUNOFF	2.534 2.470	1.412 1.465	1.602 6.655	0.537 2.363	0.115 0.063	0.572 0.175
EVAPOTRANSPIRATION	0.475 3.010	0.417 3.927	2.741 2.510	2.977 1.724	3.158 1.064	6.172 0.584
LATERAL DRAINAGE COLLECTED	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

FROM LAYER 4	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
PERCOLATION/LEAKAGE THROUGH LAYER 6	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 5	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 5	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000

ANNUAL TOTALS FOR YEAR 10

	INCHES	CU. FEET	PERCENT
PRECIPITATION	57.44	208507.234	100.00
RUNOFF	19.962	72460.508	34.75
EVAPOTRANSPIRATION	28.758	104390.289	50.07
DRAINAGE COLLECTED FROM LAYER 4	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 6	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 5	0.0000		
CHANGE IN WATER STORAGE	8.721	31656.510	15.18
SOIL WATER AT START OF YEAR	650.264	2360458.000	
SOIL WATER AT END OF YEAR	659.281	2393190.250	
SNOW WATER AT START OF YEAR	0.296	1075.748	0.52
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	-0.074	0.00

CHANGE IN WATER STORAGE	3.330	12086.854	7.37
SOIL WATER AT START OF YEAR	659.281	2393190.250	
SOIL WATER AT END OF YEAR	662.611	2405277.250	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	-0.066	0.00

MONTHLY TOTALS (IN INCHES) FOR YEAR 12

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	8.05 5.35	2.10 3.72	8.59 2.36	9.03 6.26	4.39 5.12	8.03 5.83
RUNOFF	0.433 1.710	3.053 0.589	8.641 0.452	3.356 2.560	0.612 1.904	2.638 1.538
EVAPOTRANSPIRATION	0.693 3.665	0.450 3.131	1.945 0.743	4.024 1.088	5.306 1.061	7.390 0.792
LATERAL DRAINAGE COLLECTED FROM LAYER 4	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000
PERCOLATION/LEAKAGE THROUGH LAYER 6	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 5	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 5	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000

MONTHLY TOTALS (IN INCHES) FOR YEAR 11

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	3.93 10.86	3.22 3.62	3.86 1.46	2.79 1.67	1.90 2.93	6.67 2.27
RUNOFF	2.697 3.997	1.553 0.538	0.527 0.217	0.313 0.160	0.097 0.522	1.024 0.413
EVAPOTRANSPIRATION	0.152 6.675	0.758 4.069	2.954 0.711	3.863 1.224	2.044 0.759	6.091 0.494
LATERAL DRAINAGE COLLECTED FROM LAYER 4	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000
PERCOLATION/LEAKAGE THROUGH LAYER 6	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 5	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 5	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000

ANNUAL TOTALS FOR YEAR 11

	INCHES	CU. FEET	PERCENT
PRECIPITATION	45.18	164003.359	100.00
RUNOFF	12.056	43764.238	26.68
EVAPOTRANSPIRATION	29.794	108152.336	65.95
DRAINAGE COLLECTED FROM LAYER 4	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 6	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 5	0.0000		

ANNUAL TOTALS FOR YEAR 12

	INCHES	CU. FEET	PERCENT
PRECIPITATION	68.83	249852.844	100.00
RUNOFF	27.486	99775.250	39.93
EVAPOTRANSPIRATION	30.288	109943.766	44.00
DRAINAGE COLLECTED FROM LAYER 4	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 6	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 5	0.0000		
CHANGE IN WATER STORAGE	11.056	40133.910	16.06
SOIL WATER AT START OF YEAR	662.611	2405277.250	
SOIL WATER AT END OF YEAR	671.625	2437999.750	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	2.042	7411.400	2.97
ANNUAL WATER BUDGET BALANCE	0.0000	-0.076	0.00

MONTHLY TOTALS (IN INCHES) FOR YEAR 13

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	2.02 3.99	1.24 0.38	5.86 6.34	2.65 6.41	2.08 1.89	1.82 4.28
RUNOFF	0.738 1.416	0.526 0.000	1.843 1.838	0.290 3.112	0.020 0.100	0.197 0.957
EVAPOTRANSPIRATION	0.548 2.574	0.241 0.380	2.343 2.087	3.197 1.804	2.227 1.165	3.552 0.762
LATERAL DRAINAGE COLLECTED	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

FROM LAYER 4	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
PERCOLATION/LEAKAGE THROUGH LAYER 6	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 5	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 5	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000

ANNUAL TOTALS FOR YEAR 13

	INCHES	CU. FEET	PERCENT
PRECIPITATION	38.96	141424.828	100.00
RUNOFF	11.038	40069.562	28.33
EVAPOTRANSPIRATION	20.881	75797.305	53.60
DRAINAGE COLLECTED FROM LAYER 4	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 6	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 5	0.0000		
CHANGE IN WATER STORAGE	7.041	25557.678	18.07
SOIL WATER AT START OF YEAR	671.625	2437999.750	
SOIL WATER AT END OF YEAR	679.989	2468360.000	
SNOW WATER AT START OF YEAR	2.042	7411.400	5.24
SNOW WATER AT END OF YEAR	0.719	2608.595	1.84
ANNUAL WATER BUDGET BALANCE	0.0001	0.277	0.00

MONTHLY TOTALS (IN INCHES) FOR YEAR 14

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	1.68 2.56	0.64 1.74	4.01 2.98	4.21 2.88	3.90 1.21	3.86 8.76
RUNOFF	0.082 0.346	0.643 0.156	0.558 0.210	0.426 0.154	0.221 0.080	0.363 3.703
EVAPOTRANSPIRATION	0.657 2.977	0.321 1.511	2.766 2.255	4.318 1.605	3.228 0.766	5.064 0.616
LATERAL DRAINAGE COLLECTED FROM LAYER 4	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000
PERCOLATION/LEAKAGE THROUGH LAYER 6	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 5	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 5	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000

ANNUAL TOTALS FOR YEAR 14

	INCHES	CU. FEET	PERCENT
PRECIPITATION	38.43	139500.906	100.00
RUNOFF	6.943	25204.252	18.07
EVAPOTRANSPIRATION	26.085	94686.859	67.88
DRAINAGE COLLECTED FROM LAYER 4	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 6	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 5	0.0000		
CHANGE IN WATER STORAGE	5.402	19609.875	14.06
SOIL WATER AT START OF YEAR	679.989	2468360.000	
SOIL WATER AT END OF YEAR	684.567	2484979.750	
SNOW WATER AT START OF YEAR	0.719	2608.595	1.87
SNOW WATER AT END OF YEAR	1.542	5598.767	4.01
ANNUAL WATER BUDGET BALANCE	0.0000	-0.083	0.00

MONTHLY TOTALS (IN INCHES) FOR YEAR 15

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	0.95 2.68	4.60 12.91	4.04 4.59	0.69 3.00	3.91 3.10	2.40 4.24
RUNOFF	0.780 0.240	3.576 6.421	1.196 1.217	0.000 0.457	1.501 0.680	0.370 0.234
EVAPOTRANSPIRATION	0.627 2.443	0.526 5.538	2.267 2.922	1.752 1.409	1.891 0.774	4.190 0.452
LATERAL DRAINAGE COLLECTED FROM LAYER 4	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000
PERCOLATION/LEAKAGE THROUGH LAYER 6	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 5	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 5	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000

ANNUAL TOTALS FOR YEAR 15

	INCHES	CU. FEET	PERCENT
PRECIPITATION	47.11	171009.375	100.00
RUNOFF	16.672	60520.562	35.39
EVAPOTRANSPIRATION	24.791	89989.617	52.62
DRAINAGE COLLECTED FROM LAYER 4	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 6	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 5	0.0000		
CHANGE IN WATER STORAGE	5.647	20499.143	11.99
SOIL WATER AT START OF YEAR	684.567	2484979.750	
SOIL WATER AT END OF YEAR	689.605	2503267.000	
SNOW WATER AT START OF YEAR	1.542	5598.767	3.27
SNOW WATER AT END OF YEAR	2.152	7810.766	4.57
ANNUAL WATER BUDGET BALANCE	0.0000	0.054	0.00

MONTHLY TOTALS (IN INCHES) FOR YEAR 16

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	3.42 5.56	2.71 3.22	4.10 3.06	3.22 0.90	1.44 2.77	4.36 3.04
RUNOFF	1.609 0.972	1.721 0.435	1.052 0.335	0.296 0.137	0.039 0.290	0.764 0.255
EVAPOTRANSPIRATION	0.647 3.551	0.357 4.195	2.171 1.220	4.051 1.099	2.248 0.706	4.686 0.488
LATERAL DRAINAGE COLLECTED	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

FROM LAYER 4	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
PERCOLATION/LEAKAGE THROUGH LAYER 6	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 5	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 5	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000

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ANNUAL TOTALS FOR YEAR 16

	INCHES	CU. FEET	PERCENT
PRECIPITATION	37.80	137213.984	100.00
RUNOFF	7.904	28691.494	20.91
EVAPOTRANSPIRATION	25.418	92266.547	67.24
DRAINAGE COLLECTED FROM LAYER 4	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 6	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 5	0.0000		
CHANGE IN WATER STORAGE	4.478	16255.932	11.85
SOIL WATER AT START OF YEAR	689.605	2503267.000	
SOIL WATER AT END OF YEAR	696.235	2527333.750	
SNOW WATER AT START OF YEAR	2.152	7810.766	5.69
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.011	0.00

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CHANGE IN WATER STORAGE	3.506	12728.485	12.17
SOIL WATER AT START OF YEAR	696.235	2527333.750	
SOIL WATER AT END OF YEAR	699.742	2540062.250	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	-0.126	0.00

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MONTHLY TOTALS (IN INCHES) FOR YEAR 18

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	1.87 2.42	1.39 5.10	4.15 3.84	2.02 3.78	1.86 1.81	5.95 7.26
RUNOFF	0.119 0.088	0.142 0.748	2.052 1.514	0.031 0.686	0.034 0.169	0.486 2.208
EVAPOTRANSPIRATION	0.963 3.314	0.595 3.493	1.890 1.569	2.785 1.450	1.925 1.087	6.426 0.654
LATERAL DRAINAGE COLLECTED FROM LAYER 4	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000
PERCOLATION/LEAKAGE THROUGH LAYER 6	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 5	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 5	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000

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MONTHLY TOTALS (IN INCHES) FOR YEAR 17

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	0.66 2.67	1.49 1.56	3.09 3.30	2.64 2.64	1.65 5.00	2.73 1.38
RUNOFF	0.000 0.235	0.475 0.004	0.490 0.197	0.021 0.381	0.022 1.131	0.238 0.018
EVAPOTRANSPIRATION	0.679 2.299	0.382 1.428	2.411 2.767	2.419 1.587	2.109 0.907	4.463 0.639
LATERAL DRAINAGE COLLECTED FROM LAYER 4	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000
PERCOLATION/LEAKAGE THROUGH LAYER 6	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 5	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 5	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000

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ANNUAL TOTALS FOR YEAR 17

	INCHES	CU. FEET	PERCENT
PRECIPITATION	28.81	104580.328	100.00
RUNOFF	3.213	11663.300	11.15
EVAPOTRANSPIRATION	22.091	80188.664	76.68
DRAINAGE COLLECTED FROM LAYER 4	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 6	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 5	0.0000		

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ANNUAL TOTALS FOR YEAR 18

	INCHES	CU. FEET	PERCENT
PRECIPITATION	41.45	150463.469	100.00
RUNOFF	8.277	30047.045	19.97
EVAPOTRANSPIRATION	26.151	94928.109	63.09
DRAINAGE COLLECTED FROM LAYER 4	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 6	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 5	0.0000		
CHANGE IN WATER STORAGE	7.022	25488.209	16.94
SOIL WATER AT START OF YEAR	699.742	2540062.250	
SOIL WATER AT END OF YEAR	706.763	2565550.250	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.114	0.00

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MONTHLY TOTALS (IN INCHES) FOR YEAR 19

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	2.12 2.92	4.54 0.75	4.19 7.04	4.19 2.82	7.87 1.75	5.80 0.61
RUNOFF	0.428 0.403	1.220 0.005	2.552 2.629	0.199 0.761	1.875 0.037	1.129 0.000
EVAPOTRANSPIRATION	0.804 3.427	0.663 0.357	1.738 1.541	4.081 1.766	4.558 1.223	6.578 0.747
LATERAL DRAINAGE COLLECTED	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

FROM LAYER 4	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
PERCOLATION/LEAKAGE THROUGH LAYER 6	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 5	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 5	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000

ANNUAL TOTALS FOR YEAR 19

	INCHES	CU. FEET	PERCENT
PRECIPITATION	44.60	161897.969	100.00
RUNOFF	11.238	40794.555	25.20
EVAPOTRANSPIRATION	27.484	99768.094	61.62
DRAINAGE COLLECTED FROM LAYER 4	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 6	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 5	0.0000		
CHANGE IN WATER STORAGE	5.878	21335.334	13.18
SOIL WATER AT START OF YEAR	706.763	2565550.250	
SOIL WATER AT END OF YEAR	712.641	2586885.750	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	-0.017	0.00

CHANGE IN WATER STORAGE	2.789	10125.848	6.56
SOIL WATER AT START OF YEAR	712.641	2586885.750	
SOIL WATER AT END OF YEAR	715.430	2597011.500	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.028	0.00

MONTHLY TOTALS (IN INCHES) FOR YEAR 21

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	4.44 3.62	2.19 4.51	3.41 2.28	4.62 4.43	2.81 3.12	4.90 1.74
RUNOFF	0.725 0.096	1.772 0.892	1.219 0.142	0.211 1.091	0.245 0.471	0.500 0.041
EVAPOTRANSPIRATION	0.943 3.636	0.399 4.235	2.167 1.252	3.441 1.427	4.388 0.874	4.947 0.726
LATERAL DRAINAGE COLLECTED FROM LAYER 4	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000
PERCOLATION/LEAKAGE THROUGH LAYER 6	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 5	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 5	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000

MONTHLY TOTALS (IN INCHES) FOR YEAR 20

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	7.06 6.60	1.11 4.40	2.48 3.85	2.14 1.57	2.69 1.57	7.65 1.38
RUNOFF	4.479 3.126	0.003 1.001	0.502 0.921	0.064 0.065	0.473 0.095	1.543 0.066
EVAPOTRANSPIRATION	0.547 4.169	1.402 3.461	0.939 1.668	2.951 1.425	2.866 0.591	6.780 0.573
LATERAL DRAINAGE COLLECTED FROM LAYER 4	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000
PERCOLATION/LEAKAGE THROUGH LAYER 6	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 5	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 5	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000

ANNUAL TOTALS FOR YEAR 20

	INCHES	CU. FEET	PERCENT
PRECIPITATION	42.50	154274.984	100.00
RUNOFF	12.339	44789.547	29.03
EVAPOTRANSPIRATION	27.372	99359.562	64.40
DRAINAGE COLLECTED FROM LAYER 4	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 6	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 5	0.0000		

ANNUAL TOTALS FOR YEAR 21

	INCHES	CU. FEET	PERCENT
PRECIPITATION	42.07	152714.141	100.00
RUNOFF	7.406	26882.111	17.60
EVAPOTRANSPIRATION	28.437	103226.094	67.59
DRAINAGE COLLECTED FROM LAYER 4	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 6	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 5	0.0000		
CHANGE IN WATER STORAGE	6.228	22605.967	14.80
SOIL WATER AT START OF YEAR	715.430	2597011.500	
SOIL WATER AT END OF YEAR	721.658	2619617.500	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	-0.035	0.00

MONTHLY TOTALS (IN INCHES) FOR YEAR 22

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	0.98 5.57	4.73 8.02	8.53 7.27	3.09 4.94	5.72 3.35	3.65 3.28
RUNOFF	0.013 0.942	3.088 1.927	3.510 2.618	0.147 2.415	1.485 0.399	0.798 0.083
EVAPOTRANSPIRATION	0.882 5.629	0.433 4.470	2.221 3.509	3.789 1.427	4.523 1.135	3.538 0.581
LATERAL DRAINAGE COLLECTED	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

FROM LAYER 4	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
PERCOLATION/LEAKAGE THROUGH LAYER 6	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 5	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 5	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000

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ANNUAL TOTALS FOR YEAR 22

	INCHES	CU. FEET	PERCENT
PRECIPITATION	59.13	214641.937	100.00
RUNOFF	17.425	63254.305	29.47
EVAPOTRANSPIRATION	32.137	116658.875	54.35
DRAINAGE COLLECTED FROM LAYER 4	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 6	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 5	0.0000		
CHANGE IN WATER STORAGE	9.567	34728.723	16.18
SOIL WATER AT START OF YEAR	721.658	2619617.500	
SOIL WATER AT END OF YEAR	730.804	2652819.250	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.421	1526.985	0.71
ANNUAL WATER BUDGET BALANCE	0.0000	0.024	0.00

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CHANGE IN WATER STORAGE	3.586	13017.829	7.31
SOIL WATER AT START OF YEAR	730.804	2652819.250	
SOIL WATER AT END OF YEAR	734.811	2667364.000	
SNOW WATER AT START OF YEAR	0.421	1526.985	0.86
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.083	0.00

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MONTHLY TOTALS (IN INCHES) FOR YEAR 24

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	4.59 2.29	1.40 5.56	6.05 4.84	3.72 1.83	1.78 7.03	2.82 4.79
RUNOFF	0.213 0.069	1.863 1.250	2.381 1.670	0.251 0.528	0.036 2.184	0.638 1.450
EVAPOTRANSPIRATION	0.677 1.649	0.437 4.122	2.212 1.902	3.428 1.490	2.989 1.157	3.695 0.784
LATERAL DRAINAGE COLLECTED FROM LAYER 4	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000
PERCOLATION/LEAKAGE THROUGH LAYER 6	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 5	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 5	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000

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MONTHLY TOTALS (IN INCHES) FOR YEAR 23

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	3.86 5.26	2.45 7.83	4.12 3.95	3.55 2.25	4.92 4.13	5.49 1.23
RUNOFF	2.824 1.248	0.349 2.279	0.811 0.894	0.367 0.254	0.875 1.208	1.022 0.116
EVAPOTRANSPIRATION	0.506 4.237	1.225 4.953	2.812 3.241	3.767 1.180	3.253 0.800	6.739 0.494
LATERAL DRAINAGE COLLECTED FROM LAYER 4	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000
PERCOLATION/LEAKAGE THROUGH LAYER 6	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 5	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 5	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000

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ANNUAL TOTALS FOR YEAR 23

	INCHES	CU. FEET	PERCENT
PRECIPITATION	49.04	178015.187	100.00
RUNOFF	12.247	44458.012	24.97
EVAPOTRANSPIRATION	33.206	120539.266	67.71
DRAINAGE COLLECTED FROM LAYER 4	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 6	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 5	0.0000		

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ANNUAL TOTALS FOR YEAR 24

	INCHES	CU. FEET	PERCENT
PRECIPITATION	46.70	169521.000	100.00
RUNOFF	12.531	45489.008	26.83
EVAPOTRANSPIRATION	24.542	89088.914	52.55
DRAINAGE COLLECTED FROM LAYER 4	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 6	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 5	0.0000		
CHANGE IN WATER STORAGE	9.626	34943.180	20.61
SOIL WATER AT START OF YEAR	734.811	2667364.000	
SOIL WATER AT END OF YEAR	744.437	2702307.250	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	-0.100	0.00

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MONTHLY TOTALS (IN INCHES) FOR YEAR 25

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	5.72 1.71	2.50 4.59	3.55 1.64	6.62 3.14	2.37 2.70	3.40 3.09
RUNOFF	1.920 0.179	1.652 0.854	0.568 0.137	2.019 0.679	0.035 0.668	0.443 0.351
EVAPOTRANSPIRATION	0.863 1.422	0.283 3.789	2.302 1.781	4.285 0.932	2.958 0.889	4.732 0.576
LATERAL DRAINAGE COLLECTED	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

FROM LAYER 4	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
PERCOLATION/LEAKAGE THROUGH LAYER 6	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 5	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 5	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000

ANNUAL TOTALS FOR YEAR 25

	INCHES	CU. FEET	PERCENT
PRECIPITATION	41.03	148938.891	100.00
RUNOFF	9.506	34506.887	23.17
EVAPOTRANSPIRATION	24.812	90067.937	60.47
DRAINAGE COLLECTED FROM LAYER 4	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 6	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 5	0.0000		
CHANGE IN WATER STORAGE	6.712	24363.939	16.36
SOIL WATER AT START OF YEAR	744.437	2702307.250	
SOIL WATER AT END OF YEAR	750.632	2724793.500	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.517	1877.615	1.26
ANNUAL WATER BUDGET BALANCE	0.0000	0.134	0.00

MONTHLY TOTALS (IN INCHES) FOR YEAR 26

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	4.63 5.22	2.81 6.98	2.61 10.80	4.64 0.60	3.92 4.39	5.10 3.09
RUNOFF	2.152 1.789	3.518 2.169	0.071 4.764	0.606 0.017	0.145 0.733	0.830 0.289
EVAPOTRANSPIRATION	0.385 3.421	1.042 4.356	2.593 2.980	4.101 1.477	4.069 1.271	5.267 0.806
LATERAL DRAINAGE COLLECTED FROM LAYER 4	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000
PERCOLATION/LEAKAGE THROUGH LAYER 6	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 5	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 5	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000

ANNUAL TOTALS FOR YEAR 26

	INCHES	CU. FEET	PERCENT
PRECIPITATION	54.79	198887.719	100.00
RUNOFF	17.084	62016.180	31.18
EVAPOTRANSPIRATION	31.770	115325.164	57.99
DRAINAGE COLLECTED FROM LAYER 4	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 6	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 5	0.0000		
CHANGE IN WATER STORAGE	5.936	21546.344	10.83
SOIL WATER AT START OF YEAR	750.632	2724793.500	
SOIL WATER AT END OF YEAR	757.085	2748217.500	
SNOW WATER AT START OF YEAR	0.517	1877.615	0.94
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.032	0.00

MONTHLY TOTALS (IN INCHES) FOR YEAR 27

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	3.98 6.20	2.12 5.67	4.68 11.97	3.52 7.03	3.38 2.02	4.46 2.41
RUNOFF	0.802 2.457	1.370 1.463	1.886 6.646	0.550 2.365	0.115 0.018	0.582 0.186
EVAPOTRANSPIRATION	1.263 3.034	0.466 4.095	1.851 2.377	3.238 1.760	3.138 1.120	6.237 1.074
LATERAL DRAINAGE COLLECTED FROM LAYER 4	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000
PERCOLATION/LEAKAGE THROUGH LAYER 6	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 5	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 5	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000

ANNUAL TOTALS FOR YEAR 27

	INCHES	CU. FEET	PERCENT
PRECIPITATION	57.44	208507.234	100.00
RUNOFF	18.440	66938.883	32.10
EVAPOTRANSPIRATION	29.653	107641.125	51.62
DRAINAGE COLLECTED FROM LAYER 4	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 6	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 5	0.0000		
CHANGE IN WATER STORAGE	9.346	33927.117	16.27
SOIL WATER AT START OF YEAR	757.085	2748217.500	
SOIL WATER AT END OF YEAR	766.431	2782144.750	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.111	0.00

MONTHLY TOTALS (IN INCHES) FOR YEAR 28

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	3.93 10.86	3.22 3.65	4.40 1.43	2.25 1.67	2.75 2.93	5.82 2.27
RUNOFF	1.379 3.936	2.271 0.544	0.932 0.217	0.396 0.158	0.188 0.522	0.[illegible] 0.[illegible]
EVAPOTRANSPIRATION	0.716 7.028	0.607 3.612	1.475 0.843	2.857 1.165	2.077 0.614	6.267 0.528
LATERAL DRAINAGE COLLECTED	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

FROM LAYER 4	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
PERCOLATION/LEAKAGE THROUGH LAYER 6	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 5	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 5	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000

ANNUAL TOTALS FOR YEAR 28

	INCHES	CU. FEET	PERCENT
PRECIPITATION	45.18	164003.359	100.00
RUNOFF	11.571	42004.523	25.61
EVAPOTRANSPIRATION	27.790	100875.922	61.51
DRAINAGE COLLECTED FROM LAYER 4	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 6	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 5	0.0000		
CHANGE IN WATER STORAGE	5.819	21123.082	12.88
SOIL WATER AT START OF YEAR	766.431	2782144.750	
SOIL WATER AT END OF YEAR	772.250	2803267.750	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	-0.170	0.00

MONTHLY TOTALS (IN INCHES) FOR YEAR 29

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	8.05 5.35	2.10 3.72	8.59 2.36	7.13 6.26	6.01 5.12	8.31 5.36
RUNOFF	3.050 1.711	3.357 0.592	3.326 0.455	2.588 2.481	1.470 1.925	2.688 1.034
EVAPOTRANSPIRATION	0.661 3.977	0.567 3.133	2.430 0.818	3.635 1.352	5.222 0.834	7.209 0.566
LATERAL DRAINAGE COLLECTED FROM LAYER 4	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000
PERCOLATION/LEAKAGE THROUGH LAYER 6	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 5	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 5	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000

ANNUAL TOTALS FOR YEAR 29

	INCHES	CU. FEET	PERCENT
PRECIPITATION	68.36	248146.750	100.00
RUNOFF	24.677	89577.805	36.10
EVAPOTRANSPIRATION	30.405	110370.039	44.48
DRAINAGE COLLECTED FROM LAYER 4	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 6	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 5	0.0000		
CHANGE IN WATER STORAGE	13.278	48198.953	19.42
SOIL WATER AT START OF YEAR	772.250	2803267.750	
SOIL WATER AT END OF YEAR	783.923	2845640.750	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	1.605	5825.835	2.35
ANNUAL WATER BUDGET BALANCE	0.0000	-0.054	0.00

MONTHLY TOTALS (IN INCHES) FOR YEAR 30

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	2.02 3.99	1.24 0.38	5.86 6.34	2.65 6.41	2.08 1.89	1.82 4.28
RUNOFF	1.490 1.428	0.560 0.000	1.663 1.866	0.271 3.111	0.019 0.082	0.199 0.927
EVAPOTRANSPIRATION	0.572 2.562	0.431 0.380	2.368 2.066	3.423 1.934	2.234 1.145	3.507 1.035
LATERAL DRAINAGE COLLECTED FROM LAYER 4	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000
PERCOLATION/LEAKAGE THROUGH LAYER 6	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 5	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 5	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000

ANNUAL TOTALS FOR YEAR 30

	INCHES	CU. FEET	PERCENT
PRECIPITATION	38.96	141424.828	100.00
RUNOFF	11.615	42163.184	29.81
EVAPOTRANSPIRATION	21.658	78619.023	55.59
DRAINAGE COLLECTED FROM LAYER 4	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 6	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 5	0.0000		
CHANGE IN WATER STORAGE	5.687	20642.566	14.60
SOIL WATER AT START OF YEAR	783.923	2845640.750	
SOIL WATER AT END OF YEAR	790.780	2870532.750	
SNOW WATER AT START OF YEAR	1.605	5825.835	4.12
SNOW WATER AT END OF YEAR	0.434	1576.404	1.11
ANNUAL WATER BUDGET BALANCE	0.0000	0.054	0.00

MONTHLY TOTALS (IN INCHES) FOR YEAR 31

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	1.68 2.56	0.64 1.74	4.01 2.98	4.21 2.88	3.90 1.21	3.86 8.76
RUNOFF	0.959 0.345	0.002 0.157	0.313 0.210	0.450 0.162	0.220 0.075	0.367 3.988
EVAPOTRANSPIRATION	0.396 2.997	1.039 1.602	2.007 2.134	4.124 1.539	3.260 0.881	5.178 0.763
LATERAL DRAINAGE COLLECTED	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

FROM LAYER 4	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
PERCOLATION/LEAKAGE THROUGH LAYER 6	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 5	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 5	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000

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ANNUAL TOTALS FOR YEAR 31

	INCHES	CU. FEET	PERCENT
PRECIPITATION	38.43	139500.906	100.00
RUNOFF	7.248	26309.857	18.86
EVAPOTRANSPIRATION	25.920	94089.437	67.45
DRAINAGE COLLECTED FROM LAYER 4	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 6	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 5	0.0000		
CHANGE IN WATER STORAGE	5.262	19101.568	13.69
SOIL WATER AT START OF YEAR	790.780	2870532.750	
SOIL WATER AT END OF YEAR	796.477	2891210.750	
SNOW WATER AT START OF YEAR	0.434	1576.404	1.13
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.040	0.00

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CHANGE IN WATER STORAGE	5.817		21116.111			12.35
SOIL WATER AT START OF YEAR	796.477		2891210.750			
SOIL WATER AT END OF YEAR	802.265		2912223.250			
SNOW WATER AT START OF YEAR	0.000		0.000			0.00
SNOW WATER AT END OF YEAR	0.029		103.587			0.06
ANNUAL WATER BUDGET BALANCE	0.0000		-0.085			0.00

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MONTHLY TOTALS (IN INCHES) FOR YEAR 33

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	3.42 5.60	2.71 3.22	4.10 2.02	3.03 1.94	1.63 2.77	4.32 3.04
RUNOFF	0.880 0.957	0.314 0.430	0.661 0.121	0.312 0.345	0.038 0.240	0.759 1.242
EVAPOTRANSPIRATION	0.867 3.699	1.305 4.236	2.159 1.176	3.650 1.158	2.666 0.519	4.489 0.539
LATERAL DRAINAGE COLLECTED FROM LAYER 4	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000
PERCOLATION/LEAKAGE THROUGH LAYER 6	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY BEAD ON TOP OF LAYER 5	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 5	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000

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MONTHLY TOTALS (IN INCHES) FOR YEAR 32

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	0.95 7.38	4.60 8.21	4.09 4.59	0.64 3.00	3.91 3.10	2.40 4.24
RUNOFF	0.011 3.259	2.385 3.405	1.358 1.215	0.000 0.444	1.508 0.072	0.370 2.149
EVAPOTRANSPIRATION	0.756 2.556	0.645 6.251	2.212 2.588	1.743 1.220	1.986 0.642	4.124 0.393
LATERAL DRAINAGE COLLECTED FROM LAYER 4	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000
PERCOLATION/LEAKAGE THROUGH LAYER 6	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 5	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 5	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000

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ANNUAL TOTALS FOR YEAR 32

	INCHES	CU. FEET	PERCENT
PRECIPITATION	47.11	171009.375	100.00
RUNOFF	16.177	58722.539	34.34
EVAPOTRANSPIRATION	25.116	91170.805	53.31
DRAINAGE COLLECTED FROM LAYER 4	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 6	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 5	0.0000		

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ANNUAL TOTALS FOR YEAR 33

	INCHES	CU. FEET	PERCENT
PRECIPITATION	37.80	137213.984	100.00
RUNOFF	6.298	22860.926	16.66
EVAPOTRANSPIRATION	26.463	96059.867	70.01
DRAINAGE COLLECTED FROM LAYER 4	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 6	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 5	0.0000		
CHANGE IN WATER STORAGE	5.039	18293.229	13.33
SOIL WATER AT START OF YEAR	802.265	2912223.250	
SOIL WATER AT END OF YEAR	807.333	2930620.250	
SNOW WATER AT START OF YEAR	0.029	103.587	0.08
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	-0.035	0.00

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MONTHLY TOTALS (IN INCHES) FOR YEAR 34

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	0.66 2.67	1.49 1.56	3.09 3.30	2.64 2.64	1.65 5.00	2.73 1.38
RUNOFF	0.016 0.235	0.233 0.004	0.112 0.194	0.013 0.403	0.023 1.174	0.22 0.00
EVAPOTRANSPIRATION	0.533 2.259	0.993 1.468	2.312 2.663	2.655 1.293	2.411 1.023	4.326 0.599
LATERAL DRAINAGE COLLECTED	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

FROM LAYER 4	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
PERCOLATION/LEAKAGE THROUGH LAYER 6	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 5	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 5	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000

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ANNUAL TOTALS FOR YEAR 34

	INCHES	CU. FEET	PERCENT
PRECIPITATION	28.81	104580.328	100.00
RUNOFF	2.635	9565.111	9.15
EVAPOTRANSPIRATION	22.533	81794.687	78.21
DRAINAGE COLLECTED FROM LAYER 4	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 6	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 5	0.0000		
CHANGE IN WATER STORAGE	3.642	13220.343	12.64
SOIL WATER AT START OF YEAR	807.333	2930620.250	
SOIL WATER AT END OF YEAR	810.975	2943840.500	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0001	0.182	0.00

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CHANGE IN WATER STORAGE	6.704	24335.002	16.17			
SOIL WATER AT START OF YEAR	810.975	2943840.500				
SOIL WATER AT END OF YEAR	817.679	2968175.500				
SNOW WATER AT START OF YEAR	0.000	0.000	0.00			
SNOW WATER AT END OF YEAR	0.000	0.000	0.00			
ANNUAL WATER BUDGET BALANCE	0.0000	-0.035	0.00			

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MONTHLY TOTALS (IN INCHES) FOR YEAR 36

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	2.12 2.92	4.54 0.75	4.19 8.39	4.19 1.47	8.03 1.75	5.64 0.61
RUNOFF	0.739 0.405	1.656 0.005	1.207 3.355	0.197 0.041	1.825 0.032	1.080 0.000
EVAPOTRANSPIRATION	1.016 2.732	0.896 0.426	2.728 1.481	4.349 1.760	4.527 1.130	7.178 0.806
LATERAL DRAINAGE COLLECTED FROM LAYER 4	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000
PERCOLATION/LEAKAGE THROUGH LAYER 6	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 5	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 5	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000

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MONTHLY TOTALS (IN INCHES) FOR YEAR 35

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	1.87 2.42	1.39 5.10	4.15 3.84	2.02 3.78	1.86 1.81	5.95 7.26
RUNOFF	0.414 0.088	0.292 0.757	0.501 1.526	0.036 0.676	0.033 0.184	0.494 3.420
EVAPOTRANSPIRATION	0.600 3.315	0.727 3.461	2.627 1.559	2.918 1.469	1.951 0.915	6.344 0.440
LATERAL DRAINAGE COLLECTED FROM LAYER 4	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000
PERCOLATION/LEAKAGE THROUGH LAYER 6	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 5	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 5	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000

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ANNUAL TOTALS FOR YEAR 35

	INCHES	CU. FEET	PERCENT
PRECIPITATION	41.45	150463.469	100.00
RUNOFF	8.422	30570.783	20.32
EVAPOTRANSPIRATION	26.324	95557.727	63.51
DRAINAGE COLLECTED FROM LAYER 4	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 6	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 5	0.0000		

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ANNUAL TOTALS FOR YEAR 36

	INCHES	CU. FEET	PERCENT
PRECIPITATION	44.60	161897.969	100.00
RUNOFF	10.542	38267.664	23.64
EVAPOTRANSPIRATION	29.029	105376.187	65.09
DRAINAGE COLLECTED FROM LAYER 4	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 6	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 5	0.0000		
CHANGE IN WATER STORAGE	5.029	18254.133	11.28
SOIL WATER AT START OF YEAR	817.679	2968175.500	
SOIL WATER AT END OF YEAR	822.708	2986429.750	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	-0.017	0.00

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MONTHLY TOTALS (IN INCHES) FOR YEAR 37

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	7.06 6.60	1.11 4.24	2.48 3.95	2.14 1.63	2.69 1.57	7.65 1.38
RUNOFF	3.671 3.166	0.316 1.011	0.003 0.922	0.056 0.065	0.435 0.079	1.578 0.067
EVAPOTRANSPIRATION	0.777 3.875	0.948 3.536	2.458 1.545	2.762 1.523	2.871 0.759	6.710 0.532
LATERAL DRAINAGE COLLECTED	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

FROM LAYER 4	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
PERCOLATION/LEAKAGE THROUGH LAYER 6	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 5	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 5	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000

****

ANNUAL TOTALS FOR YEAR 37

	INCHES	CU. FEET	PERCENT
PRECIPITATION	42.50	154274.984	100.00
RUNOFF	11.370	41271.980	26.75
EVAPOTRANSPIRATION	28.297	102717.086	66.58
DRAINAGE COLLECTED FROM LAYER 4	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 6	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 5	0.0000		
CHANGE IN WATER STORAGE	2.834	10285.812	6.67
SOIL WATER AT START OF YEAR	822.708	2986429.750	
SOIL WATER AT END OF YEAR	825.541	2996715.500	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.104	0.00

****

CHANGE IN WATER STORAGE	4.599	16694.588	10.93			
SOIL WATER AT START OF YEAR	825.541	2996715.500				
SOIL WATER AT END OF YEAR	830.141	3013410.000				
SNOW WATER AT START OF YEAR	0.000	0.000	0.00			
SNOW WATER AT END OF YEAR	0.000	0.000	0.00			
ANNUAL WATER BUDGET BALANCE	0.0000	0.128	0.00			

****

MONTHLY TOTALS (IN INCHES) FOR YEAR 39

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	0.98 5.57	4.73 8.02	8.53 7.27	3.09 4.94	5.72 3.35	3.65 3.28
RUNOFF	0.157 0.937	0.898 1.904	7.318 2.631	0.153 2.413	1.547 0.326	0.798 0.259
EVAPOTRANSPIRATION	0.474 5.741	0.286 4.475	1.302 3.600	3.686 1.346	4.269 0.911	3.440 0.842
LATERAL DRAINAGE COLLECTED FROM LAYER 4	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000
PERCOLATION/LEAKAGE THROUGH LAYER 6	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 5	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 5	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000

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MONTHLY TOTALS (IN INCHES) FOR YEAR 38

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	4.44 3.62	2.19 4.51	3.41 2.28	4.62 4.43	2.81 3.12	4.90 1.74
RUNOFF	2.734 0.097	1.305 0.894	1.838 0.143	0.213 1.105	0.243 0.469	0.491 0.049
EVAPOTRANSPIRATION	0.511 3.337	0.460 4.363	1.924 1.171	3.750 1.324	4.312 0.890	5.099 0.749
LATERAL DRAINAGE COLLECTED FROM LAYER 4	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000
PERCOLATION/LEAKAGE THROUGH LAYER 6	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 5	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 5	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000

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ANNUAL TOTALS FOR YEAR 38

	INCHES	CU. FEET	PERCENT
PRECIPITATION	42.07	152714.141	100.00
RUNOFF	9.582	34780.859	22.78
EVAPOTRANSPIRATION	27.889	101238.562	66.29
DRAINAGE COLLECTED FROM LAYER 4	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 6	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 5	0.0000		

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ANNUAL TOTALS FOR YEAR 39

	INCHES	CU. FEET	PERCENT
PRECIPITATION	59.13	214641.937	100.00
RUNOFF	19.340	70205.977	32.71
EVAPOTRANSPIRATION	30.371	110248.086	51.36
DRAINAGE COLLECTED FROM LAYER 4	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 6	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 5	0.0000		
CHANGE IH WATER STORAGE	9.418	34187.891	15.93
SOIL WATER AT START OF YEAR	830.141	3013410.000	
SOIL WATER AT END OF YEAR	839.559	3047598.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	-0.021	0.00

****

MONTHLY TOTALS (IN INCHES) FOR YEAR 40

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	3.86 5.26	2.74 7.89	3.83 3.89	3.55 2.25	5.78 4.13	4.63 1.23
RUNOFF	0.366 1.213	0.202 2.286	1.354 0.926	0.343 0.254	1.084 1.225	0.862 0.003
EVAPOTHANSPIRATION	1.107 4.212	1.452 4.615	2.232 2.896	3.980 1.164	3.295 0.781	6.808 0.565
LATERAL DRAINAGE COLLECTED	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

FROM LAYER 4	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
PERCOLATION/LEAKAGE THROUGH LAYER 6	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 5	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 5	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000

ANNUAL TOTALS FOR YEAR 40

	INCHES	CU. FEET	PERCENT
PRECIPITATION	49.04	178015.187	100.00
RUNOFF	10.118	36728.961	20.63
EVAPOTRANSPIRATION	33.107	120177.656	67.51
DRAINAGE COLLECTED FROM LAYER 4	0.0000	0.000	0.00
PERC./LEAKAGE THROUGH LAYER 6	0.000000	0.000	0.00
AVG. HEAD ON TOP OF LAYER 5	0.0000		
CHANGE IN WATER STORAGE	5.815	21108.627	11.86
SOIL WATER AT START OF YEAR	839.559	3047598.000	
SOIL WATER AT END OF YEAR	845.185	3068020.500	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.189	686.110	0.39
ANNUAL WATER BUDGET BALANCE	0.0000	-0.054	0.00

AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1 THROUGH 40

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	3.51 4.54	2.48 4.67	4.54 4.81	3.60 3.30	3.57 3.09	4.75 3.30
STD. DEVIATIONS	2.09 2.19	1.27 2.72	1.77 2.88	1.65 1.80	1.84 1.46	1.72 2.20
RUNOFF						
TOTALS	1.297 1.186	1.319 1.134	1.592 1.555	0.466 0.908	0.548 0.570	0.808 0.763
STD. DEVIATIONS	1.216 1.179	1.078 1.190	1.774 1.689	0.722 0.968	0.645 0.621	0.558 1.061
EVAPOTRANSPIRATION						
TOTALS	0.696 3.506	0.715 3.406	2.190 2.014	3.467 1.422	3.255 0.943	5.388 0.650
STD. DEVIATIONS	0.238 1.277	0.403 1.520	0.439 0.807	0.660 0.243	1.009 0.212	1.232 0.162
LATERAL DRAINAGE COLLECTED FROM LAYER 4						
TOTALS	0.0288 0.0000	0.0042 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000
STD. DEVIATIONS	0.1823 0.0000	0.0266 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000
PERCOLATION/LEAKAGE THROUGH LAYER 6						
TOTALS	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000
STD. DEVIATIONS	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000

AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)

DAILY AVERAGE HEAD ON TOP OF LAYER 5						
AVERAGES	0.0001	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0004 0.0000	0.0001 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000

AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1 THROUGH 40

	INCHES		CU. FEET	PERCENT
PRECIPITATION	46.15	(8.949)	167511.8	100.00
RUNOFF	12.148	(5.2950)	44095.67	26.324
EVAPOTRANSPIRATION	27.652	(3.1332)	100377.84	59.923
LATERAL DRAINAGE COLLECTED FROM LAYER 4	0.03303	(0.20893)	119.917	0.07159
PERCOLATION/LEAKAGE THROUGH LAYER 6	0.00000	(0.00000)	0.000	0.00000
AVERAGE HEAD ON TOP OF LAYER 5	0.000	(0.000)		
CHANGE IN WATER STORAGE	6.314	(2.4147)	22918.36	13.682

PEAK DAILY VALUES FOR YEARS 1 THROUGH 40

	(INCHES)	(CU. FT.)
PRECIPITATION	5.15	18694.500
RUNOFF	4.174	15150.4219
DRAINAGE COLLECTED FROM LAYER 4	0.08712	316.24957
PERCOLATION/LEAKAGE THROUGH LAYER 6	0.000000	0.00020
AVERAGE HEAD ON TOP OF LAYER 5	0.006	
MAXIMUM HEAD ON TOP OF LAYER 5	0.012	
LOCATION OF MAXIMUM HEAD IN LAYER 4 (DISTANCE FROM DRAIN)	0.0 FEET	
SNOW WATER	8.08	29328.5547

MAXIMUM VEG. SOIL WATER (VOL/VOL) 0.3703

MINIMUM VEG. SOIL WATER (VOL/VOL) 0.1285

*** Maximum heads are computed using McEnroe's equations. ***

Reference: Maximum Saturated Depth over Landfill Liner
by Bruce M. McEnroe, University of Kansas
ASCE Journal of Environmental Engineering
Vol. 119, No. 2, March 1993, pp. 262-270.

FINAL WATER STORAGE AT END OF YEAR 40

LAYER	(INCHES)	(VOL/VOL)
1	3.4302	0.2859
2	402.4313	0.2096
3	7.3680	0.3070
4	0.0020	0.0100
5	0.0000	0.0000
6	431.9532	0.4270
SNOW WATER	0.189	

Appendix VIb-G.2

Geotextile Filter/ Protective Cover Soil Clogging Evaluation

GEOSYNTEC CONSULTANTS

COMPUTATION COVER SHEET

Client: DSWA **Project:** Cherry Island **Project/Proposal #:** ME0250 **Task #:** 2.2

TITLE OF COMPUTATIONS GEOTEXTILE FILTER/PROTECTIVE COVER SOIL CLOGGING EVALUATION

COMPUTATIONS BY:
Signature Carrie H. Pendleton — DATE 04/01/03
Printed Name and Title: Carrie H. Pendleton, Staff Engineer

ASSUMPTIONS AND PROCEDURES CHECKED BY:
(Peer Reviewer)
Signature — DATE 04/01/03
Printed Name and Title: R. David Espinoza, Senior Engineer

COMPUTATIONS CHECKED BY:
Signature Douglas T. Mandeville — DATE 4/1/03
Printed Name and Title: Douglas T. Mandeville, Senior Staff Engineer

COMPUTATIONS BACKCHECKED BY:
(Originator)
Signature Carrie H. Pendleton — DATE 04/01/03
Printed Name and Title: Carrie H. Pendleton, Staff Engineer

APPROVED BY:
(PM or Designate)
Signature — DATE 04/01/03
Printed Name and Title: R. David Espinoza, Senior Engineer

APPROVAL NOTES:

REVISIONS (Number and initial all revisions)

NO.	SHEET	DATE	BY	CHECKED BY	APPROVAL

Written by: Carrie Pendleton Date: 04/01/03 Reviewed by: Doug Mandeville Date: 04/01/03

Client: DSWA Project: Cherry Island Proj./Proposal No.: ME0250 Task No.: 2.2.7

GEOTEXTILE FILTER/PROTECTIVE COVER SOIL CLOGGING EVALUATION

INTRODUCTION

The purpose of this package is to present an evaluation of the clogging potential of the geotextiles proposed to be used for the proposed expansion at Cherry Island Landfill (CIL). The various soil types which will come into contact with a geotextile are granular fill, structural fill, backdrain fill, and the existing dredge/alluvium subsurface layer.

GEOTEXTILE FILTER EVALUATION

Method

A geotextile filter was considered for separating the AASHTO No. 57 stone, which is placed around leachate collection pipes, from the drainage/protective cover layer (similar criteria applies for the geotextile component of the geocomposite, if used). The method used to evaluate the factor of safety against clogging was developed by Koerner et al. [1994]. This evaluation is presented briefly below.

Leachate has high suspended solids as well as high organic content [Koerner et al., 1994]. This can lead to filters becoming excessively clogged when permeated with leachate over long periods of time. Therefore, the geotextile biological clogging potential is checked using the following method based on Koerner et al. [1994].

Permeability Criterion

- Step 1. Determine k_{allow} for the proposed geotextile from Figure 1 based on material type and leachate flow rate (i.e., Leachate Generation Analysis calculation package).
- Step 2. Determine a drain correction factor (DCF) using the equation:

$$DCF = \frac{\text{Plan Area of Cell}}{\text{Area of Flow through Filter}}$$

Note that the area of flow through the filter depends on the height of leachate flow. Leachate heads for various conditions are presented in Appendix V1b-G.1 ("Leachate Generation Analysis").

- Step 3. Assume $k_{req'd}$ is equivalent to the impingement rate calculated using HELP (see Appendix V1b-G.1, "Leachate Generation Analysis").
- Step 4. Calculate the factor of safety (FS) against clogging (a minimum FS of 10 is acceptable):

$$FS = \frac{(k_{allow})}{(DCF)(k_{req})}$$

- Step 5. Select a geotextile such that the filter criteria proposed by Holtz and Kovacs [1984] (Table 1) is met.

Calculations

Step 1: From the HELP analysis results presented in Appendix V1b-G.1 ("Leachate Generation Analysis"), a representative leachate generation rate corresponding to the progressive cover condition is 2,366 gallons per acre per day (gpad). The candidate geotextile filter is 8 oz./yd^2 needle-punched non-woven geotextile (i.e., material H 8 NPNW on Figure 2). From Figure 1, $k_{allow} = 7\times10^{-3}$ cm/s.

Step 2: The plan area of Phase Va is approximately 10 acres and has a total of approximately 670 ft of leachate collection trenches (i.e., the length of the filter flow area). The height of the filter flow area is taken to be the maximum average peak daily leachate head calculated in the "Leachate Generation Analysis" calculation package for the progressive cover and intermediate cover cell conditions (i.e., 10.5 in).

$$DCF = \frac{(10\text{ ac.})(43{,}560\text{ ft}^2/\text{ac.})}{(670\text{ ft})[(10.5\text{ in.})/(12\text{ in./ft})](2\text{ sides})} = 372$$

Step 3: Select $k_{req'd}$ to be equal to the historical 10-year average leachate generation rate (i.e., **780 gal./ac.-day (8.44×10^{-7} cm/s)**).

Step 4: Calculate the factor of safety.

$$FS = \frac{\left(7 \times 10^{-3}\ \text{cm/s}\right)}{(372)(8.44 \times 10^{-7}\ \text{cm/s})} = 22$$

Step 5: The protective cover soil around the proposed geotextile shall comply with the retention criterion presented by Christopher and Holtz [1984], which is presented on the attached Table 1.

REFERENCES

Christopher, B.R. and Holtz, R.D., *"Geotextile Engineering Manual"*, FHWA-DTFH61-80-C-00094, 1984.

Koerner, G.R., Koerner, R.M., and Martin, J.P., "Design of Landfill Leachate-Collection Filters", *ASCE Journal of Geotechnical Engineering*, Vol. 120, No. 10, October 1994, p. 1792-1803.

TABLE 1: Filter Criteria for Geotextile, Adapted From [Christopher and Holtz, 1984]

1. RETENTION CRITERION

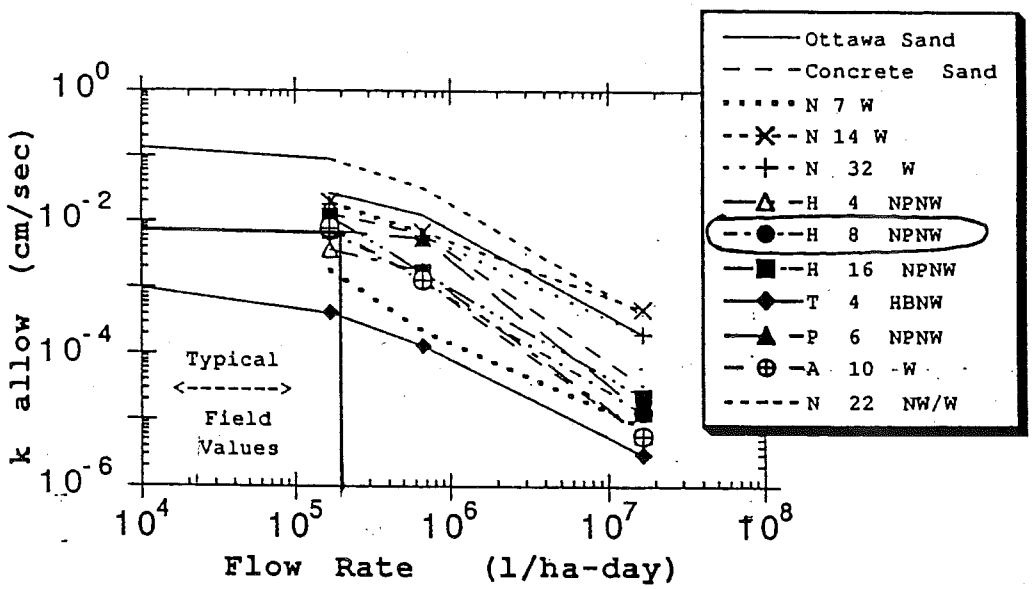
1.1 Soils with less than 50 percent particles < 0.075 mm (> US Sieve No. 200)

	Density index of the soil (Relative density)	Linear coefficient of uniformity of the soil	
		$1 < C'_u < 3$	$C'_u > 3$
loose soil	$I_D < 35\%$	$O_{95} < C'_u\, d_{50}$	$O_{95} < \frac{9}{C'_u} d_{50}$
medium dense soil	$35\% < I_D < 65\%$	$O_{95} < 1.5\, C'_u\, d_{50}$	$O_{95} < \frac{13.5}{C'_u} d_{50}$
dense soil	$I_D > 65\%$	$O_{95} < 2\, C'_u\, d_{50}$	$O_{95} < \frac{18}{C'_u} d_{50}$

1.2 Soils with more than 50 percent particles < 0.075 mm (US Sieve 200)

$O_{95} \leq 210\ \mu m$ ($\geq$ US Sieve 70)

FIGURE 1



Average Master Curve for Obtaining k_{allow} of All 12 Filters Tested for this Investigation (Note that 1 gal./acre-day = 9.35 L/ha-day)

SOURCE: [KOERNER ET AL., 1994]

Flow Rate = 2,366 gpad = 22,122 L/ha-day ≈ 2.2×10^4 L/ha-day

Since the appropriate curve doesn't extend to this low of a flow rate, we will use a flow rate of 2×10^5 L/ha-day. This will result in a conservative estimate of k_{allow}.

$$k_{allow} \approx 7 \times 10^{-3} \text{ cm/s}$$

Appendix VIb-G.3

Flow Capacity of Leachate Collection Pipes

GEOSYNTEC CONSULTANTS

COMPUTATION COVER SHEET

Client: DSWA **Project:** Cherry Island Landfill **Project/Proposal #:** ME0250 **Task #:** ____

TITLE OF COMPUTATIONS FLOW CAPACITY OF LEACHATE COLLECTION PIPES

COMPUTATIONS BY:
Signature Carrie H. Pendleton — DATE 03/18/03
Printed Name and Title: Carrie H. Pendleton, Staff Engineer

ASSUMPTIONS AND PROCEDURES CHECKED BY:
(Peer Reviewer)
Signature Douglas T. Mandeville — DATE 3/21/03
Printed Name and Title: Douglas T. Mandeville, Senior Staff Engineer

COMPUTATIONS CHECKED BY:
Signature Douglas T. Mandeville — DATE 3/21/03
Printed Name and Title: Douglas T. Mandeville, Senior Staff Engineer

COMPUTATIONS BACKCHECKED BY:
iginator)
Signature Carrie H. Pendleton — DATE 03/27/03
Printed Name and Title: Carrie H. Pendleton, Staff Engineer

APPROVED BY:
(PM or Designate)
Signature [illegible] — DATE 3/30/03
Printed Name and Title: R. David Espinoza, Senior Engineer

APPROVAL NOTES: ____

REVISIONS (Number and initial all revisions)

NO.	SHEET	DATE	BY	CHECKED BY	APPROVAL

Written by: C. Pendleton Date: 03/18/03 Reviewed by: D. Mandeville Date: 03/21/03

Client: DSWA Project: Cherry Island Proj./Proposal No.: ME0250 Task No.:

FLOW CAPACITY OF LEACHATE COLLECTION PIPES

PURPOSE

The purpose of this calculation is to evaluate the flow capacity of the proposed leachate collection system (LCS) pipe design at the Cherry Island Landfill (CIL). To satisfy the Delaware Regulations Governing Solid Waste (DRGSW), the LCS must efficiently convey the leachate volume collected in the drainage layer to the leachate collection sump.

The maximum flow capacity of the pipe will be evaluated, and a factor of safety against pipe overflow will be calculated. The factor of safety is defined by the ratio of the maximum flow capacity to the required conveyance. A computed factor of safety greater than one is considered adequate for the proposed design. Also, part of this calculation package is an evaluation of the minimum pipe perforation size.

BACKGROUND

The DRGSW stipulate that the leachate control system "shall be sized according to water balance calculations and shall be capable of handling peak flows". Monthly leachate generation has been modeled in the design calculation entitled, "Leachate Generation Analysis" presented in Appendix VIb-G.1. Based on the peak flow from this calculation package, the daily leachate flow is estimated.

PROCEDURE

The volume of leachate required to flow through the LCS at any one time is based on the per acre impingement rate (the volume of leakage into the system over a given time) calculated in the "Leachate Generation Analysis" calculation package. The maximum impingement rate calculated for the LCS corresponds to the progressive cover condition for Phase VA and is calculated to be 2,366 gallons per acre per day (gpad) (from Leachate Generation Analysis, GeoSyntec, 2003). The maximum flow rate of leachate entering a collection pipe may be conservatively calculated by multiplying the rate of impingement on the LCS drainage layer by the plan area of Phase VA, which is approximately 10 acres. The maximum flow is calculated by the following equation:

$$Q_{max} = q_i A_d$$

where:

Q_{max} = flow rate (gpd)
q_i = impingement rate (gpad)
A_d = plan area of largest cell (ac)

LCS Pipe Flow Capacity:

The pipe capacity is calculated using Manning's equation:

$$Q_{avail} = \frac{1.49}{n} A R_h^{2/3} S^{1/2}$$

where:

Q_{avail} = available flow rate (cfs)
R_h = hydraulic radius (ft) (wetted area/wetted perimeter)
S = hydraulic gradient (ft/ft)
A = cross-sectional flow area (ft^2)
n = Manning's roughness coefficient

The factor of safety against pipe overflow is:

$$FS = \frac{Q_{avail}}{Q_{max}}$$

CALCULATIONS

The proposed LCS pipe design is an 8 inch nominal outer diameter (OD) HDPE pipe. Manufacturer literature for HDPE pipe specifies a Manning's coefficient, n, of 0.009. The hydraulic gradient used in calculating the full flow pipe capacity is a conservative value of ½ percent, which is the minimum calculated slope after all settlement has occurred.

Using the equations described in the procedures section of this calculation package, the maximum flow into the leachate collection system is:

$$Q_{max} = \left(2{,}366 \frac{\text{gal}}{\text{day ac}}\right)(10\text{ac}) = \mathbf{23{,}660\ gal/day}$$

$$Q_{max} = 23{,}660 \frac{gal}{day} \times \frac{day}{1440 min} = \mathbf{16.43\ gal/min}$$

For an average leachate collection pipe length of 500 ft, the maximum flow per linear foot is equal to 16.43 gpm/500 ft = 0.033 gpm/lf.

The full flowing pipe capacity for an 8 inch nominal pipe size:

$$Q_{avail} = \frac{1.49}{0.009}\left(0.3491 ft^2\right)\left(\frac{0.3491 ft^2}{2.094 ft}\right)^{2/3}(0.005)^{1/2} = \mathbf{1.24\ ft^3/sec}$$

$$Q_{avail} = 1.24 \frac{ft^3}{sec} \times \frac{60 sec}{min} \times \frac{7.48 gal}{ft^3} = \mathbf{556\ gal/min}$$

$$V_{max} = \frac{1.49}{0.009}\left(\frac{0.3491 ft^2}{2.094 ft}\right)^{2/3}(0.005)^{1/2} = \mathbf{3.5\ ft/sec}$$

The factor of safety for the leachate collection pipe is:

$$Fs = \frac{Q_{avail}}{Q_{max}} = \frac{556\ gal/min}{16.43 gal/min} = \mathbf{33.8}$$

Pipe Perforation Sizing

Maximum allowable diameter of perforations in the collector pipe will be specified to ensure the retention of the LCS gravel particles (DEL NO. 57 stone). The maximum allowable diameter of the perforations in the collector pipes to provide particle retention of gravel particles may be determined as follows [USEPA, 1983]:

$$d_{h\,max} = \frac{d_{85}}{F} \qquad (6)$$

Where:

d_{hmax}	=	Maximum perforation diameter to provide particle retention
d_{85}	=	Particle size of the pipe bedding material for which 85 percent by weight of the particle are finer
F	=	Factor varying between 1.2 to 2

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For calculations of the maximum perforation diameter in the leachate collection pipes surrounded by DEL NO. 57 stone a particle gradation curve is shown in Figure 1. The range of d_{85} taken from Figure 1 varies from 23 mm (0.905 inches) to 30 mm (1.18 inches). For design, the minimum d_{85} will be used with an F factor of 1.8. The maximum pipe perforation size allowable for pipes surrounded by DEL NO. 57 stone varies from 1/2 inch to 5/8 inch.

The ability of the pipe perforation to convey leachate collected is evaluated using the equation of flow (Q) through an orifice:

$$Q = a\, C_B \sqrt{2gh}$$

where a is the area of the orifice; C_B is the orifice coefficient (usually 0.6); g is the acceleration of gravity; and h is the liquid depth above the hole. Thus for a pipe perforation equal to 0.5-in. and a leachate head equal to 0.5 ft, the calculated flow is:

$$Q = 0.25\ (0.5/12)^2\ \pi\ (0.6)\ \sqrt{2(32.2\ \text{ft}/\text{s}^2)(0.5\ \text{ft})} = 0.046\ \text{cfs} = 2.08\ \text{gpm}/\text{hole}$$

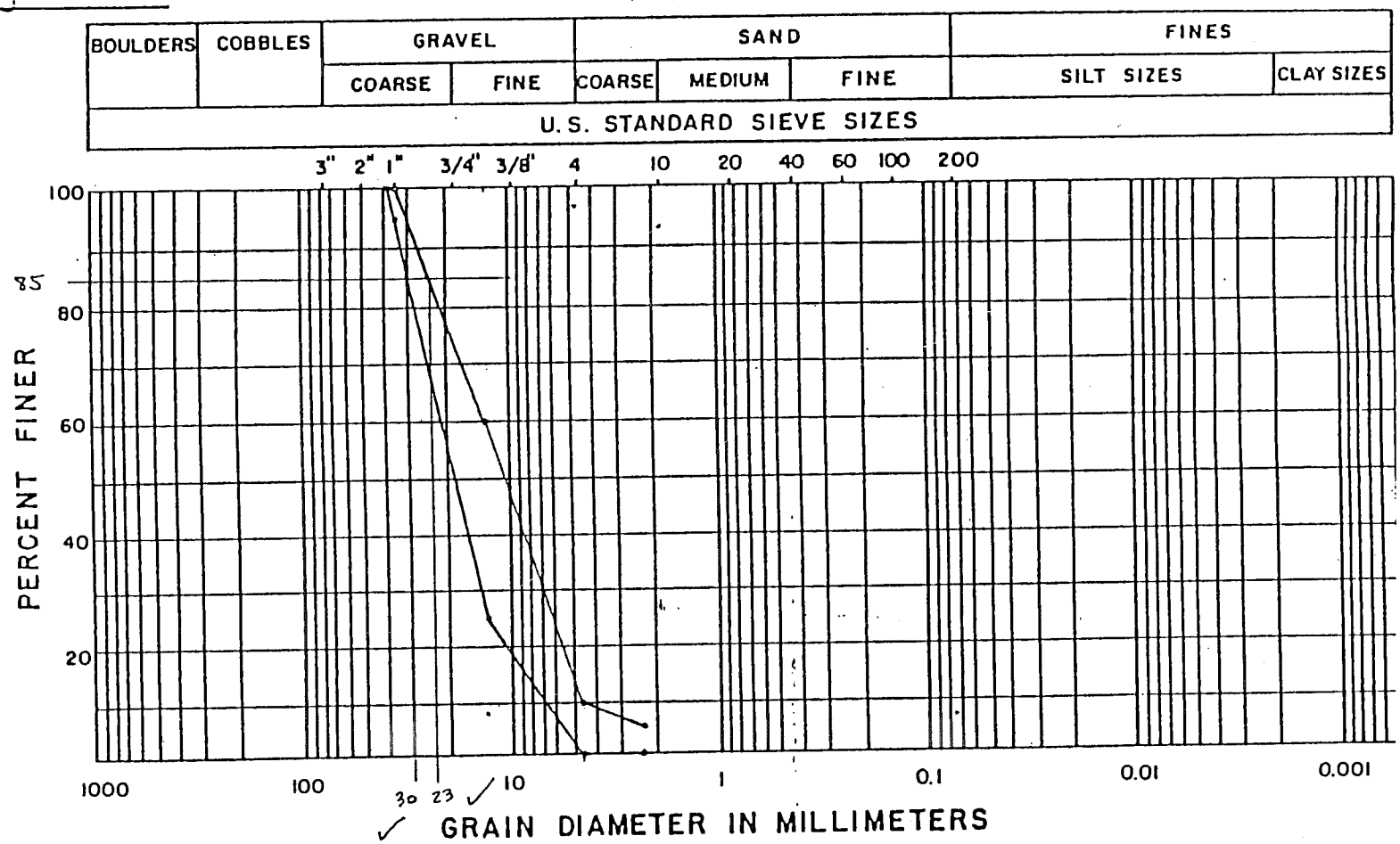
Thus, the 0.5-in perforations spaced every 6-in. will have more than enough capacity to handle 0.033 gpm/lf.

CONCLUSION

Based on the analysis shown here, an 8-in diameter leachate collection system pipe can adequately covey the expected leachate flow. The maximum pipe perforation size allowable for pipes surrounded by DEL NO. 57 stone is 0.5 inch.

FIGURE 1

SOIL DESCRIPTION AASHTO #57 STONE



NOTE: AASHTO #57 STONE HAS THE SAME PROPERTIES AS DEL NO. 57 STONE.

Appendix VIb-G.4

Structural Integrity of Leachate Collection Pipes

GEOSYNTEC CONSULTANTS

COMPUTATION COVER SHEET

Client: DSWA Project: Cherry Island Project/Proposal #: ME0250 Task #: 2.2.7

TITLE OF COMPUTATIONS STRUCTURAL INTEGRITY OF LEACHATE COLLECTION PIPES

COMPUTATIONS BY:
Signature Douglas T. Mandeville 9/3/03 DATE
Printed Name Douglas T. Mandeville
and Title Senior Staff Engineer

ASSUMPTIONS AND PROCEDURES CHECKED BY:
(Peer Reviewer)
Signature 9/3/03 DATE
Printed Name R. David Espinoza
and Title Senior Engineer

COMPUTATIONS CHECKED BY:
Signature Carrie H. Pendleton 09/03/2003 DATE
Printed Name Carrie H. Pendleton
and Title Staff Engineer

COMPUTATIONS BACKCHECKED BY:
(Originator)
Signature Douglas T. Mandeville 9/3/03 DATE
Printed Name Douglas T. Mandeville
and Title Senior Staff Engineer

APPROVED BY:
(PM or Designate)
Signature 9/3/03 DATE
Printed Name R. David Espinoza
and Title Senior Engineer

APPROVAL NOTES: The calculations presented herein are suitable for a landfill elevation of 195 ft-msl. As shown in this calculation package, the design was performed for a more conservative grading configuration than that shown in Drawing 78 entitled "Landfill Final Development and Grading Plan" (Appendix VIb-A).

RDE 6/10/04

REVISIONS (Number and initial all revisions)

NO.	SHEET	DATE	BY	CHECKED BY	APPROVAL

Written by: Doug Mandeville Date: 9/3/03 Reviewed by: Carrie Pendleton Date:

Client: DSWA Project: Cherry Island Proj./Proposal No.: ME0250 Task No.: 2.2.7

STRUCTURAL INTEGRITY OF LEACHATE COLLECTION PIPES

OBJECTIVES

The objective of this calculation is to evaluate the structural adequacy of the leachate collection pipes at the Cherry Island Landfill (CIL). The leachate collection pipes are evaluated for structural stability in terms of wall crushing, buckling, and ring deflection. A factor of safety is calculated for wall crushing and buckling. This calculation evaluates the structural stability for both the existing leachate collection pipes in Phases III, IV, and V of the landfill and the proposed leachate collection pipes in the south west corner of the landfill (i.e., Phase Va).

BACKGROUND

Regulations stipulate that landfills must have a leachate collection network in place that can effectively convey leachate collected in the drainage layer. In order to effectively convey the leachate, the pipes must be structurally able to withstand expected loads.

Existing Leachate Collection System Pipes

A series of leachate collection pipes have been installed in Phases III, IV and V of CIL (see Figure 1). The information regarding the existing pipes was obtained from the following sources:

- Phase III – Drawings entitled "Construction of the Phase III Disposal Area", Contract No. DSWA-236, prepared by Gannett Fleming, dated June 1991, sheet 11.
- Phase IV – Drawings entitled "As-built Conditions of the Phase IV Disposal Area", Contract No. DSWA-270, prepared by Weston, dated May 1996, Drawings 207 and 208.
- Phase V – Drawings entitled "Record Drawings for Phase V Disposal Area", Contract No. DSWA-297, prepared by Weston, dated May 1998, Drawings 207 and 208.

Copies of this information are provided in Attachment A. In general, the existing pipes are HDPE, perforated, have a diameter of 4-in., 6-in., or 8-in., and a standard dimension ratio (SDR) of 15.5. The table below summarizes the existing leachate pipe information. Parameters used for the design of the HDPE pipe are taken from Phillips 66 [1991] (See Attachment B).

Pipe Parameters	Phase III		Phase IV	Phase V	
	laterals	headers	headers	laterals	headers
Outer Diameter	6 inches	8 inches	8 inches	4 inches	8 inches
Standard Dimension ratio	15.5 (1)	15.5 (1)	15.5	15.5	15.5
Inner diameter	5.771 inches	7.513 inches	7.513 inches	3.020 inches	7.513 inches
Wall thickness	0.427 inches	0.556 inches	0.556 inches	0.290 inches	0.556 inches
Compressive yield strength	1,500 lbs/in^2	1,500 lbs/in^2	1,500 lbs/in^2	1,500 lbs/in^2	1,500 lbs/in^2
Modulus of Elasticity (E_o) (2)	130,000 lbs/in^2	130,000 lbs/in^2	130,000 lbs/in^2	130,000 lbs/in^2	130,000 lbs/in^2
Maximum allowable ring Deflection	3.9%	3.9%	3.9%	3.9%	3.9%

Notes: (1) assumed value based on Phase IV and Phase V drawings, no information on the SDR is given in Phase III drawings

(2) typical value measured at 75 degrees (short term modulus)

Proposed Leachate Collection System Pipes

The proposed leachate collection pipes in Phase Va will be HDPE, perforated, have a diameter of 8-in., and a standard dimension ratio (SDR) of 17. The table below summarizes the proposed leachate collection pipe information. Parameters used for the design of the HDPE pipe are taken from Phillips 66 [1991] (See Attachment B).

	New liner area
Outer Diameter	8 inches
Standard Dimension ratio	17
Inner diameter	7.611 inches
Wall thickness	0.507 inches
Compressive yield strength	1,500 lbs/in^2
Modulus of Elasticity (E_o)	130,000 lbs/in^2
Maximum allowable ring deflection	4.2%

PROCEDURE

Evaluation of the stability of the leachate collection pipes will be done based on engineering procedures described in Phillips 66 [1991] and Chevron [1992]. Loads imposed on

the pipe must be limited to stresses which will not cause failure of the pipe. Three typical loading conditions are analyzed:

CASE 1: The maximum pressure on the pipe induced by construction equipment during construction of the landfill liner and leachate collection pipes. This case is only evaluated for the proposed leachate collection pipes.

CASE 2: The stress induced by a 90 cubic yard capacity waste truck placing select waste on top of the soil drainage layer. The minimum thickness of the first lift of select waste will be 10 ft.

CASE 3: The maximum pressure exerted on the pipe due to the overburden of the landfill after the final grades have been achieved. This case is evaluated for both the existing and proposed leachate collection pipes.

Induced Pipe Stresses

Case 1 (Construction Equipment, Proposed Leachate Collection Pipes)

The initial conditions for the leachate collection system assumes that the collector pipe is buried under 24 inches of granular material before construction equipment will cross the pipe. The typical cross section for a leachate collection pipe along a cell base is shown in Figure 2. The stress due to traffic above the pipe is assumed to come from a HS-20 standard truck load which applies an axle load of 32,000 lbs (i.e., 16,000 per tire). For the calculations, a concentrated load of 20,000 lbs is assumed to be applied above the crown of the pipe. The stress on the pipe will be calculated as described in Chevron [1992].

$$\sigma_{max} = C_H \frac{I\ W_l}{L\ D} \tag{1}$$

Where:

σ_{max}	=	Maximum stress applied (lbs/ft^2)
I	=	Impact factor
L	=	Pipe length (ft)
C_H	=	Load coefficient
D	=	Pipe outer diameter (ft)
W_l	=	Wheel load (pounds)

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The Chevron manual suggests an impact factor of 1.5 be used for calculations and a pipe length of 3 feet for pipes which are 3 feet or longer. The load coefficient (C_H) is a function of the pipe burial depth (H), length (L) and outer diameter (D).

$$C_H = f\left(\frac{L}{2H}, \frac{D}{2H}\right)$$

The load coefficient is taken from Table 1 of this calculation, $C_H = 0.38$. The induced pipe stress for Case 1 is:

$$\sigma_{max} = \left(0.38\frac{1.5(20{,}000\text{lbs})}{(3\text{ft})(8\text{in}/12)}\right)\times\left(\frac{\text{ft}^2}{144\text{in}^2}\right) = \mathbf{39.58}\ \text{lbs/in}^2$$

Case 2 (Select Waste Placement on Top of Leachate Collection Zone)

This case considers a 90 cubic yard waste truck (operating weight of 100,000 lbs when full) driving on a 10-ft layer of select waste within the newly lined area (Phase Va). The unit weight of the waste is assumed to be 65 lbs/ft^3 for this 10-ft layer of select waste. This case considers the stresses induced on the pipe by the weight of the truck and the overburden stress resulting from the 10 feet of select waste. The maximum stress acting on the pipe is calculated in the same manner as Case 1. For Case 2, an impact factor of 1.5 and a pipe length of 3 was used in accordance with the Chevron manual. The load coefficient from Table 1 is C_H = 0.026. The induced pipe stress for Case 2 is:

$$\sigma_{max} = \left(0.026\frac{1.5(100{,}000\text{lbs})}{(3\text{ft})(8\text{in}/12)}\right)\times\left(\frac{\text{ft}^2}{144\text{in}^2}\right) + 65\,lbs/ft^3 \times 10\,ft \times \left(\frac{\text{ft}^2}{144\text{in}^2}\right) = \mathbf{18.05}\ \text{lbs/in}^2$$

Case 3 (Landfill Overburden, Existing and Proposed Leachate Collection Pipes)

During post closure conditions the pipe will be subjected to overburden stresses due to the materials above the pipe, (i.e., waste and protective cover soils). Assuming plane strain conditions, the pressure due to this loading can be estimated by averaging the vertical and horizontal stresses acting on the pipe. The vertical and horizontal stresses can be calculated as follows:

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$$\sigma_{vertical} = (\gamma_{waste})\ (H) \quad (2)$$

$$\sigma_{horizontal} = K_o\ (\gamma_{waste})\ (H) \quad (3)$$

Where:

$\sigma_{vertical}$	=	Maximum vertical applied stress (lbs/ft^2)
$\sigma_{horizontal}$	=	Maximum horizontal applied stress (lbs/ft^2)
γ_{waste}	=	Unit weight of the waste (lbs/ft^3)
H	=	Maximum depth of waste in the landfill (ft)
K_o	=	lateral earth pressure coefficient = 1-sin(ϕ), where ϕ=34°

The maximum volumetric stress (σ_{max}) applied to the pipe can be calculated as:

$$\sigma_{max} = 0.5\ (\sigma_v + \sigma_h) = 0.5\ \gamma\ H\ (1 + K_o)$$

GeoSyntec performed field investigations in March and April 2002 to characterize the waste at the CIL [GeoSyntec, 2003]. Based on the results of the field investigation and subsequent laboratory testing, the MSW was found to have an average density ranging from 55 to 75 lbs/ft^3. These unit weights are for the existing conditions; the table below shows the variation in unit weight for depths exceeding for the proposed expansion.

Depth Range	Unit Weight (lbs/ft^3)	
	Total	Saturated
0-20	60	100
20-100	75	100
100-150	80	100
150-200	85	100
>200	90	100

For the existing leachate collection pipes, the maximum depth of the waste is approximately 250-ft, see Figure 3 (290-ft MSL maximum landfill height minus 40-ft MSL base of landfill). For the proposed leachate collection pipes, the maximum depth of waste is approximately 90-ft, see Figure 3 (130-ft MSL maximum landfill height minus 40-ft MSL base of landfill). Using Equation 3, the stresses acting on the pipe are shown in the table below.

	Case 3 – Existing Pipes	Case 3 – Proposed Pipes
Depth (ft)	250	90
σ_{max} (lbs/in^2)	99.8	39.58
average unit weight (lbs/ft^3)	80	72

FACTOR OF SAFETY CALCULATIONS

Wall Crushing

Wall crushing can occur when the stress in the pipe wall, due to external vertical pressure, exceeds the compressive strength of the pipe material. The factor of safety against pipe wall crushing may be calculated using the following equation [Phillips 66, 1991]:

$$FS_{wc} = \frac{2\sigma_y}{(SDR-1)\sigma_{max}} \tag{4}$$

where:

FS_{wc} = Factor of safety against pipe wall crushing
σ_y = Compressive yield strength of the pipe (lbs/in^2)
SDR = Standard dimension ratio of the pipe
σ_{max} = Maximum stress applied to the pipe (lbs/in^2)

Wall Buckling

Wall buckling, a longitudinal wrinkling in the pipe wall, can occur when the external vertical pressure exceeds the critical buckling pressure of the pipe/bedding aggregate system. The factor of safety against pipe wall buckling can be calculated using the following equation [Phillips 66, 1991]:

$$FS_{wb} = \frac{1.2}{\sigma_{max}}\left[\frac{E'E}{(SDR)^3}\right]^{1/2} \tag{5}$$

where:

FS_{wb} = Factor of safety against pipe wall buckling
σ_{max} = Maximum stress applied to the pipe (lbs/in^2)
E' = Modulus of soil reaction for pipe bedding (lbs/in^2)

E = Time dependent modulus of elasticity of the pipe material (lbs/in^2)
SDR = Standard dimension ratio of the pipe

The modulus of soil reaction, E', for the pipe bedding material is based on Table 2 taken from Phillips 66 [1991]. The soil reaction modulus for granular material with a minimum standard Proctor density of 70% is 3,000 lbs/in^2.

The time dependent modulus of elasticity (E) is calculated as follows:

$$S_A = \frac{(SDR-1)\sigma_{max}}{2}$$

where:

S_A = stress in the pipe wall
σ_{max} = induced stress from overburden, equipment, etc.

The time dependent modulus of elasticity of the pipe can then be calculated as:

$$E = fE_o$$

where f is a reduction factor that takes into consideration the design life as well as the maximum stress in the pipe wall (S_A). The reduction factor (f) can be calculated using Chart 25 from Driscopipe for a given design period (i.e., 50 years). As shown on Chart 25, the time dependent modulus is stress dependent. The reduction factors and corresponding time dependent modulus of elasticity of the pipe used in this calculation are summarized in the table below.

	S_A (lbs/in^2)	Reduction Factor (2)	E (2) (lbs/in^2)
New Liner Area (1)	316.64	0.24	31,200
Phases III through V laterals and headers	724	0.15	19,500

Note (1) The stress in the pipe was calculated for the Case 1 - Construction Equipment, Proposed Leachate Collection Pipes, which had the highest value of σ_{max} for the new liner system.
(2) The reduction factor and calculation of E are shown on Page 24 of this calculation package.

Ring Deflection

Ring deflection is the change in vertical diameter of the pipe as the pipe/bedding aggregate system deforms under the external vertical pressure. The actual ring deflection of the pipe must be less than the allowable ring deflection of the pipe. The pipe ring deflection may be estimated as equal to the strain of the soil backfill around the pipe, which is calculated by the following equation:

$$\Delta_R = \frac{\sigma_{max}}{E'} \times 100 \qquad (6)$$

where:

Δ_R	=	Pipe ring deflection (percent)
E'	=	Modulus of soil reaction for pipe bedding (lbs/in^2)
σ_{max}	=	Maximum stress applied to the pipe (lbs/in^2)

CALCULATIONS:

The factors of safety for Case 1 for the proposed leachate collection pipes are calculated below.

Wall Crushing

$$FS_{wc} = \frac{2(1{,}500 \text{ lbs/in}^2)}{(17.0-1)39.58 \text{ lbs/in}^2} = \mathbf{4.74}$$

Wall Buckling

$$FS_{wb} = \frac{1.2}{39.58 lbs/in^2}\left[\frac{(3{,}000 lbs/in^2)(31{,}200 lbs/in^2)}{(17)^3}\right]^{1/2} = \mathbf{4.18}$$

Ring Deflection

$$\Delta_R = \frac{(39.58 \, lbs/in^2)}{(3{,}000 \text{ lbs/in}^2)} = \mathbf{1.3\ \%}$$

The factors of safety results for the Cases 1, 2, and 3 are shown in Table 2.

CONCLUSIONS

The calculated factors of safety for the worst case scenario are all greater than 1, and the calculated ring deflection for both cases are smaller than the allowable ring deflection (i.e. 4.2 percent). Based on this result, the structural stability of the proposed 8 inch diameter SDR 17 leachate collection pipe is adequate for use in the CIL landfill. Similarly, the existing leachate collection pipes will withstand the additional stress resulting from the vertical expansion of the landfill.

REFERENCES

Chevron Chemical Company, "*Plexico/Spirolite Engineering Manual, 2. System Design*", Chevron Chemical Company, Bensennville, Il. 1992.

Phillips 66, "*Driscopipe System Design*", Manufactures Literature NO. 1089-91 A17, Phillips 66, 1991.

USEPA, "*Lining of Waste Impoundment and Disposal Facilities*", SW-870, U.S. Environmental Protection Agency, Washington, DC, March 1983, Revised Edition.

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Load Coefficient, C_H, for Holl's Integration of Boussinesq's Equation

Case 1

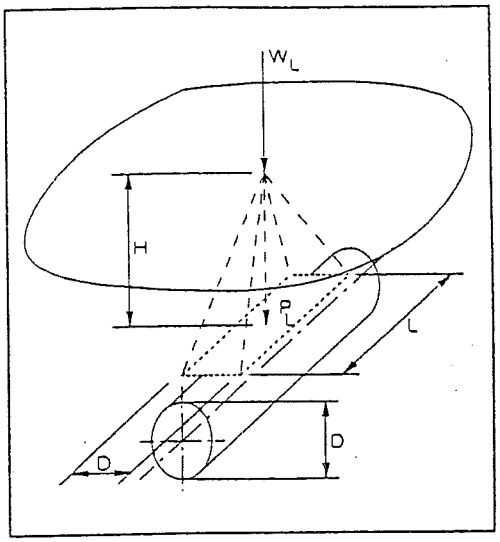
$H_{min} = 1$ ft

$\frac{L}{2H} = \frac{3}{2 \cdot 1} = 1.5$

$\frac{D}{2H} = \frac{8/12}{2 \cdot 1} = 0.33$

interpolate between 0.346 and 0.442

$C_H = 0.38$



Case 2

$H_{min} = 11$ ft

$\frac{L}{2H} = \frac{3}{22} = 0.14$

$\frac{D}{2H} = \frac{8/12}{22} = 0.03$

with use $\frac{D}{2H} = 0.1$

interpolate between 0.019 and 0.037

$C_H = 0.026$

D/2H	Case 2 L/2H 0.1	0.2	0.3	0.4	0.5	0.6	0.7
0.1	0.019	0.037	0.053	0.067	0.079	0.089	0.097
0.2	0.037	0.072	0.103	0.131	0.155	0.174	0.189
0.3	0.053	0.103	0.149	0.190	0.224	0.252	0.274
0.4	0.067	0.131	0.190	0.241	0.284	0.320	0.349
0.5	0.079	0.155	0.224	0.284	0.336	0.379	0.414
0.6	0.089	0.174	0.252	0.320	0.379	0.428	0.467
0.7	0.097	0.189	0.274	0.349	0.414	0.467	0.511
0.8	0.103	0.202	0.292	0.373	0.441	0.499	0.546
0.9	0.108	0.211	0.306	0.391	0.463	0.524	0.574
1.0	0.112	0.219	0.318	0.405	0.481	0.544	0.597
1.2	0.117	0.229	0.333	0.425	0.505	0.572	0.628
1.5	0.121	0.238	0.346	0.442	0.525	0.596	0.655
2.0	0.124	0.244	0.355	0.454	0.540	0.613	0.674
20.0	0.127	0.248	0.361	0.462	0.550	0.625	0.688

D/2H	L/2H 0.8	0.9	1.0	1.2	1.5	2.0	20.0
0.1	0.103	0.108	0.112	0.117	0.121	0.124	0.127
0.2	0.202	0.211	0.219	0.229	0.238	0.244	0.248
0.3	0.292	0.306	0.318	0.333	0.346	0.355	0.361
0.4	0.373	0.391	0.405	0.425	0.442	0.454	0.462
0.5	0.441	0.463	0.481	0.505	0.525	0.540	0.550
0.6	0.499	0.524	0.544	0.572	0.596	0.613	0.625
0.7	0.546	0.574	0.597	0.628	0.655	0.674	0.688
0.8	0.584	0.615	0.639	0.674	0.703	0.725	0.740
0.9	0.615	0.647	0.673	0.711	0.743	0.766	0.783
1.0	0.639	0.673	0.701	0.740	0.775	0.800	0.818
1.2	0.674	0.711	0.740	0.783	0.821	0.849	0.871
1.5	0.703	0.743	0.775	0.821	0.863	0.895	0.920
2.0	0.725	0.766	0.800	0.849	0.895	0.930	0.960
20.0	0.740	0.783	0.818	0.871	0.920	0.960	1.000

Case 1

Table 1

Table 2

	Phase III laterals	Phase III headers	Phase IV headers	Phase V laterals	Phase V headers	New Liner Area
Outer Diameter (inches)	6	8	8	4	8	8
SDR (dimensionless)	15.5	15.5	15.5	15.5	15.5	17
Compressive yield strength (psi)	1500	1500	1500	1500	1500	1500
Time Dependent Modulus of Elasticity (psi)	19500	19500	19500	19500	19500	31200
Maximum Allowable Ring Deflection (percent)	3.9	3.9	3.9	3.9	3.9	4.2
Subgrade Modulus (psi)	3000	3000	3000	3000	3000	3000
σ_{max} (Case 1) (psi)	NA	NA	NA	NA	NA	39.58
FS_{wc}	NA	NA	NA	NA	NA	4.74
FS_{wb}	NA	NA	NA	NA	NA	4.18
Δ_R	NA	NA	NA	NA	NA	1.32
σ_{max} (Case 2) (psi)	NA	NA	NA	NA	NA	18.05
FS_{wc}	NA	NA	NA	NA	NA	10.39
FS_{wb}	NA	NA	NA	NA	NA	9.18
Δ_R	NA	NA	NA	NA	NA	0.60
σ_{max} (Case 3) (psi)	99.8	99.8	99.8	99.8	99.8	32.3
FS_{wc}	2.07	2.07	2.07	2.07	2.07	5.80
FS_{wb}	1.51	1.51	1.51	1.51	1.51	5.13
Δ_R	3.33	3.33	3.33	3.33	3.33	1.08

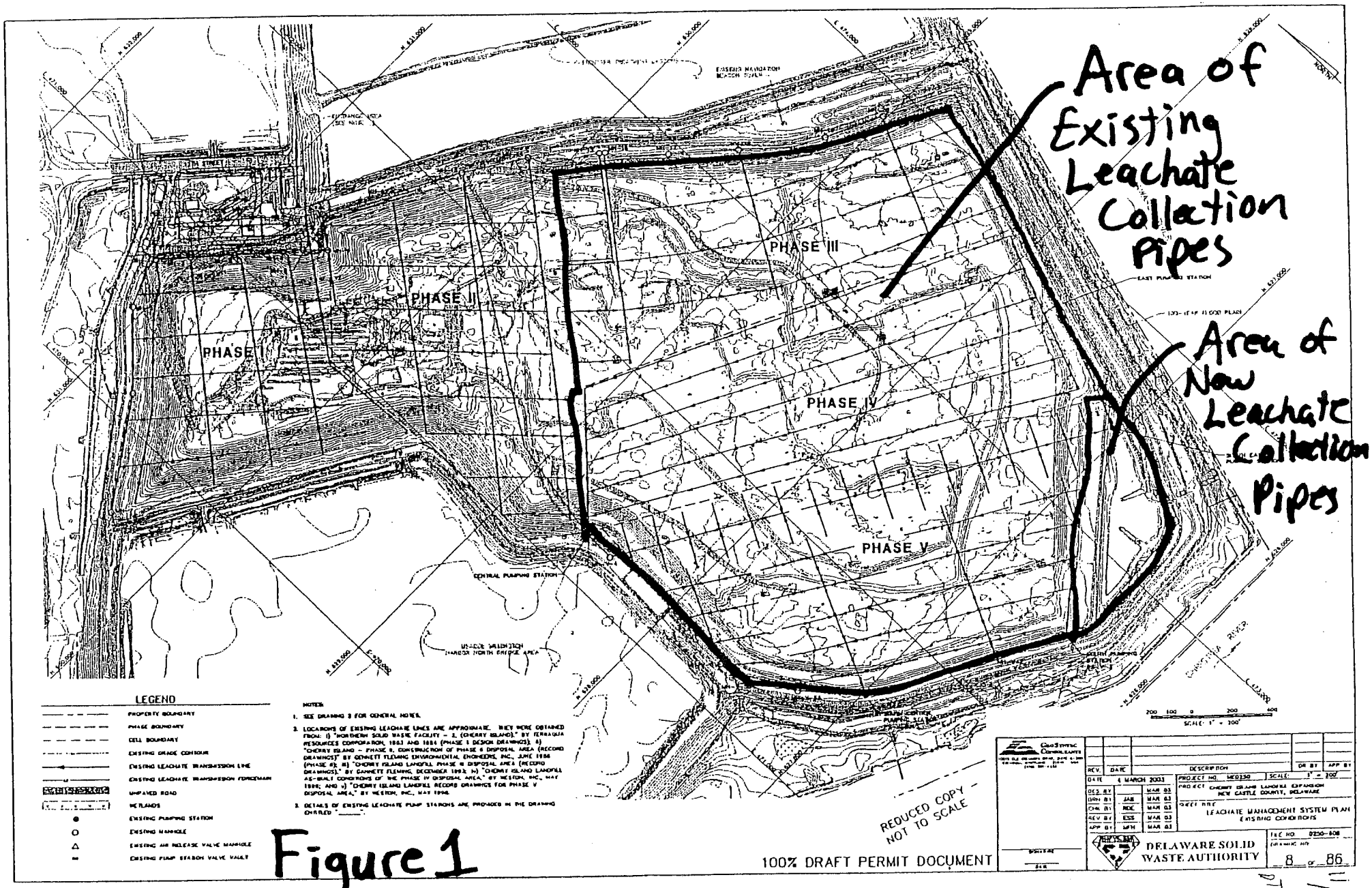
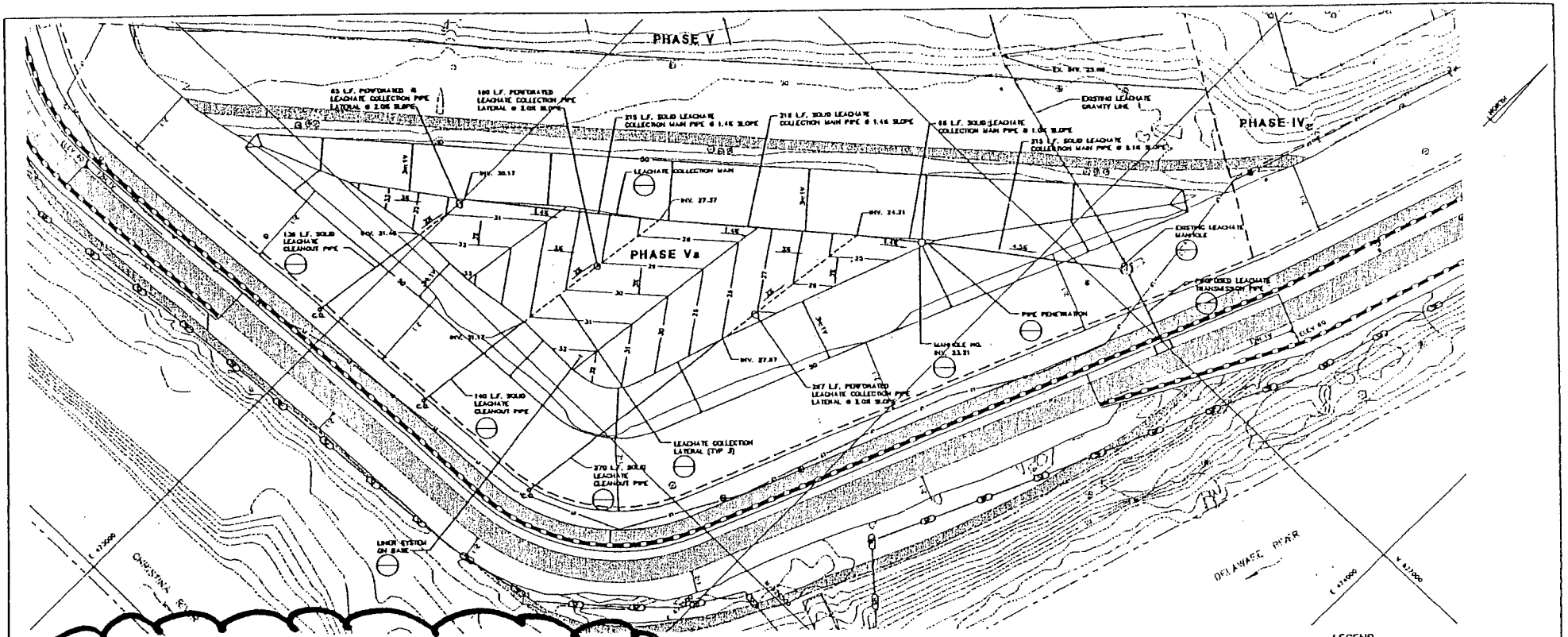
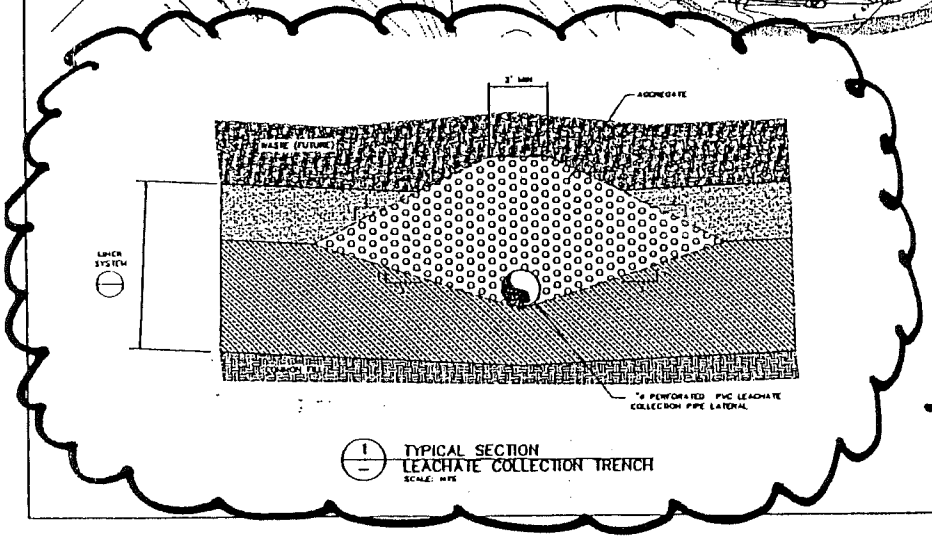

Area of Existing Leachate Collection Pipes
Area of New Leachate Collection Pipes
PHASE I
PHASE II
PHASE III
PHASE IV
PHASE V
CENTRAL PUMPING STATION
EAST PUMPING STATION
LEGEND
PROPERTY BOUNDARY
PHASE BOUNDARY
CELL BOUNDARY
EXISTING GRADE CONTOUR
EXISTING LEACHATE TRANSMISSION LINE
EXISTING LEACHATE TRANSMISSION FORCEMAIN
UNPAVED ROAD
WETLANDS
EXISTING PUMPING STATION
EXISTING MANHOLE
EXISTING AIR RELEASE VALVE MANHOLE
EXISTING PUMP STATION VALVE VAULT
NOTES:
1. SEE DRAWING 2 FOR GENERAL NOTES.
2. LOCATIONS OF EXISTING LEACHATE LINES ARE APPROXIMATE. THEY WERE OBTAINED FROM: i) "NORTHERN SOLID WASTE FACILITY – 2, (CHERRY ISLAND)," BY TERRAQUA RESOURCES CORPORATION, 1983 AND 1984 (PHASE I DESIGN DRAWINGS); ii) "CHERRY ISLAND – PHASE II, CONSTRUCTION OF PHASE II DISPOSAL AREA (RECORD DRAWINGS)" BY GENNETT FLEMING ENVIRONMENTAL ENGINEERS, INC., JUNE 1986 (PHASE II); iii) "CHERRY ISLAND LANDFILL PHASE III DISPOSAL AREA (RECORD DRAWINGS)," BY GANNETT FLEMING, DECEMBER 1993; iv) "CHERRY ISLAND LANDFILL AS-BUILT CONDITIONS OF THE PHASE IV DISPOSAL AREA," BY WESTON, INC., MAY 1996; AND v) "CHERRY ISLAND LANDFILL RECORD DRAWINGS FOR PHASE V DISPOSAL AREA," BY WESTON, INC., MAY 1996.
3. DETAILS OF EXISTING LEACHATE PUMP STATIONS ARE PROVIDED IN THE DRAWING ENTITLED "_____".
REDUCED COPY – NOT TO SCALE
100% DRAFT PERMIT DOCUMENT
GeoSystems Consultants
REV. DATE DESCRIPTION DR BY APP BY
DATE 4 MARCH 2003
PROJECT NO. MED250
SCALE: 1" = 200'
PROJECT CHERRY ISLAND LANDFILL EXPANSION NEW CASTLE COUNTY, DELAWARE
SHEET TITLE LEACHATE MANAGEMENT SYSTEM PLAN EXISTING CONDITIONS
DELAWARE SOLID WASTE AUTHORITY
FILE NO. 0250-608
DRAWING NO. 8 OF 86

Figure 1

2





1 TYPICAL SECTION
LEACHATE COLLECTION TRENCH
SCALE: NTS

Figure 2

Leachate Collection Trench Detail

REDUCED COPY - NOT TO SCALE

LEGEND

- PROPERTY BOUNDARY
- PHASE BOUNDARY
- PHASE Va BOUNDARY
- 35 EXISTING GRADE ELEVATION (FEET, MSL)
- 30 PROPOSED GRADE ELEVATION (FEET, MSL)
- EXISTING LEACHATE TRANSMISSION FORCEMAIN
- EXISTING LEACHATE GRAVITY TRANSMISSION PIPE
- PROPOSED PERFORATED LEACHATE COLLECTION PIPE LATERAL
- PROPOSED SOLID LEACHATE TRANSMISSION PIPE
- C.O. PROPOSED CLEAN OUT
- INV. INVERT (ELEVATION, FEET, MSL)
- L.F. LINEAR FEET

NOTES
1. SEE DRAWING 2 FOR GENERAL NOTES

SCALE IN FEET: 50 25 0 50 100

100% DRAFT PERMIT DOCUMENT

REV	DATE	DESCRIPTION	DR BY	APP BY

DATE: 4 MARCH 2003 | PROJECT NO. 14-0790 | SCALE: 1" = 50'

PROJECT: CHERRY ISLAND LANDFILL EXPANSION, NEW CASTLE COUNTY, DELAWARE

SHEET TITLE: LEACHATE COLLECTION SYSTEM PHASE Va

DES BY	SMG	MAR 03
DRN BY	JGC	MAR 03
CHK BY	RDC	MAR 03
REV BY	CSS	MAR 03
APP BY	MFK	MAR 03

DELAWARE SOLID WASTE AUTHORITY

FILE NO. 0250 647

DRAWING NO. 47 of 86

12/25 OTV

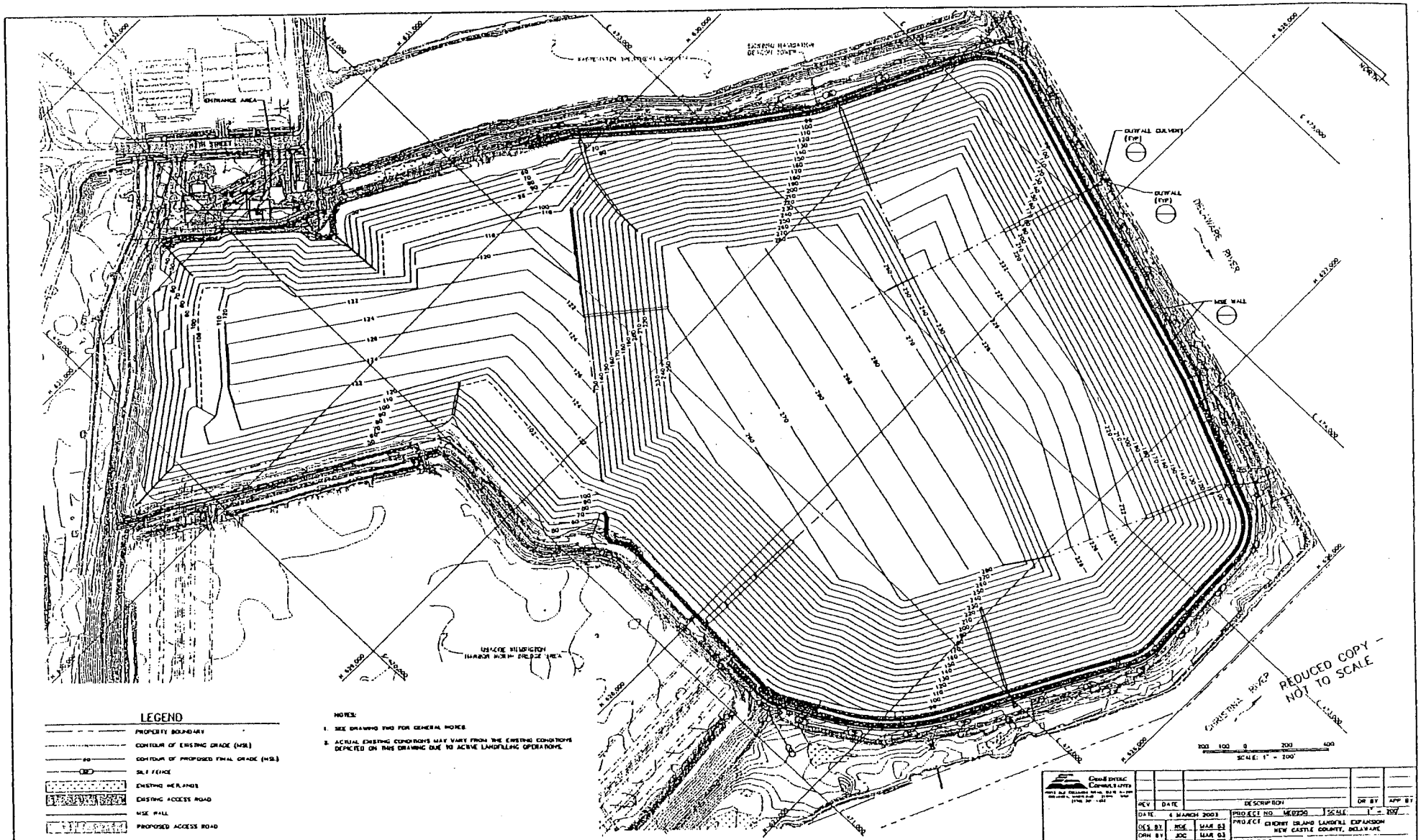


Figure 3

100% DRAFT PERMIT DOCUMENT

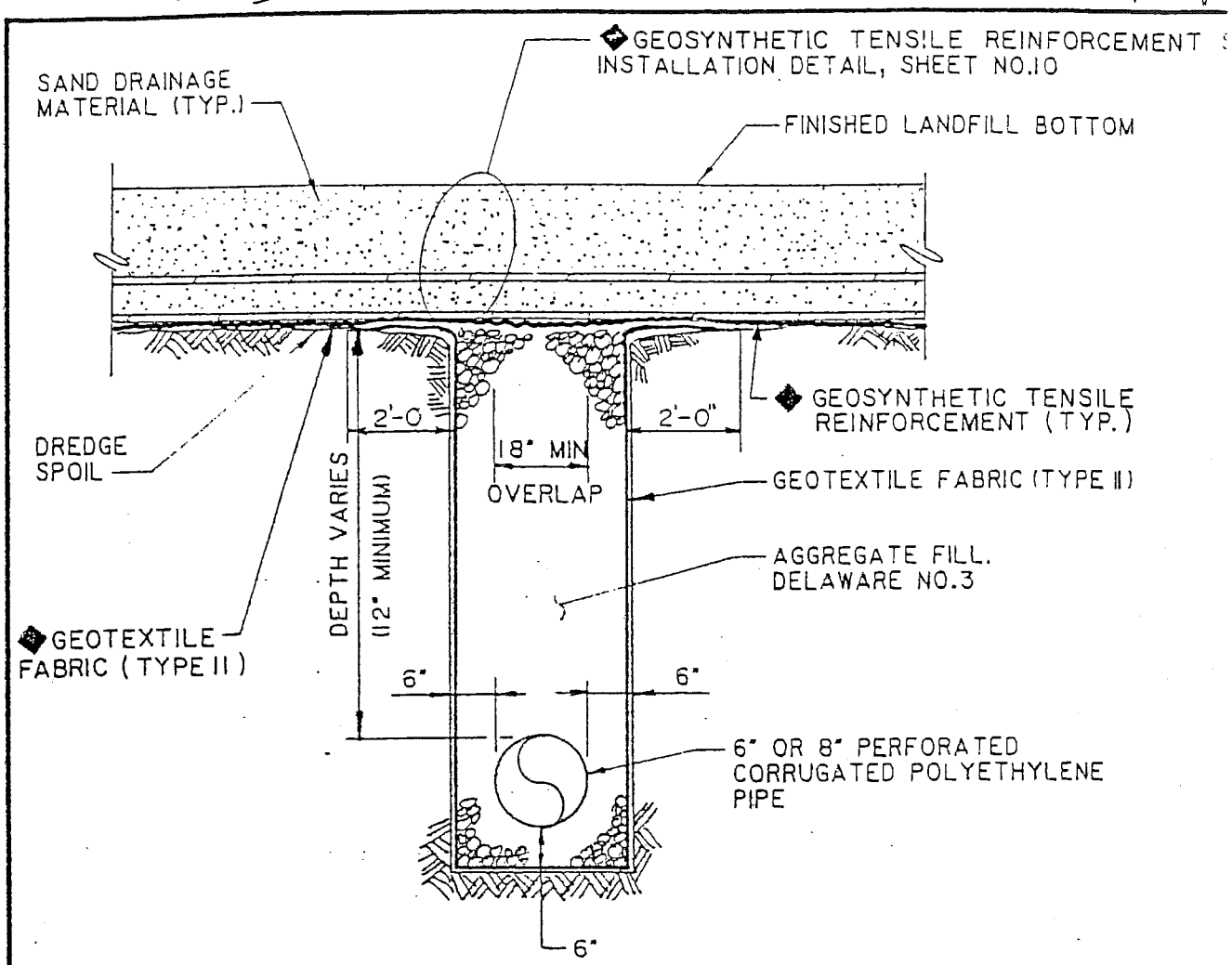
13/25

14/25
PTM

ATTACHMENT A

Phase III

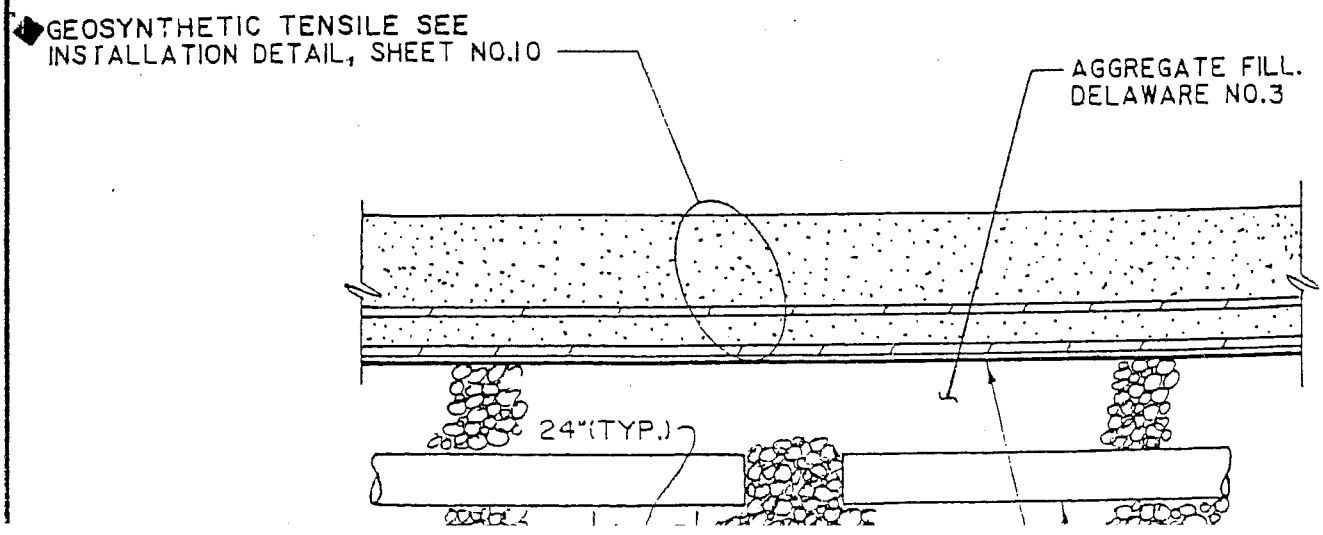
15/25



LEACHATE PIPE BEDDING

L-1

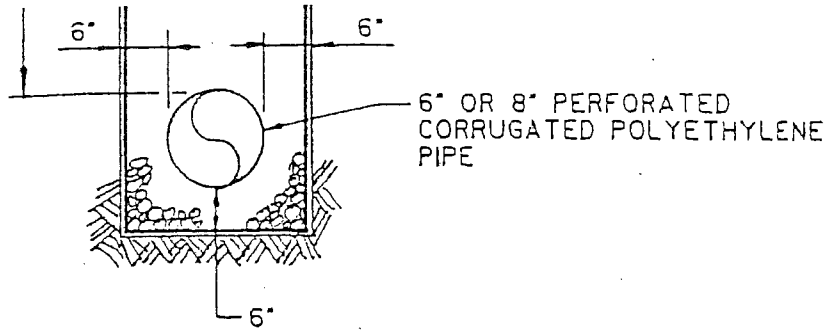
NO SCALE



Construction of the Phase III Disposal Area
contract No. SSWA-236
prepared by Gannett Fleming, Inc.
dated June 1991

Sheet 11
drawing No. 1-38609

FABRIC (TYPE II)



16/25 DTM

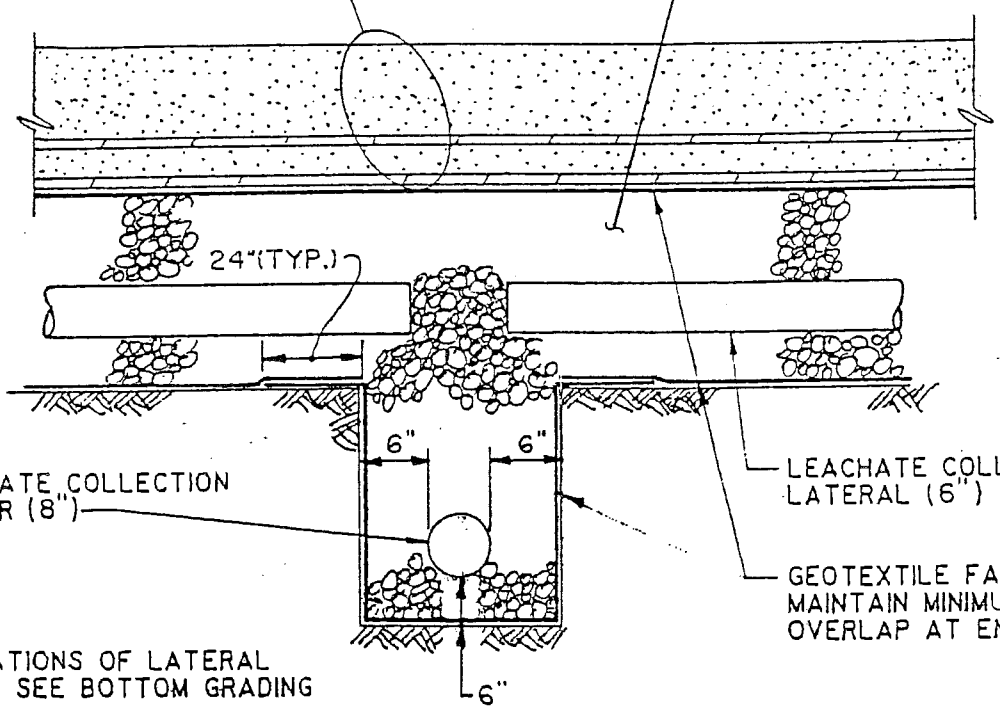
LEACHATE PIPE BEDDING

L-1

NO SCALE

GEOSYNTHETIC TENSILE SEE INSTALLATION DETAIL, SHEET NO.10

same reference as previous sheet



NOTE:

1. FOR INVERT ELEVATIONS OF LATERAL AND HEADER PIPES SEE BOTTOM GRADING PLAN, SHEET NO.2
2. FOR TYPICAL LEACHATE PIPE BEDDING, SEE DETAIL L-1.

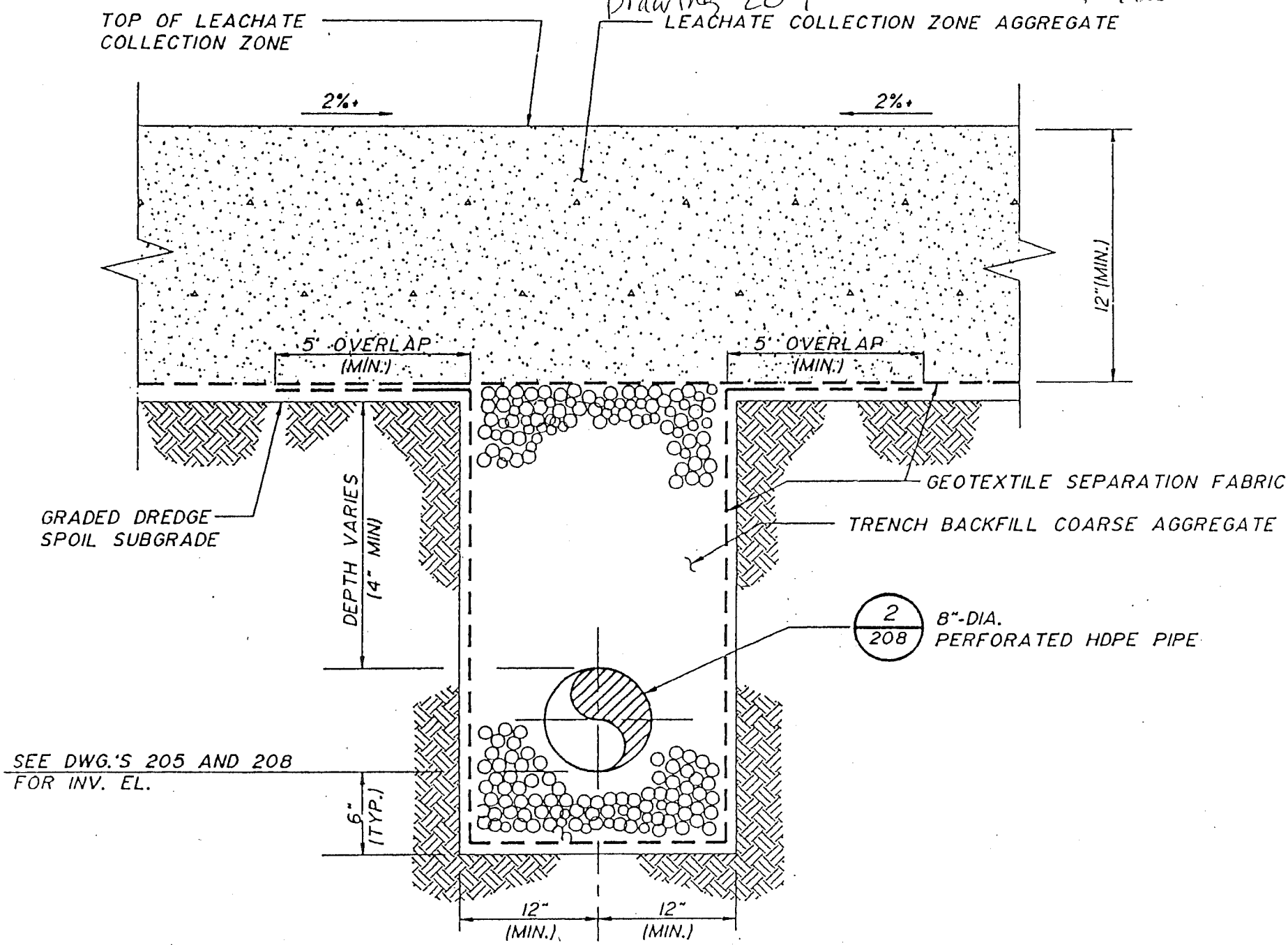
LEACHATE PIPE CONNECTION

L-2

NO SCALE

As built conditions of the [illegible] area contract No. A-70, Weston, dated May 1996 ph IV

Drawing 207

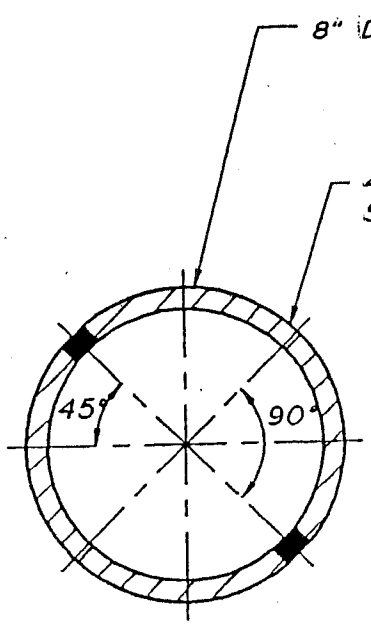


TYPICAL LEACHATE COLLECTION PIPE TRENCH SECTION

17/25 DTM

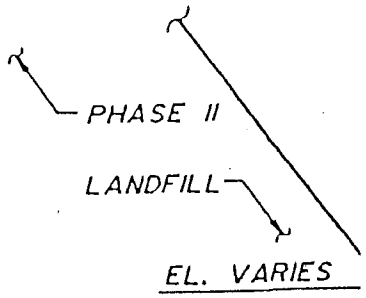
Phase V - same drawing set as previous p

Drawing 208



NOTE:
HOLES SHALL BE TERMINATED A MINIMUM OF 3-1/2" FROM SEALS AND/OR ENDS.

SECTION



LIMIT OF COARSE AGGR

LEACHATE COLLECTION PIPE PERFORATION DETAIL

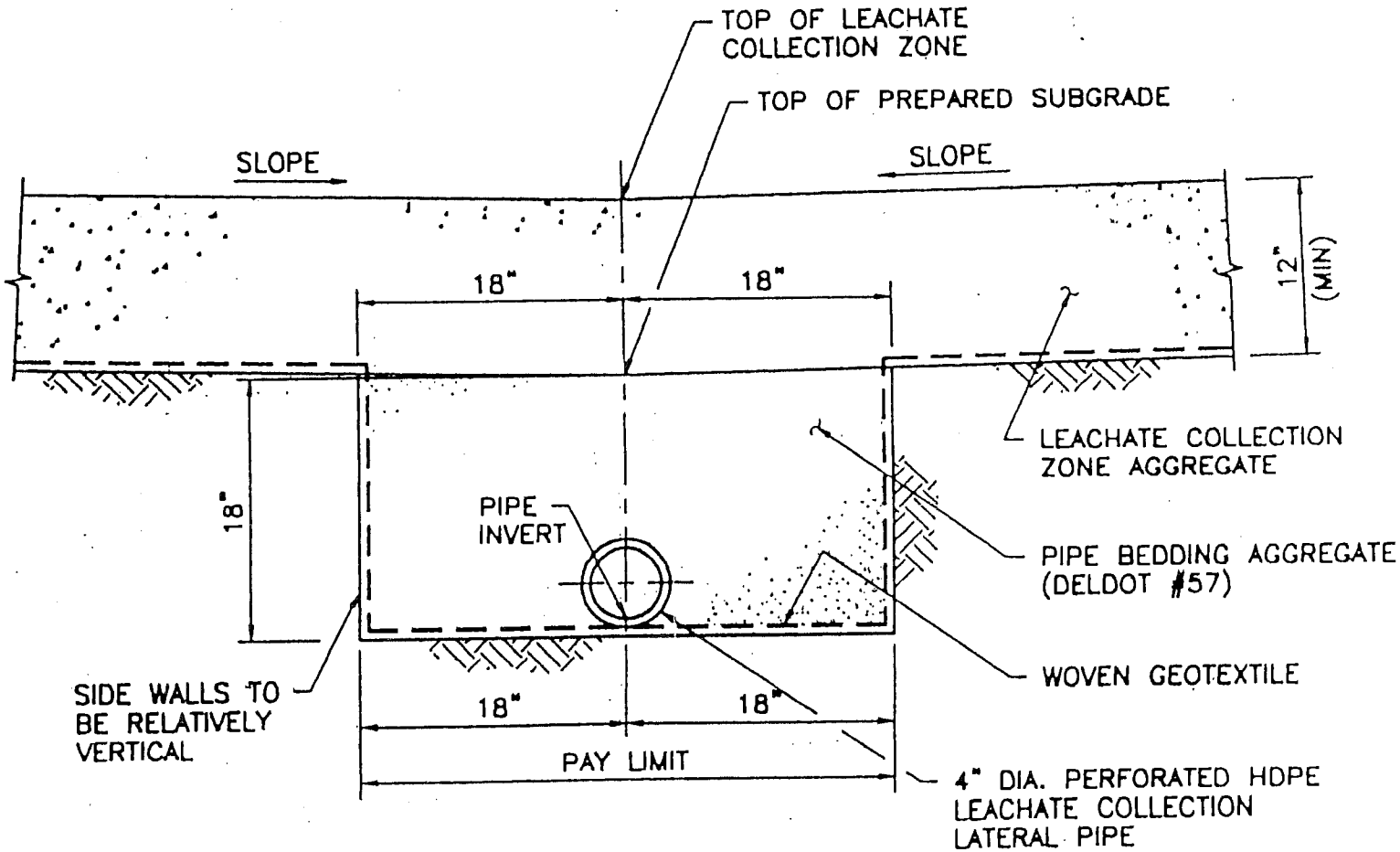
2
208

N.T.S.

18/25

Record Drawings for Phase V Disposal Area
Contract No. DSWA-291
Weston, May 1998

Drawing 207

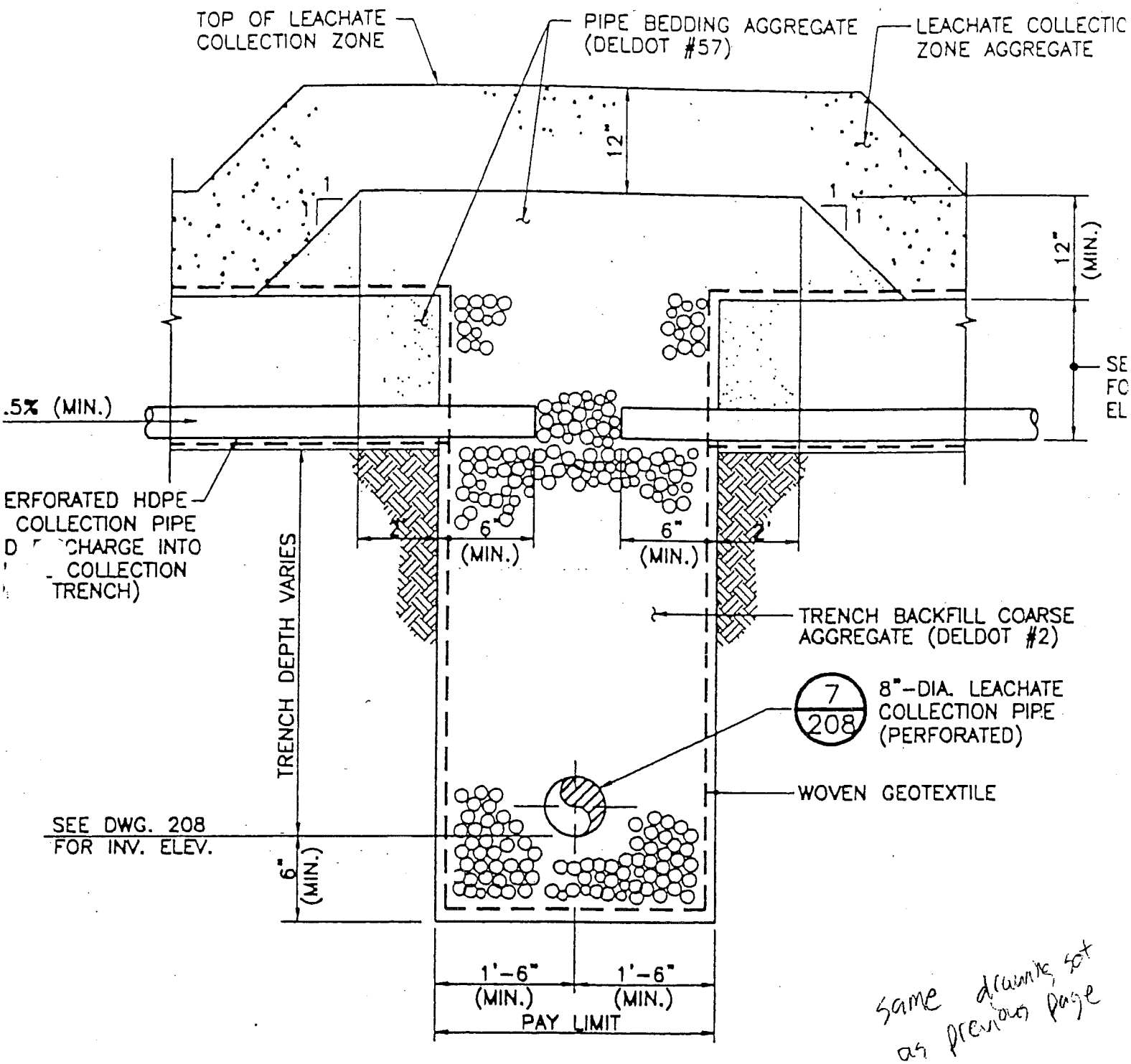


TYPICAL LEACHATE COLLECTION LATERAL PIPE TRENCH SECTION

DETAIL 4
N.T.S.
204B
208
213

19/25

20/25
PTM



same drawing set as previous page

TYPICAL LEACHATE COLLECTION HEADER PIPE TRENCH SECT

DETAIL 2
N.T.S.
204B
210
213

21/25
pTM

ATTACHMENT B

22/25 PTM

Simplified Burial Design: A conservative estimate of the ability of Driscopipe pipelines to perform in a buried environment is found in Chart 24. It is based on a minimum 2:1 safety factor and 50 year design service life. A detailed burial design starts on page 37. The detailed design should be used for critical or marginal applications or whenever a more precise solution is desired.

Detailed Burial Design:
Design by Wall Crushing: Wall crushing would theoretically occur when the stress in a pipe wall, due to the external vertical pressure, exceeded the long-term compressive strength of the pipe material. To ensure that the Driscopipe wall is strong enough to endure the external pressure the following check should be made:

$$S_A = \frac{(SDR - 1)}{2} P_T$$

Values of E′

Based on Soil Type (ASTM D2321) and Degree of Compaction

Soil Type of Initial Backfill Embedment Material	Description	E′ (psi) for Degree of Compaction (Proctor Density, %)			
		Loose	Slight (70-85%)	Moderate (85-95%)	High (95%)
I	Manufactured angular, granular materials (crushed stone or rock, broken coral, cinders, etc.)	1,000	3,000	3,000	3,000
II	Coarse grained soils with little or no fines	N.R.	1,000	2,000	3,000
III	Coarse grained soils with fines	N.R.	N.R.	1,000	2,000
IV	Fine-grained soils	N.R.	N.R.	N.R.	N.R.
V	Organic soils (peat, muck, clay, etc.)	N.R.	N.R.	N.R.	N.R.

N.R. = Not Recommended for use by ASTM D2321 for pipe wall support

Chart 24

SDR	Maximum Burial Depth, ft. in dry soil of 100 lbs/cu. ft.			Maximum External Pressure psi			Maximum Deflection, % after installation		
	Soil Modulus, psi*			Soil Modulus, psi*			Soil Modulus, psi*		
	1000	2000	3000	1000	2000	3000	1000	2000	3000
32.5	25	32	37	17	22	26	1.7	0.9	0.6
26	33	45	52	23	31	36	2.3	1.2	0.8
21	46	61	71	32	42	49	3.2	1.6	1.1
19	52	69	81	36	48	56	3.6	1.8	1.2
17	61	121	181	42	84	126	4.2	2.1	1.4
15.5	56	112	168	39	78	117	3.9	2.0	1.3
13.5	49	98	147	34	68	102	3.4	1.7	1.1
11	39	78	117	27	54	81	2.7	1.4	0.9
9.3	33	68	101	23	47	70	2.3	1.2	0.8
8.3	30	61	89	21	42	62	2.1	1.1	0.7
7.3	26	52	79	18	36	55	1.8	0.9	0.6

*assumes no external loads

3/4" (1.050 OD)				
SDR 11	160 psi	0.12 lbs./ft.	0.860 ID	.095 wall
1" (1.315 OD)				
SDR 11	160 psi	0.19 lbs./ft.	1.075 ID	.120 wall
1-1/4" (1.660 OD)				
SDR 11	160 psi	0.30 lbs./ft.	1.358 ID	.151 wall
1-1/2" (1.900 OD)				
SDR 11	160 psi	0.40 lbs./ft.	1.554 ID	.173 wall
2" (2.375 OD)				
SDR 7	267 psi	0.92 lbs/ft	1.697 ID	.339 wall
SDR 9	200 psi	0.74	1.847	.264
SDR 11 ●	**160 psi**	**0.62**	**1.943**	**.216**
SDR 13.5	128 psi	0.52	2.023	.176
SDR 15.5	110 psi	0.45	2.069	.153
SDR 17	100 psi	0.42	2.095	.140
3" (3.500 OD)				
SDR 7	267 psi	2.00 lbs/ft.	2.500 ID	.500 wall
SDR 9	200 psi	1.62	2.722	.389
SDR 11 ●	**160 psi**	**1.35**	**2.864**	**.318**
SDR 13.5	128 psi	1.12	2.982	.259
SDR 15.5	110 psi	0.99	3.048	.226
SDR 17 ●	**100 psi**	**0.91**	**3.088**	**.206**
SDR 19	89 psi	0.82	3.132	.184
SDR 21	80 psi	0.74	3.166	.167
SDR 26	64 psi	0.61	3.230	.135
SDR 32.5	51 psi	0.49	3.284	.108
4" (4.500 OD)				
SDR 7	267 psi	3.31 lbs/ft.	3.214 ID	.643 wall
SDR 9	200 psi	2.67	3.500	.500
SDR 11 ●	**160 psi**	**2.23**	**3.682**	**.409**
SDR 13.3	128 psi	1.85	3.834	.333
SDR 15.5	110 psi	1.63	3.020-	.290
SDR 17 ●	**100 psi**	**1.50**	**3.970**	**.265**
SDR 19	89 psi	1.35	4.026	.237
SDR 21	80 psi	1.23	4.072	.214
SDR 26 ●	**64 psi**	**1.00**	**4.154**	**.173**
SDR 32.5	51 psi	0.81	4.224	.138
5-3/8" (5.375 OD)				
SDR 17	100 psi	2.14 lbs./ft.	4.743 ID	.316 wall
SDR 21	80 psi	1.75	4.863	.256
SDR 26	64 psi	1.43	4.961	.207
SDR 32.5	51 psi	1.15	5.045	.165

● denotes standard sizes

5" (5.563 OD)				
SDR 7	267 psi	5.05 lbs/ft.	3.973 ID	.795 wall
SDR 9	200 psi	4.08	4.327	.618
SDR 11	160 psi	3.42	4.551	.506
SDR 13.5	128 psi	2.84	4.739	.412
SDR 15.5	110 psi	2.50	4.845	.359
SDR 17	100 psi	2.29	4.909	.327
SDR 19	89 psi	2.07	4.977	.293
SDR 21	80 psi	1.88	5.033	.265
SDR 26	64 psi	1.53	5.135	.214
SDR 32.5	51 psi	1.23	5.221	.171
6" (6.625 OD)				
SDR 7	267 psi	7.16 lbs./ft.	4.733 ID	.946 wall
SDR 9	200 psi	5.78	5.153	.736
SDR 11 ●	**160 psi**	**4.84**	**5.421**	**.602**
SDR 13.5	128 psi	4.03	5.643	.491
SDR 15.5	110 psi	3.54	5.771	.427
SDR 17 ●	**100 psi**	**3.25**	**5.845**	**.390**
SDR 19	89 psi	2.93	5.927	.349
SDR 21 ●	**80 psi**	**2.66**	**5.995**	**.315**
SDR 26 ●	**64 psi**	**2.17**	**6.115**	**.255**
SDR 32.5 ●	**51 psi**	**1.75**	**6.217**	**.204**
7" (7.125 OD)				
SDR 7	267 psi	8.29 lbs./ft.	5.089 ID	1.018 wall
SDR 9	200 psi	6.69	5.541	.792
SDR 11	160 psi	5.61	5.829	.648
SDR 13.5	128 psi	4.66	6.069	.528
SDR 15.5	110 psi	4.10	6.205	.460
SDR 19	89 psi	3.39	6.375	.375
SDR 17	100 psi	3.76	6.287	.419
SDR 21	80 psi	3.08	6.445	.340
SDR 26 ●	**64 psi**	**2.51**	**6.577**	**.274**
SDR 32.5	51 psi	2.02	6.685	.220
8" (8.625 OD)				
SDR 7	267 psi	12.14 lbs./ft.	6.161 ID	1.232 wall
SDR 9	200 psi	9.80	6.709	.958
SDR 11 ●	**160 psi**	**8.21**	**7.057**	**.784**
SDR 13.5	128 psi	6.82	7.347	.639
SDR 15.5	110 psi	6.00	7.513	.556
SDR 17 ●	**100 psi**	**5.50**	**7.611**	**.507**
SDR 19	89 psi	4.96	7.717	.454
SDR 21 ●	**80 psi**	**4.52**	**7.803**	**.411**
SDR 26 ●	**64 psi**	**3.68**	**7.961**	**.332**
SDR 32.5 ●	**51 psi**	**2.97**	**8.095**	**.265**

compressive strength of pipe

24/25 PTM

Where: S_A = Actual compressive stress, psi
SDR = Standard Dimension Ratio
P_T = External Pressure, psi

Safety Factor = (1500 psi) ÷ S_A where 1500 psi is the Compressive Yield Strength of Driscopipe.

Design by Wall Buckling: Local wall buckling is a longitudinal wrinkling of the pipe wall. Tests of *non-pressurized* Driscopipe show that buckling and collapse do not occur when the soil envelope is in full contact with the pipe and is compacted to a dense state. However, it can be forced to occur over the long term in *non-pressurized* pipe if the total external soil pressure, P_t, is allowed to exceed the pipe-soil system's critical buckling pressure, P_{cb}. If $P_t > P_{cb}$, gradual collapse may occur over the long term. A calculated, conservative value for the critical buckling pressure may be obtained by the following approximate formula. All pipe diameters with the same SDR in the same burial situation have the same critical collapse and critical buckling endurance

$$P_{cb} = 0.8\sqrt{E' \times P_c}$$

Where:

P_t = Total vertical soil pressure at the top of the pipe, psi

P_{cb} = Critical buckling soil pressure at the top of the pipe, psi

E' = Soil modulus in psi calculated as the ratio of the vertical soil pressure to vertical soil strain at a specified density

P_C = Hydrostatic, critical-collapse differential pressure, psi

$$P_C = \frac{2E\,(t/D)^3\,(D_{MIN}/D_{MAX})^3}{(1-\mu^2)}$$

$$P_c = \frac{2.32\,E}{(SDR)^3}$$

Where: (D_{MIN}/D_{MAX}) = .95
μ = Poission's Ratio
μ = .45 for Driscopipe
E = stress and time dependent tensile modulus of elasticity, psi

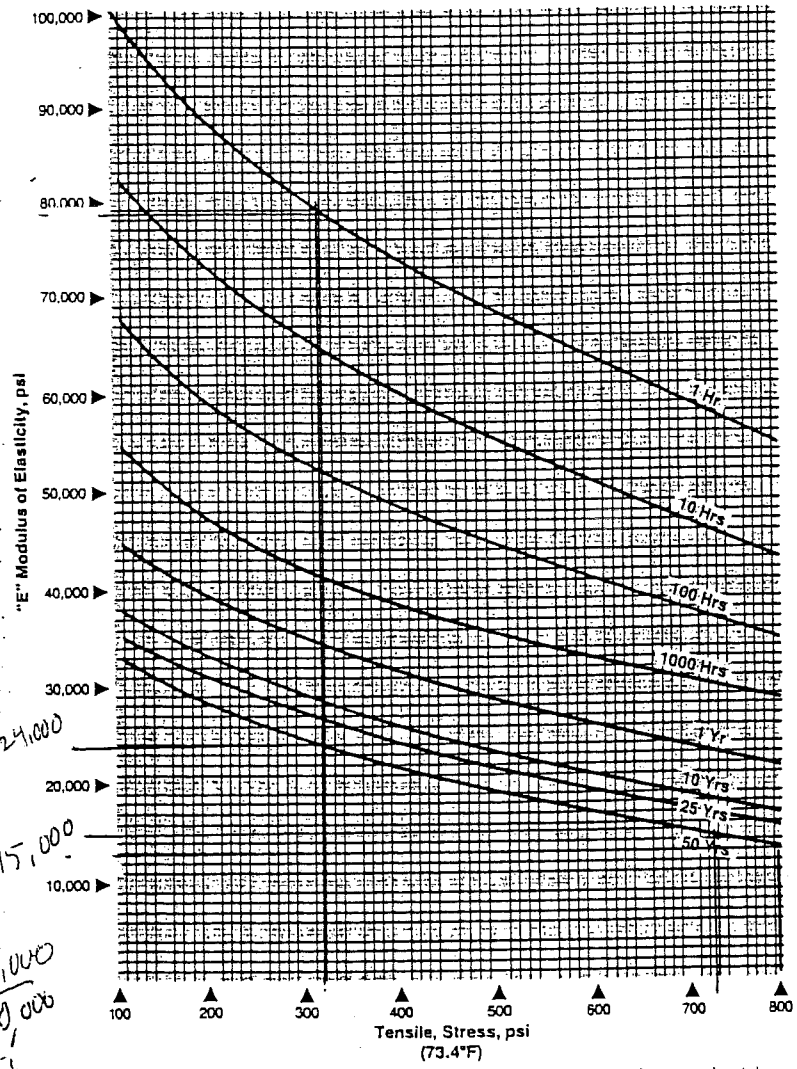
In a direct burial pressurized pipeline, the internal pressure is usually great enough to exceed the external critical-buckling soil pressure. When a pressurized line is to be shut down for a period, wall buckling should be examined.

Design by Wall Buckling Guidelines:
Although wall buckling is seldom the limiting factor in the design of a Driscopipe system, a check of non-pressurized pipelines can be made according to the following steps to insure $P_t < P_{cb}$.

1. Calculate or estimate the total soil pressure, P_t, at the top of the pipe.
2. Calculate the stress "S_A" in the pipe wall according to the formula:
$$S_A = \frac{(SDR - 1)\,P_t}{2}$$
3. Based upon the stress "S_A" and the estimated time duration of non-pressurization, use Chart 25 to find the value of the pipe's modulus of elasticity, E, in psi.

Chart 25

Time Dependent Modulus of Elasticity for Polyethylene Pipe vs. Stress Intensity (73.4°F)



NOTE: The short term modulus of elasticity of Driscopipe per ASTM D 638 is approximately 100,000 psi. Due to the cold flow (creep) characteristic of the pipe material, this modulus is dependent upon the stress intensity and the time duration of the applied stress.

reduction factor = 24,000 / 100,000 = 0.24
New liner area

reduction factor = 15,000 / 100,000 = 0.15

4. Based upon the pipe SDR and the value of the polyethylene modulus of elasticity, E, calculate the pipe's hydrostatic, critical-collapse differential pressure, P_C:

$$P_C = \frac{2.32\,(E)}{(SDR)^3}$$

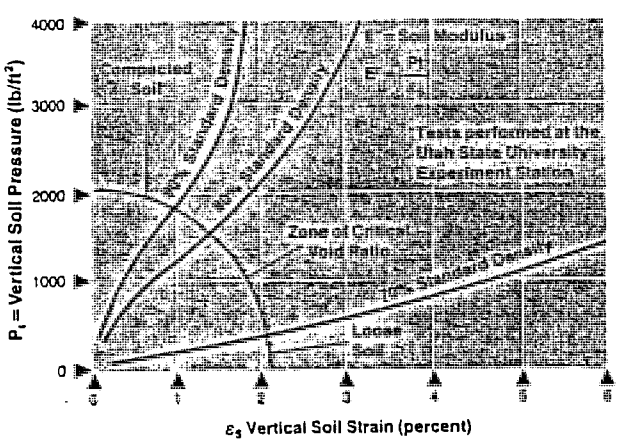
5. Calculate the soil modulus, E', by plotting the total external soil pressure, P_t, against a specified soil density to derive the soil strain as shown in the example problem on Chart 26.
6. Calculate the critical buckling pressure at the top of the pipe by the formula:

$$P_{cb} = 0.8\sqrt{E' \times P_c}$$

7. Calculate the Safety Factor: S.F. = $P_{CB} \div P_t$
   In burial applications, a safety factor of 1.0 may be considered a minimum because of the margin of safety provided by the arching action of the soil. However, Driscopipe endorses using a more conservative value approaching or exceeding a 2.0 safety factor.
8. The above procedures could be reversed to derive the minimum pipe SDR required for a given soil pressure and an estimated soil density. However, this procedure should permit the engineer to optimize the system design quickly by examining several combinations.

Chart 26

Plot of Vertical Stress-Strain Data for Typical Trench Backfill (Except Clay) from Actual Tests*



EXAMPLE

Find: E' @ 2000 PSF and 80% Density
Formula: $E' = P_t / \varepsilon_s$
Calculations: E' = 2000 PSF / .018 = 111111 PSF = 771 psi

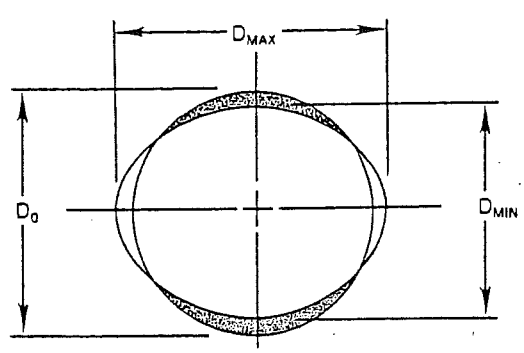
Note: The curves shown on this chart are sample curves for a granular soil. If other types of soil are used for backfill, such as clay or clay loam, curves should be developed from laboratory test data for the material used. Soil pressures greater than 4000 psf may be examined by extrapolating the slope of the curve or by generating curves by testing at those higher soil pressures. Probable error of curves is about half the distance between adjacent lines.

Design by Ring Deflection: Ring deflection is defined as the ratio of the vertical change in diameter to the original diameter. It is often expressed as a percentage. Ring deflection for buried Driscopipe is conservatively the same as (no more than) the vertical compression of the soil envelope around the pipe. Design by ring deflection matches the ability of Driscopipe to accommodate, without structural distress, the vertical compression of the soil enveloping the buried pipeline. *Design by ring deflection comprises a calculation of vertical soil strain to ensure it will be less than the allowable ring deflection of the pipe.* See Chart 27. The tabulation shows that with lower values of SDR, the allowable deflection is less. For installations which require this thicker wall to resist the external soil pressure, actual ring deflection can easily be limited to the tabular values by proper compaction of the backfill around the pipe. The recommended allowable deflection for the various SDR s are:

Chart 27

SDR	Allowable Ring Deflection
32.5	8.1%
26.0	6.5%
21.0	5.2%
19.0	4.7%
17.0	4.2%
15.5	3.9%
13.5	3.4%
11.0	2.7%

The allowable ring deflection of polyethylene pipe is a function of the allowable tangential strain in the outer surface of the pipe wall. A conservative limit of 1-1½% tangential strain in the outer surface of the pipe wall due to vertical deflection of the pipe "ring" by soil compression can be understood by comparing two pipes of the same diameter but different wall thickness.



$$\% \text{ Ring Deflection} = \left(1 - \frac{D_{MIN}}{D_o}\right) \times 100\%$$

NOTE: 5% deflection decreases flow-area by ¼%. 10% deflection decreases flow-area by 1%.

Appendix VIb-G.5

Pump Station Hydraulic Calculation – Incline P.S.

Pennoni Associates Inc.
Consulting Engineers

PROJECT CHERRY ISLAND LANDFILL EXPANSION	JOB NO. GESC	0201
	SHEET 1 OF	DATE
SUBJECT PUMP STATION HYDRAULIC CALCULATION - INCLINE P.S	BY: G.M	
	CHK'D	

Total Dynamic Head (H) = $h_d + h_s + h_M$

where h_d = Total Discharge Head
h_s = Total Suction Head
h_M = Total Minor Losses

Ex. South Central Pumping Station (INCLINED P.S)

1. SUCTION HEAD (h_s) = $h_F - h_{st}$

KNOWNS:

HDPE Pipe @ 160 psi (DR 11) C-Factor: (c)	145 (conservative)
Pump Suction size: (d)	2-inch
Pump Suction length: (L)	0-ft
Design Flowrate: (gpm)	50 GPM
Low Water Level:	@ 11.57-ft elev.
Elev. of Pump Volute:	@ 6.57-ft elev.

a.) Pipe friction loss per 100-ft of pipe ($h_F/100$)

$$\frac{h_F}{100} = 0.002083 * L * \left(\frac{100}{C}\right)^{1.85} * \frac{gpm^{1.85}}{d^{4.8655}} \times \frac{1}{100\text{-ft}}$$

$$= 0.002083 * 0 * \left(\frac{100}{145}\right)^{1.85} * \frac{50^{1.85}}{2^{4.8655}} \times \frac{1}{100\text{-ft}}$$

$$= 0\text{-Ft}/100$$

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SUBJECT	CHK'D	

b. Suction Static Head (h_{st})

h_{st} = (Elev. of Low Water Level) − pump volute elev.

= (11.57-ft) − 6.57-ft

= 5-ft

c.) Total Suction Head (h_s)

$h_s = h_F - h_{st} \Rightarrow 0 - 5\text{ ft} = -5\text{-ft}$

2. DISCHARGE HEAD (h_d) = $h_F + h_{st}$

Knowns

HDPE PIPE @ 160 psi (DR-11) C-factor:	145 (conservative)
Pump Discharge Pipe Size:	≃ HDPE 1.917-in. (2-inch)
Pump Discharge Pipe Length:	154-ft
Design Flowrate:	50 gpm
Manifold Forcemain Size:	≃ HDPE 3.633-in. (4-inch)
Manifold Forcemain Length:	1120-ft
Manifold Forcemain Design Flowrate: *(combine flow from Central P.S upstream at 75gpm and South Central P.S.)	125 gpm
Elev. of Pump Volute:	6.57-ft
Highest Pt. on Discharge Pipe/Forcemain:	56.5-ft

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PROJECT CHERRY ISLAND LANDFILL EXPANSION	JOB NO. GESC	0201
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SUBJECT	CHK'D	

a.) Pipe friction loss per 100-ft of pipe ($h_f/100$)

1.) Discharge Pipe: $\frac{h_f}{100} = 0.002083 * 154\text{-ft} * \left(\frac{100}{145}\right)^{1.85} * \frac{5.0^{1.85}}{1.917^{4.8655}} * \frac{1}{100\text{-ft}}$

$= 0.0946 \frac{\text{-ft}}{100}$

2.) Force Main: $\frac{h_f}{100} = 0.002083 * 1120\text{-ft} * \left(\frac{100}{145}\right)^{1.85} \frac{12.5^{1.85}}{3.633^{4.865}} * \frac{1}{100\text{-ft}}$

$= 0.1671 \frac{\text{-ft}}{100}$

3.) Total Pipe friction loss per 100-ft: $0.0946 + 0.1671 = 0.2617 \frac{\text{-ft}}{100}$

b.) Discharge Static Head (h_{st})

h_{st} = (Elev. of highest pt. on discharge pipe/Forcemain) − Elev. of pump volute

$= (56.5\text{-ft}) - 6.57\text{-ft}$
$= 49.93\text{-ft}$

c.) Total Discharge Head (h_d)

$h_d = h_f + h_{st} \Rightarrow 26.17 + 49.93 = 76.1\text{-ft}$

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PROJECT CHERRY ISLAND LANDFILL EXPANSION	JOB NO. GESC	0201
	SHEET 4 OF	DATE
	BY: G.M	
SUBJECT	CHK'D	

3. MINOR LOSSES (h_m)

Knowns

Design Flowrate: (GPM) — 50 gpm
Pump Suction Size: (d_1) — 2-inch
Pump Discharge Pipe Size: (d_2) — ≃ HDPE 1.917-inch (2-inch)
Manifold Forcemain Design Flowrate (GPM_2) — 125 gpm
* (combine flow from Central P.S. upstream at 75 gpm and South Central P.S.)

Manifold Forcemain Size (d_3) — ≃ HDPE 3.633 in. (4 inch)

a.) Sum of K's for fitting + valves (SEE ATTACHMENT)

1.) Suction Side (K_S) — 0.5
2.) Discharge Pipe (K_D) — 8.3
3.) Force main (K_F) — 2.7

b.) Velocity = $V = \frac{0.4085\,(GPM)}{d^2}$

1.) Suction: $V_S = \frac{0.4085\,(gpm_1)}{d_1^2} = \frac{0.4085(50)}{(2)^2} = 5.11$ Fps

2.) Discharge Pipe: $V_D = \frac{0.4085\,(gpm_1)}{d_2^2} = \frac{0.4085\,(50)}{(1.917)^2} = 5.55$ Fps

3.) Forcemain: $V_F = \frac{0.4805\,(gpm_2)}{d_3^2} = \frac{0.4085\,(125)}{(3.633)^2} = 3.869$ Fps.

FORM NO. 42

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PROJECT CHERRY ISLAND LANDFILL EXPANSION	JOB NO. 85SC	0201
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SUBJECT	BY:	
	CHK'D	

c.) Total Minor Losses (h_m)

$$h_m = K_s \frac{V_s^2}{2g} + K_d \frac{V_d^2}{2g} + K_f \frac{V_f^2}{2g}$$

$$= \frac{0.5 * (5.11)^2}{2\,(32.2\ ft/s^2)} + \frac{8.3 * (5.55)^2}{2\,(32.2\ ft/s^2)} + \frac{2.7 * (3.869)^2}{2\,(32.2\ ft/s^2)}$$

$$= 0.203\ ft + 3.97\ ft + 0.628\ ft$$

$$= 4.80\ ft$$

4. Total DYNAMIC HEAD (H)

$$H = h_d + h_s + h_m$$

$$= 76.1\ ft + (-5\ ft) + 4.80\ ft$$

$$= 75.90\ ft \simeq \underline{76\ ft}$$

FORM NO. 42

NO. 2 - SOUTH CENTRAL PUMP STATION
SUM OF K-FACTOR FOR MINOR LOSSES

VALVES AND FITTINGS	K	SUCTION SIDE No.	SUCTION SIDE Total	DISCHARGE PIPE FORCE MAIN (160psi HDPE - DR-11) No.	DISCHARGE PIPE FORCE MAIN (160psi HDPE - DR-11) Total	MANIFOLD FORCEMAIN FORCE MAIN (160psi HDPE - DR-11) No.	MANIFOLD FORCEMAIN FORCE MAIN (160psi HDPE - DR-11) Total
Entry	0.50	1	0.5		0		0
Exit	1.00		0		0	1	1
Gate Valves	0.20		0		0	1	0.2
Globe Valves	10.00		0		0		0
Plug Valves	0.80		0		0		0
Ball Valves	1.00		0	1	1		0
Butterfly Valves	1.00		0		0		0
Check Valves	2.50		0	1	2.5		0
90 Ell	0.30		0	2	0.6		0
45 Ell	0.20		0	3	0.6	3	0.6
22.5 Ell	0.15		0	4	0.6	2	0.3
Tee - Thru Side	1.80		0	1	1.8		0
Tee - Thru Run	0.60		0	2	1.2	1	0.6
Tee - Run Reduced 1/2	0.90		0		0		0
Reducer	0.25		0		0		0
Increaser	0.90		0		0		0
Other			0		0		0
Sum of K's for Fittings			**0.5**		**8.3**		**2.7**

Pennoni Associates Inc.
Consulting Engineers

PROJECT CHERRY ISLAND LANDFILL EXP.	JOB NO. 6ESC	0201
	SHEET 5 OF	DATE
SUBJECT	BY:	
	CHK'D	

C. Total Minor Losses (h_m)

$$h_m = K_s \frac{V_s^2}{2g} + K_{DID} \frac{V_{DID}^2}{2g} + K_{DOD} \frac{V_{DOD}^2}{2g} + K_{MF} \frac{V_{MF}^2}{2g}$$

$$= \frac{0.8\,(7.148\ \text{fps})^2}{2\,(32.2\ \text{ft/s}^2)} + \frac{6.3\,(7.148)^2}{2\,(32.2)} + \frac{1.45\,(3.992)^2}{2\,(32.2)} + \frac{2.7\,(5.28)^2}{2\,(32.2)}$$

$$= 0.635 + 4.998 + 0.359 + 1.169$$

$$= 7.16\text{-ft}$$

4. Total Dynamic HEAD (H)

$$H = h_d + h_s + h_m$$

$$= 23.69\text{-ft} + 12.59\text{-ft} + 7.16\text{-ft}$$

$$= 43.44\text{-ft} \simeq \underline{43\text{-ft}}$$

* Note: The Total Dynamic Head of 43-ft includes a negative Discharge Static Head of 18.09-ft (SEE Item 2.b, p.3). This is due to the pump volute elev. being the highest elev. (62.5-ft) than the highest pt. on Forcemain (44.41-ft). The design should be conservative, to not include the force of gravity. Therefore, the Discharg Static Head (h_{st}) shall be re-calculated and become 0-ft (62.5-ft − 62.5-ft) whereby the Total Dynamic Head shall be 61.53-ft ≃ 62-ft

FORM NO. 42

Pennoni Associates Inc.
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PROJECT CHERRY ISLAND LANDFILL EXPANSION	JOB NO. 65C	0201
	SHEET 1 OF	DATE
SUBJECT PUMP ST. HYDRAULIC CAL. - SELF-PRIMING P.S	BY: GM	
	CHK'D	

Total Dynamic HEAD (H) = $h_d + h_s + h_m$

where h_d = Tot Discharge HEAD
h_s = Tot. SUCTION HEAD
h_m = Tot. Minor LOSSES

Ex. SELF-Priming P.S. #No. 5

1 SUCTION HEAD (h_s) = $h_f - h_{st}$

Knowns:

D.I PIPE C-FACTOR	120
PUMP SUCTION SIZE:	4-inch
PUMP SUCTION LENGTH:	10-ft
DESIGN FLOWRATE:	280 GPM
Low Water Level:	@ 50.5-ft elev.
Elev. of Pump Volute:	@ 62.5-ft elev.

a. Pipe Friction loss for 100-ft of pipe ($h_F/100$)

$$\frac{h_F}{100} = 0.002083 * L * \left(\frac{100}{C}\right)^{1.85} * \frac{GPM^{1.85}}{d^{4.8655}} * \frac{1}{100\text{-ft}}$$

$$= 0.002083 * (10\text{-ft}) * \left(\frac{100}{120}\right)^{1.85} * \frac{(280)^{1.85}}{(4)^{4.8655}} * \frac{1}{100\text{-ft}}$$

$$= 5.89 \times 10^{-3}\ ft/100$$

b. Suction Static HEAD (h_{st})

h_{st} = (Elev. of Low Water Level) − pump volute Elev.

= (50.5-ft) − 62.5-ft

= −12.00 ft

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PROJECT CHERRY ISLAND LANDFILL EXPANSION	JOB NO. GESC	0201
	SHEET 2 OF	DATE
SUBJECT	BY:	
	CHK'D	

c. Total Suction HEAD (h_s)

$$h_s = h_f - h_{st} \Rightarrow 0.589\text{-ft} - (-12.00\text{ft}) = 12.59\text{-ft}$$

2. DISCHARGE HEAD (h_d) = $h_f + h_{st}$

Knowns

HDPE PIPE (DR-11) C-FACTOR	145 (conservative)
DI PIPE C-FACTOR	120
Size of Self-priming discharge piping (inside building)	4-inch, D.I
Size of Self-priming discharge piping/Forcemain (outside building)	6-inch, HDPE
Length of Self-priming discharge pipe (inside building)	15-ft
Length of Self-priming discharge pipe/forcemain (outside building)	3,550-ft
Design Flowrate:	280 gpm
Manifold Forcemain Size:	6-inch, HDPE
Manifold Forcemain Length:	900-ft
Manifold Forcemain Design Flowrate	370 gpm
* (combine flow from Self-priming P.S No.5 AND No.6 - North P.S (downstream))	
Elev. of Pump volute	@ 62.5-ft elev.
Highest Elev. on forcemain	@ 50.5ft elev.

a. Pipe friction loss per 100-ft of pipe ($h_f/100$)

i.) Discharge Pipe (inside Bldg.):

$$h_f/100 = 0.002083 * 15\text{-ft} * \left(\frac{100}{120}\right)^{1.85} * \frac{(280)^{1.85}}{(4)^{4.8655}} * \frac{1}{100\text{-ft}}$$

$$= 8.835 \times 10^{-3}\text{-ft}/100$$

FORM NO. 42

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PROJECT CHERRY ISLAND LANDFILL EXP.	JOB NO. GESC	0001
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2.) Discharge Pipe / Forcemain (outside bldg.):

$$h_f/_{100} = 0.002083 * 3{,}550\text{-ft} * \left(\frac{100}{145}\right)^{1.85} * \frac{(280)^{1.85}}{(5.349)^{4.8655}} * \frac{1}{100}$$

$$= 0.3583\text{-ft}/100$$

INSIDE DIAMETER OF 6-inch, HDPE PIPE (DR-11) @ 160 psi

3.) Manifold Forcemain:

$$h_f/_{100} = 0.002083 * 300\text{-ft} * \left(\frac{100}{145}\right)^{1.85} * \frac{(370)^{1.85}}{(5.349)^{4.8655}} * \frac{1}{100}$$

$$= 0.051\text{-ft}/100$$

4.) TOTAL PIPE FRICTION LOSS PER 100-ft $= 8.835 \times 10^{-3} + 0.3583 + 0.051$

$$= 0.4178\text{-ft}/100$$

b. Discharge Static Head (h_{st})

h_{st} = (Elev. of highest pt. on forcemain) − pump valute

$= (44.41\text{-ft}) - 62.5\text{ft}$

$= -18.09\text{-ft}$

c. Total Discharge Head (h_d)

$h_d = h_f + h_{st} \Rightarrow 41.78 + (-18.09) = 23.69\text{-ft}$

FORM NO. 42

Pennoni Associates Inc.
Consulting Engineers

JOB NO. GBSC	0001	
SHEET 4 OF	DATE	
BY:		
CHK'D		

PROJECT CHERRY ISLAND LANDFILL EXP.
SUBJECT

3. MINOR LOSSES (h_m)

Knowns

Design Flowrate (inside BLDG.):		280 gpm
Design Flowrate (outside BLDG.)		280 gpm
Design Flowrate (Manifold Forcemain)		370 gpm
Pump Suction Size		4-inch, D.I
Pump Discharge Size (inside BLDG.)		4-inch, D.I
Pump Discharge Size (outside BLDG.)	* HDPE	5.349-inch (6-inch)
Manifold Forcemain Size	* HDPE	5.349-inch (6-inch)

a.) Sum of K's for fitting & Values (see ATTACHMENT)

1.) Suction Side (K_S)	0.8
2.) Discharge Side Inside BLDG. (K_{DIB})	6.3
3.) Discharge Side Outside BLDG. (K_{DOB})	1.45
4.) Manifold Forcemain: (K_{MF})	2.7

b.) Velocity $= V = 0.4085\,(gpm)/d^2$

1.) Suction: $V_S = 0.4085\,(280\,gpm)/(4)^2 = 7.148$ fps

2.) Discharge (inside BLDG.): $V_{DIB} = 0.4085\,(280\,gpm)/(4)^2 = 7.148$ fps

3.) Discharge (outside BLDG.): $V_{DOB} = 0.4085\,(280)/(5.349)^2 = 3.997$ fps.

4.) Manifold Forcemain: $V_{MF} = 0.4085\,(370\,gpm)/(5.349)^2 = 5.28$ fps.

FORM NO. 42

NO. 5 - SELF-PRIMING PUMP STATION
SUM OF K-FACTOR FOR MINOR LOSSES

		SUCTION SIDE (D.I. Pipe)		DISCHARGE PIPE (INSIDE BUILDING) (D.I. Pipe)		DISCHARGE PIPE (OUTSIDE BUILDING) FORCE MAIN (160psi HDPE - DR-11)		MANIFOLD FORCEMAIN FORCE MAIN (160psi HDPE - DR-11)	
VALVES AND FITTINGS	K	No.	Total	No.	Total	No.	Total	No.	Total
Entry	0.50	1	0.5		0		0		0
Exit	1.00		0		0		0	1	1
Gate Valves	0.20		0	1	0.2		0	1	0.2
Globe Valves	10.00		0		0		0		0
Plug Valves	0.80		0		0		0		0
Ball Valves	1.00		0		0		0		0
Butterfly Valves	1.00		0		0		0		0
Check Valves	2.50		0	1	2.5		0		0
90 Ell	0.30	1	0.3	3	0.9		0		0
45 Ell	0.20		0		0	2	0.4	3	0.6
22.5 Ell	0.15		0		0	3	0.45	2	0.3
Tee - Thru Side	1.80		0	1	1.8		0		0
Tee - Thru Run	0.60		0		0	1	0.6	1	0.6
Tee - Run Reduced 1/2	0.90		0		0		0		0
Reducer	0.25		0		0		0		0
Increaser	0.90		0	1	0.9		0		0
Other			0		0		0		0
Sum of K's for Fittings			**0.8**		**6.3**		**1.45**		**2.7**

APPENDIX VIb-H

LANDFILL GAS MANAGEMENT SYSTEM CALCULATIONS

Appendix VIb-H.1

Sizing of Landfill Gas Extraction and Transmission System Components

GEOSYNTEC CONSULTANTS

COMPUTATION COVER SHEET

Client: DSWA **Project:** Cherry Island **Project/Proposal #:** ME0250 **Task:** 2.7

TITLE OF COMPUTATIONS: SIZING OF LANDFILL GAS EXTRACTION AND TRANSMISSION SYSTEM COMPONENTS

COMPUTATATIONS BY:
Signature Carrie H. Pendleton — DATE 03/18/03
Printed Name and Title: Carrie H. Pendleton, Staff Engineer

ASSUMPTIONS AND PROCEDURES CHECKED BY:
(Peer Reviewer)
Signature — DATE 3/18/03
Printed Name and Title: Jeremy W.F. Morris, Engineer

COMPUTATATIONS CHECKED BY:
Signature — DATE 3/18/03
Printed Name and Title: Jeremy W.F. Morris, Engineer

COMPUTATIONS BACKCHECKED BY:
(Originator)
Signature Carrie H. Pendleton — DATE 03/19/03
Printed Name and Title: Carrie H. Pendleton, Staff Engineer

APPROVED BY:
(PM or Designate)
Signature — DATE 3/30/03
Printed Name and Title: R. David Espinoza, Senior Engineer

APPROVAL NOTES: The calculations presented herein are suitable for a landfill elevation of 195 ft-msl. As shown in this calculation package, the design was performed for a more conservative grading configuration than that shown in Drawing 78 entitled "Landfill Final Development and Grading Plan" (Appendix VIb-A).

RDE 6/16/04

REVISIONS: (Number and initial all revisions)

NO.	SHEET	DATE	BY	CHECKED BY	APPROVAL

Written by: C. Pendleton Date: 3/18/2003 Reviewed by: J.W.F. Morris Date: 3/18/2003

Client: DSWA Project: Cherry Island Proj./Proposal No.: ME0250 Task No. 2.7

SIZING OF LANDFILL GAS EXTRACTION AND TRANSMISSION SYSTEM COMPONENTS

Gas Generation

To properly size the landfill gas extraction system components, it is necessary to know how much gas is being produced and in which areas of the landfill. Therefore, it is necessary to calculate the gas generation curves for the waste contributing to each component of the collection system. These collection system components are:

- Horizontal collectors in Phases III-V;
- Vertical extraction wells in Phases III-V; and
- Vertical extraction wells in Phases I & II.

In calculating the gas generation curves, the following assumptions were made:

1. Placement of existing waste occurred first in Phases I and II, then in Phases III-V.
2. Placement of future waste will occur first in Phases III-V, then in Phases I and II.
3. Gas generation parameters (methane generation rate constant, k, and methane generation potential, L_0) are taken as NSPS Tier 1 default values ($k = 0.05\ yr^{-1}$; $L_0 = 170\ m^3/Mg$).
4. Landfill gas is 50% methane.
5. In-place waste density is 55 pcf.
6. CIL will be filled for 35 more years beginning in 2002 (2002-2036).
7. The annual waste placement rate is constant for existing waste (1985-2001) and constant, but different than existing, for future waste (2002-2036).
8. Waste volumes are calculated in AutoCAD using the current existing grading plan, proposed final grading plan, and assuming the bottom of waste to be at 20 ft-msl in Phase I, 30 ft-msl in Phase II, and 40 ft-msl in Phases III-V. Volume calculations are shown in Attachment A.
9. The gas collection system efficiency is 80%.
10. Cover soil accounts for 25% of all total waste volumes.

The equation used to calculate the average landfill gas generation rate in any given year is taken from 40 CFR 60 and is as follows:

$$Q_{CH_4} = 2 \times L_0 \times R \times (e^{-kc} - e^{-kt})$$

where:

L_0 = methane generation potential (m^3/Mg waste)
R = average annual waste acceptance rate (Mg/year)

k = methane generation rate constant (yr^{-1})
t = age of landfill (yrs)
c = time since closure (yrs); for active landfills, c = 0

The input values for the three types of collection system components are shown in the table below.

Parameter	Phases III-V Horizontals	Phases III-V Verticals	Phases I & II Verticals
Filling Dates	1992-2001 (existing) 2002-2028 (future)	2029-2033 (future)	1985-1991 (existing) 2034-2036 (future)
Total Volume (cy)	8,319,171 (existing) 29,387,121 (future)	5,508,455 (future)	5,461,606 (existing) 2,658,020 (future)
Waste Mass (Mg)	4,202,030 (existing) 14,843,495 (future)	2,782,332 (future)	2,758,668 (existing) 1,342,571 (future)
R (Mg/yr)	409,453 (existing) 541,954 (future)	541,954 (future)	409,453 (existing) 541,954 (future)

The resulting gas generation rates and curves are shown in Attachment B.

Sizing of Components

All piping components of the landfill gas extraction system will be sized such that:

(i) velocity is less than 2,500 fpm to reduce entrainment of condensate;
(ii) head loss is less than 1 in.-water per 100 feet of pipe to minimize the required blower horsepower.

Velocity in a pipe, V, is calculated using the following standard formula:

$$V = \frac{Q}{A}$$

where Q = flow (ft^3/sec)
A = cross-sectional area of the pipe (ft^2)

Head loss is calculated using the Spitzglass formula:

$$\Delta h_w = \frac{q_h^2 \times L \times S_g}{C_s^2 \times d^5}$$

where:

Δh_w = head loss (in.-water)
q_h = flow rate (ft^3/hr)
L = pipe length (ft)
S_g = specific gravity of gas relative to air ($S_g = 1.5$)
d = pipe diameter (inches)
C_s = $3550 / (1 + 3.6/d + 0.03d)^{1/2}$

Perimeter Header

The header pipe needs to be sized for the year in which the peak gas flow for the entire site occurs. By summing the flow rates for each section, the year 2036 is determined to be the year in which the peak flow occurs. The flow rates in 2036 for each component are as follows:

Phases III-V Horizontals	= 5,430 cfm
Phases III-V Verticals	= 1,886 cfm
Phases I & II	= 1,613 cfm

The gas flow from Phases I & II and from the Phases III-V Verticals each enters the header at two points. Equal flow will be directed to each of these two points. To determine how much gas enters the header at each horizontal collector connection, we first need to determine how many horizontal collectors will be necessary. This is done through a radius of influence calculation which is shown in Attachment C. Using the results of the calculation, the horizontal collectors will be spaced 100 feet apart in the horizontal direction and 40 feet apart in the vertical direction. Refer to the design drawings for more specific layout information. To determine how much gas enters the header at each horizontal collector connection, it is assumed that an equal amount of gas is extracted for each foot of trench length. Therefore, the length of each trench was measured and the total trench length for each quadrant was calculated. An amount of gas proportional to each quadrant's total trench length was assumed to enter the header at the upstream end of the quadrant. The trench length measurements are shown in Attachment D.

Now that we know how much gas is entering the header pipe and at which points, the pipe can be sized. The transmission header is sized assuming that the flow is split between the top half and the bottom half of the header. As mentioned previously, the header will be sized for peak total flow. The calculation spreadsheet is shown in Attachment E.

As can be seen in Attachment E, the sections of pipe from the Phase I & II connection to the blower on the top side of the header and from the Quadrant 4 connection to the blower on the bottom side of the header will have velocities above 2500 fpm if a 16" pipe is used. To ensure that condensate does not become entrained, a transition to a 26" pipe (or equal area) will need to

be installed before the combined flows from each half of the header enter the condensate trap at the blower. This will allow for the entire perimeter header to be sized at 16".

Horizontal Collectors and Downslope Pipes

All horizontal collectors will be sized for the worst case – the horizontal collector with the largest flow. In addition, the horizontal collectors will be sized for the year in which the peak landfill gas generation rate occurs in that portion of waste. The peak generation rate for the Phases III-V Horizontals occurs in 2028 and is 8,100 cfm. This will not necessarily be the same year in which the peak overall generation rate for the entire site occurs. The longest horizontal collector is in Quadrant 3 at Nodes 7, 9, 11, and 13 at Level 1 and has a length of 1,500 ft.

The downslope pipes are all sized based on the node with the longest total length of pipe, and therefore the highest flow, entering the header. This occurs in Quadrant 4 at Node 15 with a total pipe length of 4,390 ft.

Internal Header (Phases III-V)

The internal header will be sized to carry the peak flow for the vertical wells in Phases III-V. The peak generation rate occurs in 2033 and is 2,191 cfm. Since this flow will be directed to the perimeter header through two connections, each segment of the internal header needs to be able to handle one-fourth of the total peak flow. The connections from the internal header to the perimeter header need to be able to handle one-half of the peak flow. As a conservative measure, the necessary pipe sizes will also be calculated assuming all the flow must enter the perimeter header at one point.

Summary of Pipe Sizes

The pipe sizes for all components of the landfill gas extraction system are as follows:

Perimeter Header	= 18"
Internal Header	= 8"
Internal Header Connections to Perimeter Header	= 10"
Horizontal Collectors	= 6"
Downslope Pipes	= 6"

Estimate of Condensate Volume

To calculate the volume of condensate that will form in the landfill gas collection piping, it is first necessary to estimate the temperature of the landfill gas at different points in the system. From previous experience, the following temperatures are expected:

At well heads → 90°F (max)
At condensate infiltrators → 65°F
At knockout tanks → 40°F (min)

From Figure 1, the water content of hydrocarbon gas can be estimated at a given temperature. Using Figure 1, the landfill gas water content can be estimated at each of the above temperatures. The estaimtes are as follows:

90°F → 2,200 lb H_2O / 10^6 ft^3 gas
65°F → 950 lb H_2O / 10^6 ft^3 gas
40°F → 400 lb H_2O / 10^6 ft^3 gas

The maximum expected change in water content is:

2,200 lb H_2O / 10^6 ft^3 gas - 400 lb H_2O / 10^6 ft^3 gas = 1,800 lb H_2O / 10^6 ft^3 gas

We will use the maximum site landfill gas generation rate to determine the maximum amount of condensate that will be generated in any one year. The peak landfill gas generation rate at CIL is 8,929 cfm. Using this value, the maximum total condensate generated at CIL in any one year is calculated as follows:

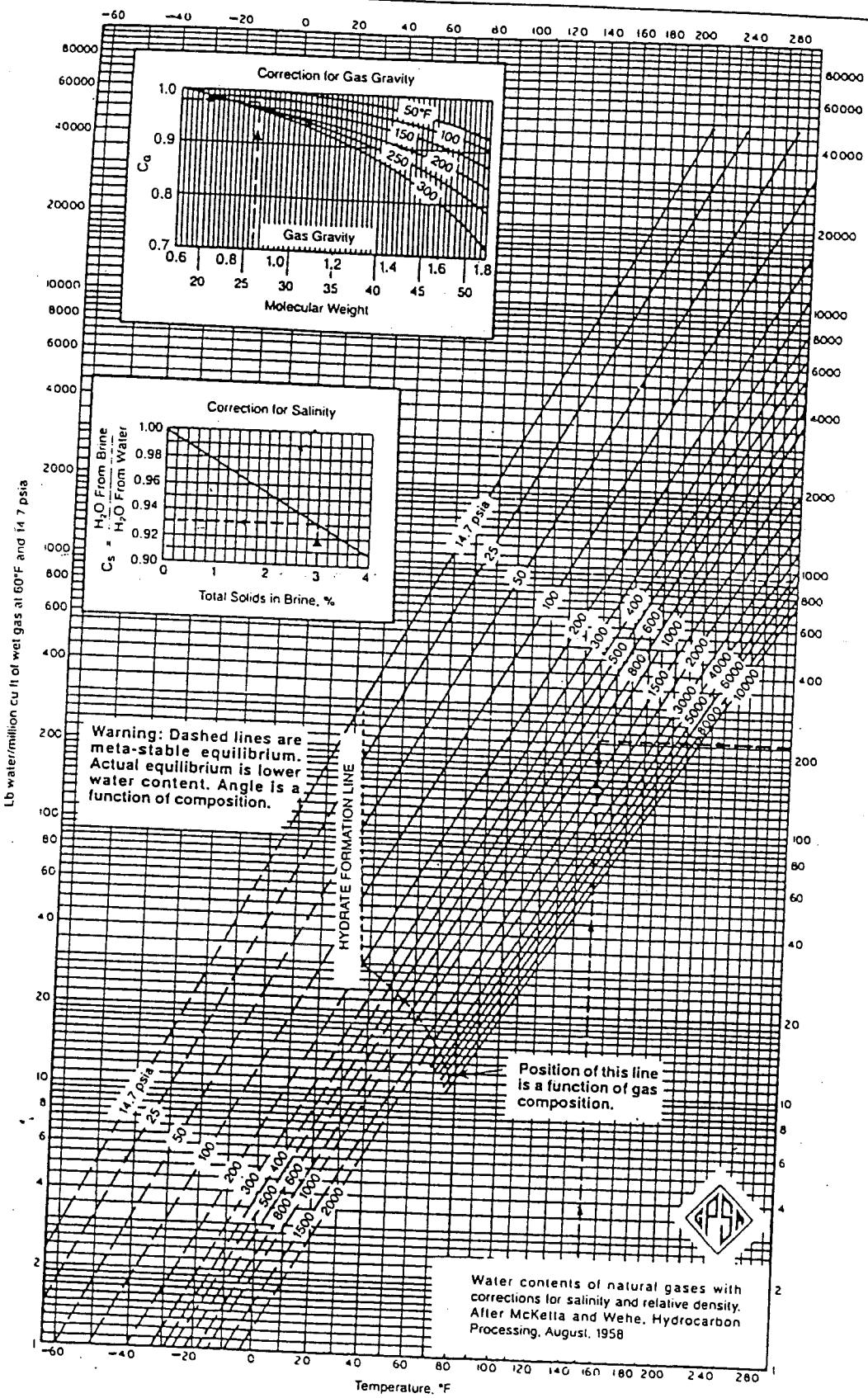
$$\frac{1{,}800\ \text{lb}\ H_2O}{10^6\ \text{ft}^3\ \text{gas}} \times \frac{8{,}929\ \text{ft}^3}{\text{min}} = 16.1\ \text{lb/min condensate}$$

$$\frac{16.1\ \text{lb}}{\text{min}} \times \frac{1440\ \text{min}}{\text{day}} \times \frac{1\ \text{ft}^3}{62.4\ \text{lb}} \times \frac{7.48\ \text{gal}}{\text{ft}^3} = 2{,}774\ \text{gal/day condensate}$$

$$\frac{2{,}774\ \text{gal}}{\text{day}} \times \frac{365\ \text{days}}{\text{year}} = \mathbf{1{,}012{,}620\ gal/year\ condensate}$$

Under a worst case scenario, the condensate knockout at the blower will need to be able to handle this entire volume of condensate.

FIGURE 1



Ref: "Engineering Data Book", Gas Processors Suppliers Association, Tulsa, OK, 10th ed., 1994.

ATTACHMENT A

LANDFILL GAS VOLUME NUMBER CALCS

eg = existing grade, October 2002 survey
fg = final grade, including berm (with counter berm) and berm to elev 65 at USACOE
ph = phase
north/south (N/S) separation within phases 3,4,5 from landfill gas tier division (per CHP)
v# = softdesk stratum
--- all volumes in cubic yards

EG vs FG	eg to fg (v2)	minus	berm (v1)	total (t1)	
ph 1-2	2,658,722	-	702	2,658,020	Phases I/II
ph 3,4,5 N	15,931,095	-	71,086	15,860,009	
ph 3,4,5 S	20,384,623	-	1,349,056	19,035,567	
	38,974,440		1,420,844	**37,553,596**	**= total**

EG vs FG to Elev 200	(v3)	minus	berm (v1)	total (t2)	
ph 1-2	2,658,722	-	702	2,658,020	
ph 3,4,5 N	11,952,757	-	71,086	11,881,671	
ph 3,4,5 S	16,379,526	-	1,349,056	15,030,470	
	30,991,005		1,420,844	**29,570,161**	**= total**

EG vs FG to Elev 240	(v4)	minus	berm (v1)	total (t3)	
ph 1-2	2,658,722	-	702	2,658,020	
ph 3,4,5 N	14,427,737	-	71,086	14,356,651	
ph 3,4,5 S	19,143,575	-	1,349,056	17,794,519	
	36,230,034		1,420,844	**34,809,190**	**= total**

Phases III-V Horizontals

FG to Elev 200 vs FG	(t1)	minus	(t2)	total (t4)	
ph 1-2	2,658,020	-	2,658,020	0	
ph 3,4,5 N	15,860,009	-	11,881,671	3,978,338	
ph 3,4,5 S	19,035,567	-	15,030,470	4,005,097	
	37,553,596		29,570,161	**7,983,435**	**= total**

FG to Elev 240 vs FG	(t1)	minus	(t3)	total (t5)	
ph 1-2	2,658,020	-	2,658,020	0	
ph 3,4,5 N	15,860,009	-	14,356,651	1,503,358	
ph 3,4,5 S	19,035,567	-	17,794,519	1,241,048	
	37,553,596		34,809,190	**2,744,406**	**= total**

Phases III-V Verticals

FG to Elev 200 vs FG to Elev 240		plus	berm (v1)	total	
ph 1-2	0	+	702	702	
ph 3,4,5 N	2,474,980	+	71,086	2,546,066	
ph 3,4,5 S	2,764,049	+	1,349,056	4,113,105	
	5,239,029		1,420,844	**6,659,873**	**= total**

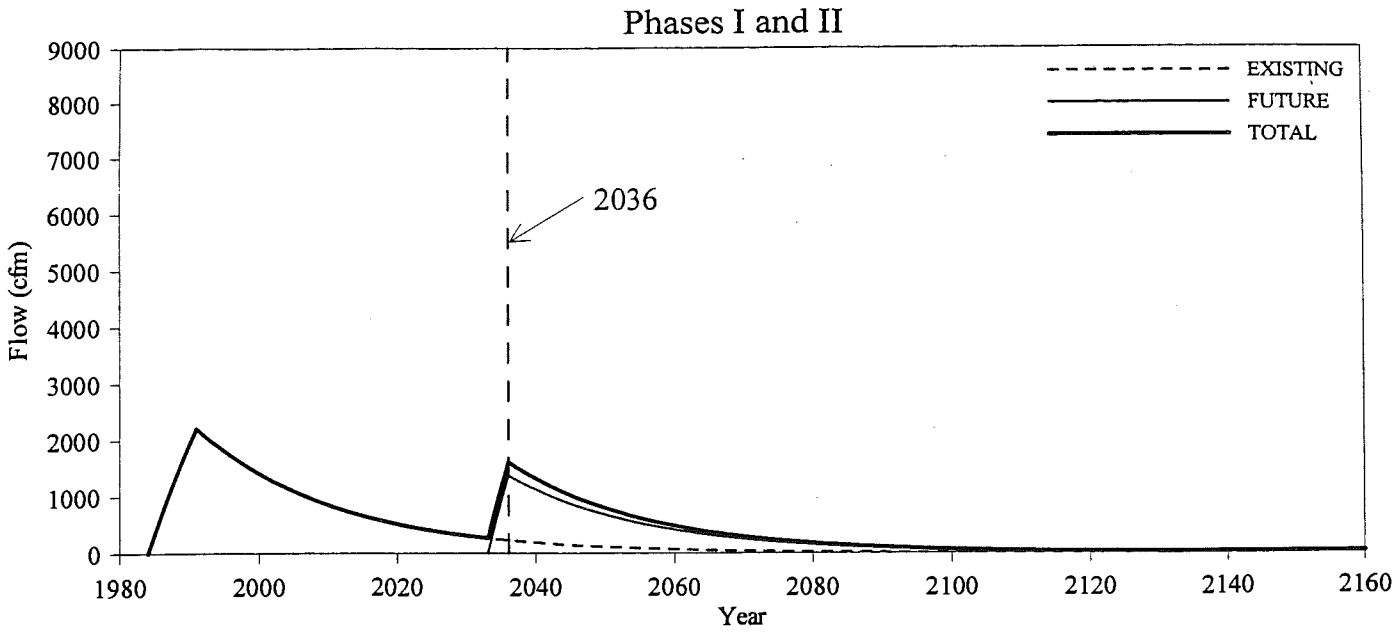
Existing Waste [elevs 20 (ph 1), 30 (ph 2) & 40 (ph 3,4,5) to EG] (v5)

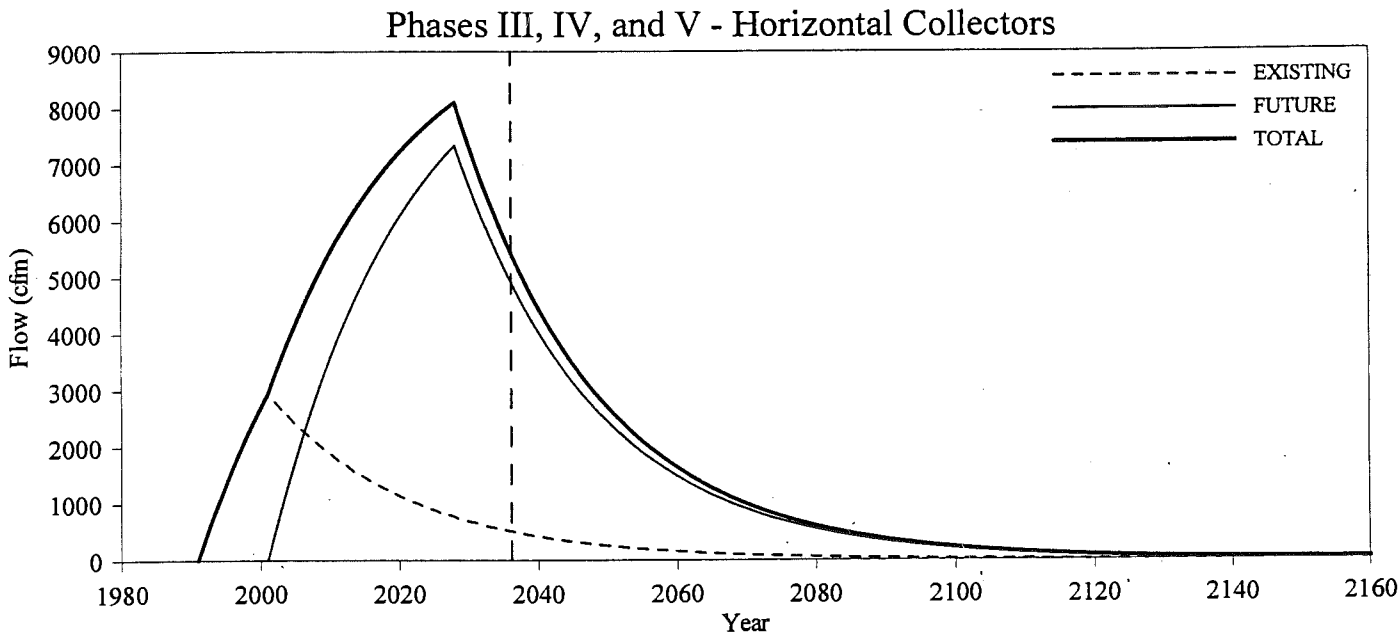
ph 1-2	5,461,606
ph 3,4,5 N	4,297,137
ph 3,4,5 S	4,022,034
total =	**13,780,777**

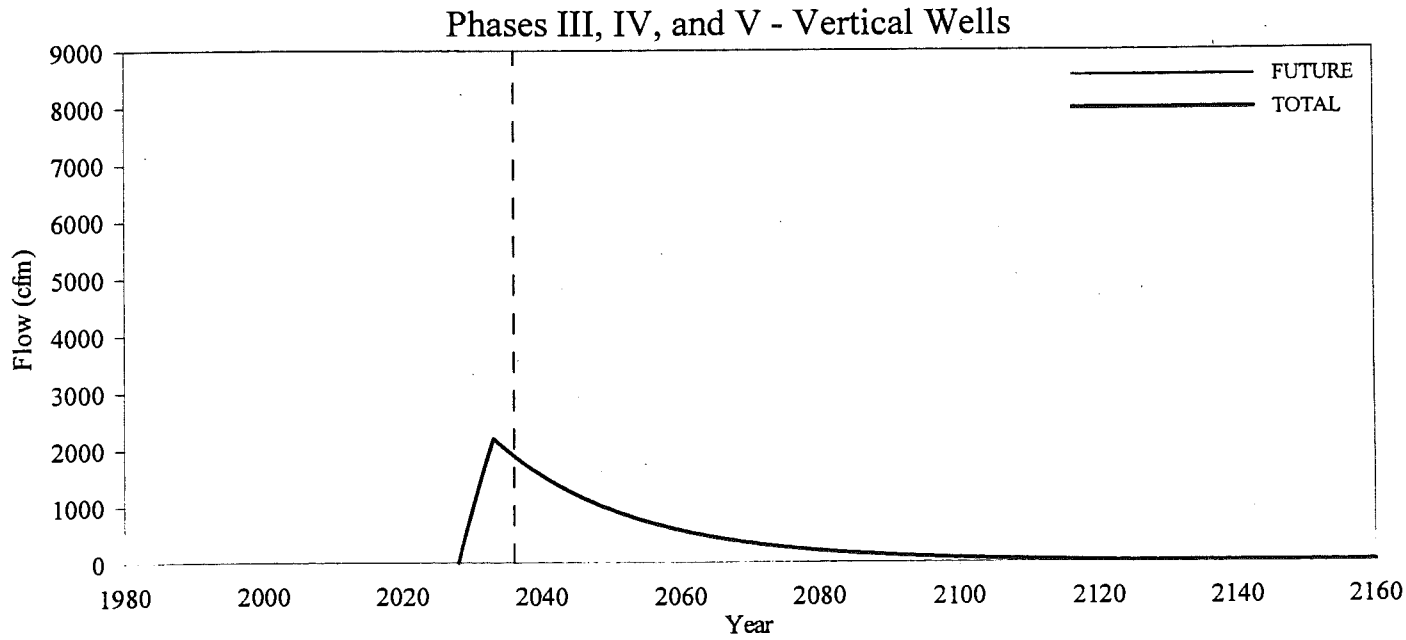
2002 Waste (April - October 2002, phases 3,4,5 only) (v6)

total = 483,409

ATTACHMENT B


Phases I and II
EXISTING
FUTURE
TOTAL
2036
Flow (cfm)
Year
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
1980
2000
2020
2040
2060
2080
2100
2120
2140
2160


Phases III, IV, and V - Horizontal Collectors
EXISTING
FUTURE
TOTAL
Flow (cfm)
Year
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
1980
2000
2020
2040
2060
2080
2100
2120
2140
2160


Phases III, IV, and V - Vertical Wells
FUTURE
TOTAL
Flow (cfm)
Year
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
1980
2000
2020
2040
2060
2080
2100
2120
2140
2160

Phases I and II

Model Year	Calendar Year	LFG Collected (Existing) [1] (cfm)	LFG Collected (Future) [2] (cfm)	LFG Collected (Total) (cfm)
0		0.0	0.0	0.0
1	1985	364.9	0.0	364.9
2	1986	712.1	0.0	712.1
3	1987	1,042.3	0.0	1,042.3
4	1988	1,356.4	0.0	1,356.4
5	1989	1,655.2	0.0	1,655.2
6	1990	1,939.4	0.0	1,939.4
7	1991	2,209.8	0.0	2,209.8
8	1992	2,102.0	0.0	2,102.0
9	1993	1,999.5	0.0	1,999.5
10	1994	1,902.0	0.0	1,902.0
11	1995	1,809.2	0.0	1,809.2
12	1996	1,721.0	0.0	1,721.0
13	1997	1,637.1	0.0	1,637.1
14	1998	1,557.2	0.0	1,557.2
15	1999	1,481.3	0.0	1,481.3
16	2000	1,409.0	0.0	1,409.0
17	2001	1,340.3	0.0	1,340.3
18	2002	1,274.9	0.0	1,274.9
19	2003	1,212.8	0.0	1,212.8
20	2004	1,153.6	0.0	1,153.6
21	2005	1,097.4	0.0	1,097.4
22	2006	1,043.8	0.0	1,043.8
23	2007	992.9	0.0	992.9
24	2008	944.5	0.0	944.5
25	2009	898.4	0.0	898.4
26	2010	854.6	0.0	854.6
27	2011	812.9	0.0	812.9
28	2012	773.3	0.0	773.3
29	2013	735.6	0.0	735.6
30	2014	699.7	0.0	699.7
31	2015	665.6	0.0	665.6
32	2016	633.1	0.0	633.1
33	2017	602.2	0.0	602.2
34	2018	572.9	0.0	572.9
35	2019	544.9	0.0	544.9
36	2020	518.4	0.0	518.4
37	2021	493.1	0.0	493.1
38	2022	469.0	0.0	469.0
39	2023	446.2	0.0	446.2

40	2024	424.4	0.0	424.4
41	2025	403.7	0.0	403.7
42	2026	384.0	0.0	384.0
43	2027	365.3	0.0	365.3
44	2028	347.5	0.0	347.5
45	2029	330.5	0.0	330.5
46	2030	314.4	0.0	314.4
47	2031	299.1	0.0	299.1
48	2032	284.5	0.0	284.5
49	2033	270.6	0.0	270.6
50	2034	257.4	483.0	740.5
51	2035	244.9	942.5	1,187.4
52	2036	232.9	1,379.6	1,612.5
53	2037	221.6	1,312.3	1,533.9
54	2038	210.7	1,248.3	1,459.1
55	2039	200.5	1,187.4	1,387.9
56	2040	190.7	1,129.5	1,320.2
57	2041	181.4	1,074.4	1,255.8
58	2042	172.5	1,022.0	1,194.6
59	2043	164.1	972.2	1,136.3
60	2044	156.1	924.8	1,080.9
61	2045	148.5	879.7	1,028.2
62	2046	141.3	836.8	978.0
63	2047	134.4	796.0	930.3
64	2048	127.8	757.1	885.0
65	2049	121.6	720.2	841.8
66	2050	115.7	685.1	800.8
67	2051	110.0	651.7	761.7
68	2052	104.7	619.9	724.6
69	2053	99.5	589.7	689.2
70	2054	94.7	560.9	655.6
71	2055	90.1	533.6	623.6
72	2056	85.7	507.5	593.2
73	2057	81.5	482.8	564.3
74	2058	77.5	459.2	536.8
75	2059	73.7	436.8	510.6
76	2060	70.2	415.5	485.7
77	2061	66.7	395.3	462.0
78	2062	63.5	376.0	439.5
79	2063	60.4	357.7	418.0
80	2064	57.4	340.2	397.6
81	2065	54.6	323.6	378.3

(1) Landfill gas collected that was generated by waste placed from 1985-2001.

(2) Landfill gas collected that was generated by waste placed from 2002-2036.

Phases III, IV, and V – Horizontal Collectors

Model Year	Calendar Year	LFG Collected (Existing) [1] (cfm)	LFG Collected (Future) [2] (cfm)	LFG Collected (Total) (cfm)
0		0.0	0.0	0.0
1	1985	0.0	0.0	0.0
2	1986	0.0	0.0	0.0
3	1987	0.0	0.0	0.0
4	1988	0.0	0.0	0.0
5	1989	0.0	0.0	0.0
6	1990	0.0	0.0	0.0
7	1991	0.0	0.0	0.0
8	1992	364.9	0.0	364.9
9	1993	712.1	0.0	712.1
10	1994	1,042.3	0.0	1,042.3
11	1995	1,356.4	0.0	1,356.4
12	1996	1,655.2	0.0	1,655.2
13	1997	1,939.4	0.0	1,939.4
14	1998	2,209.8	0.0	2,209.8
15	1999	2,467.0	0.0	2,467.0
16	2000	2,711.6	0.0	2,711.6
17	2001	2,944.3	0.0	2,944.3
18	2002	2,800.7	483.0	3,283.8
19	2003	2,664.1	942.5	3,606.7
20	2004	2,534.2	1,379.6	3,913.8
21	2005	2,410.6	1,795.4	4,206.0
22	2006	2,293.0	2,190.9	4,483.9
23	2007	2,181.2	2,567.1	4,748.3
24	2008	2,074.8	2,924.9	4,999.7
25	2009	1,973.6	3,265.3	5,238.9
26	2010	1,877.4	3,589.1	5,466.5
27	2011	1,785.8	3,897.1	5,682.9
28	2012	1,698.7	4,190.1	5,888.8
29	2013	1,615.9	4,468.8	6,084.7
30	2014	1,537.1	4,733.9	6,270.9
31	2015	1,462.1	4,986.1	6,448.2
32	2016	1,390.8	5,225.9	6,616.7
33	2017	1,323.0	5,454.1	6,777.1
34	2018	1,258.4	5,671.2	6,929.6
35	2019	1,197.1	5,877.6	7,074.7
36	2020	1,138.7	6,074.0	7,212.7
37	2021	1,083.2	6,260.8	7,344.0
38	2022	1,030.3	6,438.5	7,468.8
39	2023	980.1	6,607.6	7,587.6

40	2024	932.3	6,768.4	7,700.6
41	2025	886.8	6,921.3	7,808.1
42	2026	843.6	7,066.8	7,910.4
43	2027	802.4	7,205.2	8,007.6
44	2028	763.3	7,336.8	8,100.1
45	2029	726.1	6,979.0	7,705.1
46	2030	690.6	6,638.6	7,329.3
47	2031	657.0	6,314.9	6,971.8
48	2032	624.9	6,006.9	6,631.8
49	2033	594.4	5,713.9	6,308.4
50	2034	565.5	5,435.3	6,000.7
51	2035	537.9	5,170.2	5,708.1
52	2036	511.6	4,918.0	5,429.7
53	2037	486.7	4,678.2	5,164.9
54	2038	463.0	4,450.0	4,913.0
55	2039	440.4	4,233.0	4,673.4
56	2040	418.9	4,026.5	4,445.4
57	2041	398.5	3,830.2	4,228.6
58	2042	379.0	3,643.4	4,022.4
59	2043	360.5	3,465.7	3,826.2
60	2044	343.0	3,296.7	3,639.6
61	2045	326.2	3,135.9	3,462.1
62	2046	310.3	2,982.9	3,293.3
63	2047	295.2	2,837.5	3,132.6
64	2048	280.8	2,699.1	2,979.9
65	2049	267.1	2,567.4	2,834.5
66	2050	254.1	2,442.2	2,696.3
67	2051	241.7	2,323.1	2,564.8
68	2052	229.9	2,209.8	2,439.7
69	2053	218.7	2,102.0	2,320.7
70	2054	208.0	1,999.5	2,207.5
71	2055	197.9	1,902.0	2,099.9
72	2056	188.2	1,809.2	1,997.5
73	2057	179.0	1,721.0	1,900.0
74	2058	170.3	1,637.1	1,807.4
75	2059	162.0	1,557.2	1,719.2
76	2060	154.1	1,481.3	1,635.4
77	2061	146.6	1,409.0	1,555.6
78	2062	139.4	1,340.3	1,479.8
79	2063	132.6	1,275.0	1,407.6
80	2064	126.2	1,212.8	1,338.9
81	2065	120.0	1,153.6	1,273.6

(1) Landfill gas collected that was generated by waste placed from 1985-2001.

(2) Landfill gas collected that was generated by waste placed from 2002-2036.

Phases III, IV, and V – Vertical Wells

Model Year	Calendar Year	LFG Collected (Existing) [1] (m^3/yr)	LFG Collected (Future) [2] (m^3/yr)	LFG Collected (Total) (m^3/yr)
0		0.0	0.0	0.0
1	1985	0.0	0.0	0.0
2	1986	0.0	0.0	0.0
3	1987	0.0	0.0	0.0
4	1988	0.0	0.0	0.0
5	1989	0.0	0.0	0.0
6	1990	0.0	0.0	0.0
7	1991	0.0	0.0	0.0
8	1992	0.0	0.0	0.0
9	1993	0.0	0.0	0.0
10	1994	0.0	0.0	0.0
11	1995	0.0	0.0	0.0
12	1996	0.0	0.0	0.0
13	1997	0.0	0.0	0.0
14	1998	0.0	0.0	0.0
15	1999	0.0	0.0	0.0
16	2000	0.0	0.0	0.0
17	2001	0.0	0.0	0.0
18	2002	0.0	0.0	0.0
19	2003	0.0	0.0	0.0
20	2004	0.0	0.0	0.0
21	2005	0.0	0.0	0.0
22	2006	0.0	0.0	0.0
23	2007	0.0	0.0	0.0
24	2008	0.0	0.0	0.0
25	2009	0.0	0.0	0.0
26	2010	0.0	0.0	0.0
27	2011	0.0	0.0	0.0
28	2012	0.0	0.0	0.0
29	2013	0.0	0.0	0.0
30	2014	0.0	0.0	0.0
31	2015	0.0	0.0	0.0
32	2016	0.0	0.0	0.0
33	2017	0.0	0.0	0.0
34	2018	0.0	0.0	0.0
35	2019	0.0	0.0	0.0
36	2020	0.0	0.0	0.0
37	2021	0.0	0.0	0.0
38	2022	0.0	0.0	0.0
39	2023	0.0	0.0	0.0

40	2024	0.0	0.0	0.0
41	2025	0.0	0.0	0.0
42	2026	0.0	0.0	0.0
43	2027	0.0	0.0	0.0
44	2028	0.0	0.0	0.0
45	2029	0.0	0.0	0.0
46	2030	0.0	0.0	0.0
47	2031	0.0	0.0	0.0
48	2032	0.0	0.0	0.0
49	2033	0.0	0.0	0.0
50	2034	0.0	483.0	483.0
51	2035	0.0	942.5	942.5
52	2036	0.0	1,379.6	1,379.6
53	2037	0.0	1,312.3	1,312.3
54	2038	0.0	1,248.3	1,248.3
55	2039	0.0	1,187.4	1,187.4
56	2040	0.0	1,129.5	1,129.5
57	2041	0.0	1,074.4	1,074.4
58	2042	0.0	1,022.0	1,022.0
59	2043	0.0	972.2	972.2
60	2044	0.0	924.8	924.8
61	2045	0.0	879.7	879.7
62	2046	0.0	836.8	836.8
63	2047	0.0	796.0	796.0
64	2048	0.0	757.1	757.1
65	2049	0.0	720.2	720.2
66	2050	0.0	685.1	685.1
67	2051	0.0	890.7	890.7
68	2052	0.0	847.3	847.3
69	2053	0.0	806.0	806.0
70	2054	0.0	766.7	766.7
71	2055	0.0	729.3	729.3
72	2056	0.0	693.7	693.7
73	2057	0.0	659.9	659.9
74	2058	0.0	627.7	627.7
75	2059	0.0	597.1	597.1
76	2060	0.0	568.0	568.0
77	2061	0.0	540.3	540.3
78	2062	0.0	513.9	513.9
79	2063	0.0	488.8	488.8
80	2064	0.0	465.0	465.0
81	2065	0.0	442.3	442.3

(1) Landfill gas collected that was generated by waste placed from 1985-2001.

(2) Landfill gas collected that was generated by waste placed from 2002-2036.

ATTACHMENT C

Written by: C. Pendleton Date: 03/02/19 (YY/MM/DD) Reviewed by: _____ Date: __/__/__ (YY/MM/DD)

Client: _____ Project: _____ Project/Proposal No.: _____ Task No.: _____

RADIUS OF INFLUENCE OF LFG COMPONENTS

The radius of influence is calculated using the following formula:

$$R = \sqrt{\frac{Q_{well} \times D}{\pi \times L \times \rho_{refuse} \times Q_{gen} \times E_a}}$$ [USEPA, 1991]

where:

R = radius of influence (m);
Q_{well} = landfill gas flow rate per trench/well (m^3/s);
D = design capacity of the landfill (kg);
L = landfill depth (m);
ρ_{refuse} = density of the refuse (kg/m^3);
Q_{gen} = peak landfill gas generation rate (m^3/s); and
E_a = collection system efficiency

We need to calculate the radius of influence individually for each of the three components of the extraction system.

Phases III, IV, and V - Horizontals

The parameter values are as follows:

- Q_{well} is estimated as 1.5 m^3/min or 0.025 m^3/s.
- The design capacity, D, includes future waste in addition to one-third of the existing waste. The total mass is 17,616,551,791 kg.
- The landfill depth where horizontal collectors will be installed is approximately 153 ft or 46.6 m
- The estimated in-place refuse density is 55 pcf or 881 kg/m^3.
- The peak landfill gas generation rate is 3.58 m^3/s.
- The assumed collection system efficiency is 80%.

Using these parameter values, the calculated radius of influence is 34.5 m or 113 ft. As a conservative value, we will use 100 ft as the design radius of influence for the horizontal collectors. USEPA (1991) recommends spacing the trenches no more than two times the radius of influence horizontally and one-half the radius of influence vertically. Therefore, the trenches should be spaced at 200 ft intervals in the horizontal direction and no greater than 50 ft intervals in the vertical direction.

Written by: C. Pendleton Date: 03/02/19 (YY/MM/DD) Reviewed by: _____ Date: __/__/__ (YY/MM/DD)

Client: _____ Project: _____ Project/Proposal No.: _____ Task No.: _____

Phases III, IV, and V - Verticals

The parameter values are as follows:

- $Q_{well} = 0.025\ m^3/s$
- $D = 2{,}782{,}331{,}862\ kg$
- $L = 70\ ft$ or $21.3\ m$
- $\rho_{refuse} = 55\ pcf$ or $881\ kg/m^3$
- $Q_{gen} = 1.03\ m^3/s$
- $E_a = 80\%$

Using these parameter values, the calculated radius of influence is 37.8 m or 124 ft.

Phases I and II

The parameter values are as follows:

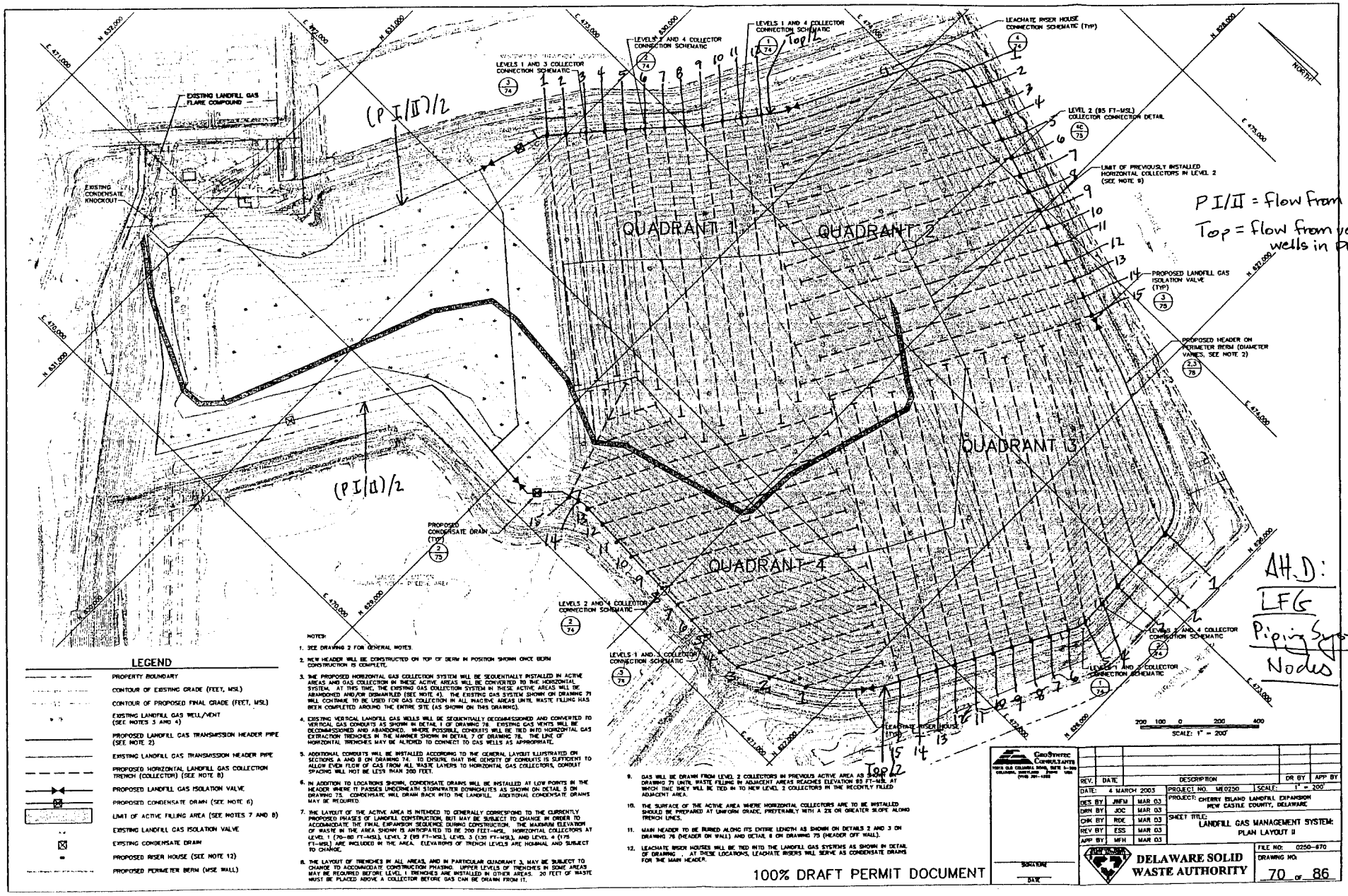
- $Q_{well} = 0.025\ m^3/s$
- $D = 4{,}101{,}239{,}663\ kg$
- $L = 100\ ft$ or $30.5\ m$
- $\rho_{refuse} = 55\ pcf$ or $881\ kg/m^3$
- $Q_{gen} = 0.76\ m^3/s$
- $E_a = 80\%$

Using these parameter values, the calculated radius of influence is 44.7 m or 147 ft.

Using a conservative value for radius of influence of 125 ft results in an area of influence of 1.13 acres. We will space the vertical extraction wells at approximately one per acre.

ATTACHMENT D

P:\cadd\0250\0250-700-post100percent\0250-770.dwg Fri Mar 14 11:31:51 2003 CHP



P I/II = flow from phase I/II

Top = flow from vertical wells in Phases II-V

AH.D: LFG Piping System Nodes

LEGEND

- PROPERTY BOUNDARY
- CONTOUR OF EXISTING GRADE (FEET, MSL)
- CONTOUR OF PROPOSED FINAL GRADE (FEET, MSL)
- EXISTING LANDFILL GAS WELL/VENT (SEE NOTES 3 AND 4)
- PROPOSED LANDFILL GAS TRANSMISSION HEADER PIPE (SEE NOTE 2)
- EXISTING LANDFILL GAS TRANSMISSION HEADER PIPE
- PROPOSED HORIZONTAL LANDFILL GAS COLLECTION TRENCH (COLLECTOR) (SEE NOTE 8)
- PROPOSED LANDFILL GAS ISOLATION VALVE
- PROPOSED CONDENSATE DRAIN (SEE NOTE 6)
- LIMIT OF ACTIVE FILLING AREA (SEE NOTES 7 AND 8)
- EXISTING LANDFILL GAS ISOLATION VALVE
- EXISTING CONDENSATE DRAIN
- PROPOSED RISER HOUSE (SEE NOTE 12)
- PROPOSED PERIMETER BERM (WSE WALL)

NOTES:

1. SEE DRAWING 2 FOR GENERAL NOTES.
2. NEW HEADER WILL BE CONSTRUCTED ON TOP OF BERM IN POSITION SHOWN ONCE BERM CONSTRUCTION IS COMPLETE.
3. THE PROPOSED HORIZONTAL GAS COLLECTION SYSTEM WILL BE SEQUENTIALLY INSTALLED IN ACTIVE AREAS AND GAS COLLECTION IN THOSE ACTIVE AREAS WILL BE CONVERTED TO THE HORIZONTAL SYSTEM. AT THIS TIME, THE EXISTING GAS COLLECTION SYSTEM IN THESE ACTIVE AREAS WILL BE ABANDONED AND/OR DISMANTLED (SEE NOTE 4). THE EXISTING GAS SYSTEM SHOWN ON DRAWING 71 WILL CONTINUE TO BE USED FOR GAS COLLECTION IN ALL INACTIVE AREAS UNTIL WASTE FILLING HAS BEEN COMPLETED AROUND THE ENTIRE SITE (AS SHOWN ON THIS DRAWING).
4. EXISTING VERTICAL LANDFILL GAS WELLS WILL BE SEQUENTIALLY DECOMMISSIONED AND CONVERTED TO VERTICAL GAS CONDUITS AS SHOWN IN DETAIL 1 OF DRAWING 78. EXISTING GAS VENTS WILL BE DECOMMISSIONED AND ABANDONED. WHERE POSSIBLE, CONDUITS WILL BE TIED INTO HORIZONTAL GAS EXTRACTION TRENCHES IN THE MANNER SHOWN IN DETAIL 7 OF DRAWING 78. THE LINE OF HORIZONTAL TRENCHES MAY BE ALTERED TO CONNECT TO GAS WELLS AS APPROPRIATE.
5. ADDITIONAL CONDUITS WILL BE INSTALLED ACCORDING TO THE GENERAL LAYOUT ILLUSTRATED ON SECTIONS A AND B ON DRAWING 74. TO ENSURE THAT THE DENSITY OF CONDUITS IS SUFFICIENT TO ALLOW EVEN FLOW OF GAS FROM ALL WASTE LAYERS TO HORIZONTAL GAS COLLECTORS, CONDUIT SPACING WILL NOT BE LESS THAN 200 FEET.
6. IN ADDITION TO LOCATIONS SHOWN, CONDENSATE DRAINS WILL BE INSTALLED AT LOW POINTS IN THE HEADER WHERE IT PASSES UNDERNEATH STORMWATER DOWNCHUTES AS SHOWN ON DETAIL 5 ON DRAWING 73. CONDENSATE WILL DRAIN BACK INTO THE LANDFILL. ADDITIONAL CONDENSATE DRAINS MAY BE REQUIRED.
7. THE LAYOUT OF THE ACTIVE AREA IS INTENDED TO GENERALLY CORRESPOND TO THE CURRENTLY PROPOSED PHASES OF LANDFILL CONSTRUCTION, BUT MAY BE SUBJECT TO CHANGE IN ORDER TO ACCOMMODATE THE FINAL EXPANSION SEQUENCE DURING CONSTRUCTION. THE MAXIMUM ELEVATION OF WASTE IN THE AREA SHOWN IS ANTICIPATED TO BE 200 FEET-MSL. HORIZONTAL COLLECTORS AT LEVEL 1 (70-80 FT-MSL), LEVEL 2 (95 FT-MSL), LEVEL 3 (135 FT-MSL), AND LEVEL 4 (175 FT-MSL) ARE INCLUDED IN THE AREA. ELEVATIONS OF TRENCH LEVELS ARE NOMINAL AND SUBJECT TO CHANGE.
8. THE LAYOUT OF TRENCHES IN ALL AREAS, AND IN PARTICULAR QUADRANT 3, MAY BE SUBJECT TO CHANGE TO ACCOMMODATE CONSTRUCTION PHASING. UPPER LEVELS OF TRENCHES IN SOME AREAS MAY BE REQUIRED BEFORE LEVEL 1 TRENCHES ARE INSTALLED IN OTHER AREAS. 20 FEET OF WASTE MUST BE PLACED ABOVE A COLLECTOR BEFORE GAS CAN BE DRAWN FROM IT.
9. GAS WILL BE DRAWN FROM LEVEL 2 COLLECTORS IN PREVIOUS ACTIVE AREA AS SHOWN ON DRAWING 73 UNTIL WASTE FILLING IN ADJACENT AREAS REACHES ELEVATION 95 FT-MSL AT WHICH TIME THEY WILL BE TIED IN TO NEW LEVEL 2 COLLECTORS IN THE RECENTLY FILLED ADJACENT AREA.
10. THE SURFACE OF THE ACTIVE AREA WHERE HORIZONTAL COLLECTORS ARE TO BE INSTALLED SHOULD BE PREPARED AT UNIFORM GRADE, PREFERABLY WITH A 2% OR GREATER SLOPE ALONG TRENCH LINES.
11. MAIN HEADER TO BE BURIED ALONG ITS ENTIRE LENGTH AS SHOWN ON DETAILS 2 AND 3 ON DRAWING 78 (HEADER ON WALL) AND DETAIL 6 ON DRAWING 75 (HEADER OFF WALL).
12. LEACHATE RISER HOUSES WILL BE TIED INTO THE LANDFILL GAS SYSTEMS AS SHOWN IN DETAIL 1 OF DRAWING . AT THESE LOCATIONS, LEACHATE RISERS WILL SERVE AS CONDENSATE DRAINS FOR THE MAIN HEADER.

100% DRAFT PERMIT DOCUMENT

GEOSYNTEC CONSULTANTS
1105 W. COLUMBIA BOULEVARD, SUITE 5-300
COLUMBIA, SOUTH CAROLINA 29201 (803) 799-4488

REV.	DATE	DESCRIPTION	DR BY	APP BY

DATE:	4 MARCH 2003	PROJECT NO.	WE0250
SCALE:	1" = 200'	PROJECT:	CHERRY ISLAND LANDFILL EXPANSION NEW CASTLE COUNTY, DELAWARE
DES BY	JWFM	MAR 03	
DRN BY	JOC	MAR 03	
CHK BY	RDE	MAR 03	
REV BY	ESS	MAR 03	
APP BY	MFH	MAR 03	
SHEET TITLE:	LANDFILL GAS MANAGEMENT SYSTEM: PLAN LAYOUT II		

SIGNATURE

DATE

DELAWARE SOLID WASTE AUTHORITY

FILE NO: 0250-870

DRAWING NO: 70 OF 86

Written by: _____ Date: ___/___/___ (YY MM DD) Reviewed by: _____ Date: ___/___/___ (YY MM DD)

Client: _____ Project: _____ Project/Proposal No.: _____ Task No.: _____

LENGTH OF HORIZONTAL COLLECTORS IN PHASE III-V

QUADRANT 1

Length of Pipe Connecting From Level... (ft)

Node	1	2	3	4	5	TOTAL
1	500	0	0	0	0	500
2	0	1200	0	0	0	1200
3	580	0	1060	0	0	1640
4	0	1220	0	940	0	2160
5	640	0	1220	0	970	2830
6	0	1380	0	1270	0	2650
7	670	0	1410	0	1170	3250
8	0	1530	0	1260	0	2790
9	680	0	1370	0	1120	3170
10	0	1500	0	1230	0	2730
11	570	0	1340	0	1090	3000
12	0	1470	0	1200	0	2670

28,590 ft

QUADRANT 2

Node	1	2	3	4	TOTAL
1	0	950	0	0	950
2	1000	0	0	0	1000
3	0	1040	0	0	1040
4	1070	0	920	0	1990
5	0	1100	0	830	1930
6	1140	0	990	0	2130
7	0	1180	0	900	2080
8	1210	0	1060	0	2270
9	0	1250	0	970	2220
10	1280	0	1130	0	2410
11	0	1320	0	1040	2360
12	1350	0	1190	0	2540
13	0	1390	0	1110	2500
14	1430	0	1270	0	2700
15	0	1460	0	1180	2640

30,760 ft

Written by: _____ Date: ___/___/___ (YY MM DD) Reviewed by: _____ Date: ___/___/___ (YY MM DD)

Client: _____ Project: _____ Project/Proposal No.: _____ Task No.: _____

QUADRANT 3

Node	1	2	3	4	TOTAL
1	1180	0	0	0	1180
2	0	1160	0	0	1160
3	1360	0	1070	0	2430
4	0	1320	0	990	2310
5	1480	0	1200	0	2680
6	0	1400	0	1120	2520
7	1500	0	1240	0	2740
8	0	1400	0	1120	2520
9	1500	0	1240	0	2740
10	0	1400	0	1120	2520
11	1500	0	1240	0	2740
12	0	1400	0	1120	2520
13	1500	0	1240	0	2740
14	0	1390	0	1110	2500
15	1490	0	1230	0	2720

36,020 ft

QUADRANT 4

Node	1	2	3	4	5	TOTAL
1	300	0	0	0	0	300
2	0	450	0	0	0	450
3	500	0	290	0	0	790
4	0	650	0	330	0	980
5	670	0	480	0	160	1310
6	0	780	0	510	0	1290
7	790	0	600	0	330	1720
8	0	890	0	630	0	1520
9	900	0	720	0	450	2070
10	0	1010	0	740	0	1750
11	1020	0	830	0	560	2410
12	0	1130	0	860	0	1990
13	1280	0	1040	0	780	3100
14	0	1290	0	1000	0	2290
15	1380	1230	1120	660	0	4390

26,360 ft

TOTAL [illegible]

ATTACHMENT E

Cherry Island Landfill Expansion
Sizing of Landfill Gas System Components

Head Loss and Pipe Sizing Calculations
Perimeter Header

From	To	Connector Flow (scfm)	Total Flow (scfm)	Pipe Size (in.)	Velocity (ft/min)	Length (ft)	C_s^2	Pressure Drop in- w.c	Δp Pressure Drop/100 ft in- w.c
CCW									
Q2	Top	1,372	1,372	18	776.4	2400	7,242,816	1.7826	0.0743
Top	Q1	943	2,315	18	1310.0	75	7,242,816	0.1586	0.2115
Q1	PI/II	1,275	3,590	18	2031.5	2190	7,242,816	11.1367	0.5085
PI/II	Pipe Junction	807	4,397	18	2488.2	970	7,242,816	7.3996	0.7628
							Head loss subtotal:	20.5	in.-w.c.
CW									
Q3	Top	1,607	1,607	18	909.4	1745	7,242,816	1.7781	0.1019
Top	Q4	943	2,550	18	1443.0	225	7,242,816	0.5773	0.2566
Q4	PI/II	1,176	3,726	18	2108.5	3110	7,242,816	17.0361	0.5478
PI/II	Pipe Junction	807	4,533	18	2565.2	2280	7,242,816	18.4855	0.8108
							Head loss subtotal:	37.9	in.-w.c.
Pipe Junction	Knockout	8,930	8,930	26	2422.0	100	6,569,066	0.5517	0.5517

Estimated head loss at condensate knock-out: 3.0 in.-w.c.

Total head loss - CCW: 24.0 in.-w.c.
Total head loss - CW: 41.4 in.-w.c.

Cherry Island Landfill Expansion
Sizing of Landfill Gas System Components

Head Loss and Pipe Sizing Calculations
Horizontal Collectors

From	To	Connector Flow (scfm)	Total Flow (scfm)	Pipe Size (in.)	Velocity (ft/min)	Length (ft)	Cs2	Pressure Drop in- w.c	Dp Pressure Drop/100 ft in- w.c
Horizontals		100	100	6	509.3	1500	7,080,056	1.4713	0.0981
							Total head loss:	1.5	in.-w.c.

Note: Worst case scenario occurs in Quadrant 3, Nodes 7, 9, 11, and 13 at Level 1.

Cherry Island Landfill Expansion
Sizing of Landfill Gas System Components

Head Loss and Pipe Sizing Calculations
Downslope Pipes

From	To	Connector Flow (scfm)	Total Flow (scfm)	Pipe Size (in.)	Velocity (ft/min)	Length (ft)	Cs2	Pressure Drop in- w.c	Dp Pressure Drop/100 ft in- w.c
Downslope Pipes		292	292	6	1487.1	150	7,080,056	1.2545	0.8363
							Total head loss:	1.3	in.-w.c.

Note: Worst case scenario occurs in Quadrant 4, Node 15.

Cherry Island Landfill Expansion
Sizing of Landfill Gas System Components

Head Loss and Pipe Sizing Calculations
Internal Header - Phases III-V Vertical Wells

From	To	Connector Flow (scfm)	Total Flow (scfm)	Pipe Size (in.)	Velocity (ft/min)	Length (ft)	Cs2	Pressure Drop in- w.c	Dp Pressure Drop/100 ft in- w.c
Flow Split in Two Directions									
Top Header		548	548	8	1569.9	1640	7,457,101	10.88	0.6636
Top	Perim. Head.	1096	1096	10	2009.5	590	7,591,867	5.04	0.8544
Flow all in One Direction									
Top Header		1096	1096	10	2009.5	820	7,591,867	7.01	0.8544
Top	Perim. Head.	2191	2191	14	2049.6	590	7,514,267	3.78	0.6414

Appendix VIb-H.2

Structural Integrity of Landfill Gas Collection Pipes

GEOSYNTEC CONSULTANTS

COMPUTATION COVER SHEET

.ent: DSWA **Project:** Cherry Island **Project/Proposal #:** ME0250 **Task #:** 2.7

TITLE OF COMPUTATIONS STRUCTURAL INTEGRITY OF LANDFILL GAS COLLECTION PIPES

COMPUTATIONS BY:
Signature Carrie H. Pendleton — DATE 03/21/03
Printed Name and Title: Carrie H. Pendleton, Staff Engineer

ASSUMPTIONS AND PROCEDURES CHECKED BY:
(Peer Reviewer)
Signature Douglas T. Mandeville — DATE 3/27/03
Printed Name and Title: Douglas T. Mandeville, Senior Staff Engineer

COMPUTATIONS CHECKED BY:
Signature Douglas T. Mandeville — DATE 3/27/03
Printed Name and Title: Douglas T. Mandeville, Senior Staff Engineer

COMPUTATIONS
ACKCHECKED BY:
ginator)
Signature Carrie H Pendleton — DATE 03/27/03
Printed Name and Title: Carrie H. Pendleton, Staff Engineer

APPROVED BY:
(PM or Designate)
Signature [illegible] — DATE 03/30/03
Printed Name and Title: R. David Espinoza, Senior Engineer

APPROVAL NOTES: The calculations presented herein are suitable for a landfill elevation of 195 ft-msl. As shown in this calculation package, the design was performed for a more conservative grading configuration than that shown in Drawing 78 entitled "Landfill Final Development and Grading Plan" (Appendix VIb-A). RDE 6/10/04

REVISIONS (Number and initial all revisions)

NO.	SHEET	DATE	BY	CHECKED BY	APPROVAL

Written by: C. Pendleton Date: 03/21/03 Reviewed by: D. Mandeville Date: 03/27/03

Client: DSWA Project: Cherry Island Proj./Proposal No.: ME0250 Task No.: 2.7

STRUCTURAL INTEGRITY OF LANDFILL GAS COLLECTION PIPES

OBJECTIVES

The objective of this calculation is to evaluate the structural adequacy of the proposed landfill gas collection pipes at the Cherry Island Landfill (CIL). The landfill gas collection pipes are evaluated for structural stability in terms of wall crushing, buckling, and ring deflection. A factor of safety is calculated for wall crushing and buckling. This calculation evaluates the structural stability for both the landfill gas header and the bottom layer of the horizontal collectors.

BACKGROUND

Regulations stipulate that landfills must have a landfill gas collection network in place that can effectively convey gas collected within the landfill to a transmission header and to the flare. In order to effectively convey the gas, the pipes must be structurally able to withstand expected loads.

Proposed Landfill Gas Collection System Pipes

The proposed landfill gas collection pipes will be high density polyethylene (HDPE). The 6-in. horizontal collector pipes will be perforated. The table below summarizes the proposed landfill gas collection pipe information. Parameters used for the design of the HDPE pipe are taken from Phillips 66 [1991] (See Attachment A).

	6-in. Horizontal Collector	18-in. Header
Outer Diameter	6 inches	18 inches
Standard Dimension ratio	17	17
Inner diameter	5.845 inches	15.882 inches
Wall thickness	0.390 inches	1.059 inches
Compressive yield strength	1,500 lbs/in^2	1,500 lbs/in^2
Modulus of Elasticity	30,000 lbs/in^2	30,000 lbs/in^2
Maximum allowable ring deflection	4.2%	4.2%

PROCEDURE

Evaluation of the stability of the leachate collection pipes will be done based on engineering procedures described in Phillips 66 [1991] and Chevron [1992]. Loads imposed on the pipe must be limited to stresses which will not cause failure of the pipe. The worst case loading condition will be analyzed for each type of pipe. The worst case condition for the 6-in. horizontal collectors is the maximum pressure exerted on the bottom layer of pipe due to the overburden of the landfill after the final grades have been achieved. The worst case condition for the 18-in. header is the maximum pressure on the pipe induced by equipment driving over the pipe, either during construction or in normal operations of the landfill.

Induced Pipe Stresses

6-in. Horizontal Collector

During post closure conditions, the horizontal collector pipe will be subjected to overburden stresses due to the materials above the pipe, (i.e., waste and protective cover soils). Assuming plane strain conditions, the pressure due to this loading can be estimated by averaging the vertical and horizontal stresses acting on the pipe. The vertical and horizontal stresses can be calculated as follows:

$$\sigma_{vertical} = (\gamma_{waste})\ (H)$$

$$\sigma_{horizontal} = K_o\ (\gamma_{waste})\ (H)$$

Where:

$\sigma_{vertical}$	=	Maximum applied stress (lbs/ft^2)
$\sigma_{horizontal}$	=	Maximum applied stress (lbs/ft^2)
γ_{waste}	=	Unit weight of the waste (lbs/ft^3)
H	=	Maximum depth of waste in the landfill (ft)
K_o	=	lateral earth pressure coefficient = 1-sin(ϕ), where ϕ=34°

The volumetric stress can be calculated as:

$$\sigma_{max} = 0.5\ (\sigma_v + \sigma_h) = 0.5\ \gamma\ H\ (1 + K_o)$$

GeoSyntec performed field investigations in March and April 2002 to characterize the waste at the CIL [GeoSyntec, 2003]. Based on the results of the field investigation and

subsequent laboratory testing, the MSW was found to have an average density ranging from 55 to 75 lbs/ft^3. These unit weights are for the existing conditions; the table below shows the variation in unit weight for depths exceeding for the proposed expansion.

Depth Range	Unit Weight (lbs/ft^3)	
	Total	Saturated
0-20	60	100
20-100	75	100
100-150	80	100
150-200	85	100
>200	90	100

For the proposed landfill gas collection pipes, the maximum depth of waste is approximately 240-ft, given that the lowest elevation a pipe will be placed at is approximately 50 ft-msl and the maximum landfill height is 290 ft-msl. Using Equation 3, the stresses acting on the pipe are shown in the table below.

	6-in. Horizontal Collector
Depth (ft)	240
σ_{max} (lbs/in^2)	99.8
average unit weight (lbs/ft^3)	79.8

18-in. Header

This calculation assumes that the header will be buried beneath 12 inches of granular material before any equipment will cross the pipe. The stress due to traffic above the pipe is assumed to come from a HS-20 standard truck load which applies an axle load of 32,000 lbs (i.e., 16,000 per tire). For the calculations, a concentrated load of 20,000 lbs is assumed to be applied above the crown of the pipe. The stress on the pipe will be calculated as described in Chevron [1992].

$$\sigma_{max} = C_H \frac{I}{L} \frac{W_l}{D}$$

where:

σ_{max} = Maximum stress applied (lbs/ft^2)

I	=	Impact factor
L	=	Pipe length (ft)
C_H	=	Load coefficient
D	=	Pipe outer diameter (ft)
W_l	=	Wheel load (pounds)

The Chevron manual suggests an impact factor of 1.5 be used for the calculations and a pipe length of 3 feet for pipes which are 3 feet or longer. The load coefficient (C_H) is a function of the pipe burial depth (H), length (L), and outer diameter (D).

$$C_H = f\left(\frac{L}{2H}, \frac{D}{2H}\right)$$

The load coefficient is taken from Table 1 of this calculation, $C_H = 0.68$. The induced pipe stress for the 18-in. header is:

$$\sigma_{max} = \left(0.68\frac{1.5(20{,}000\text{lbs})}{(3\text{ft})(18\text{in}/12)}\right)\times\left(\frac{\text{ft}^2}{144\text{in}^2}\right) = \mathbf{31.5\ lb/in^2}$$

FACTOR OF SAFETY CALCULATIONS

Wall Crushing

Wall crushing can occur when the stress in the pipe wall, due to external vertical pressure, exceeds the compressive strength of the pipe material. The factor of safety against pipe wall crushing may be calculated using the following equation [Phillips 66, 1991]:

$$FS_{wc} = \frac{2\sigma_y}{(SDR-1)\sigma_{max}}$$

where:

FS_{wc}	=	Factor of safety against pipe wall crushing
σ_y	=	Compressive yield strength of the pipe (lbs/in^2)
SDR	=	Standard dimension ratio of the pipe
σ_{max}	=	Maximum stress applied to the pipe (lbs/in^2)

Wall Buckling

Wall buckling, a longitudinal wrinkling in the pipe wall, can occur when the external vertical pressure exceeds the critical buckling pressure of the pipe/bedding aggregate system. The factor of safety against pipe wall buckling can be calculated using the following equation [Phillips 66, 1991]:

$$FS_{wb} = \frac{1.2}{\sigma_{max}} \left[\frac{E'E}{(SDR)^3} \right]^{1/2} \tag{5}$$

where:

FS_{wb}	=	Factor of safety against pipe wall buckling
σ_{max}	=	Maximum stress applied to the pipe (lbs/in^2)
E'	=	Modulus of soil reaction for pipe bedding (lbs/in^2)
E	=	Modulus of elasticity of the pipe material (lbs/in^2)
SDR	=	Standard dimension ratio of the pipe

The modulus of soil reaction, E', for the pipe bedding material is based on Table 2 taken from Phillips 66 [1991]. The soil reaction modulus for granular material with a minimum standard Proctor density of 70% is 3,000 lbs/in^2.

Ring Deflection

Ring deflection is the change in vertical diameter of the pipe as the pipe/bedding aggregate system deforms under the external vertical pressure. The actual ring deflection of the pipe must be less than the allowable ring deflection of the pipe. The pipe ring deflection may be estimated as equal to the strain of the soil backfill around the pipe, which is calculated by the following equation:

$$\Delta_R = \frac{\sigma_{max}}{E'} \times 100 \tag{6}$$

where:

Δ_R	=	Pipe ring deflection (percent)
E'	=	Modulus of soil reaction for pipe bedding (lbs/in^2)
σ_{max}	=	Maximum stress applied to the pipe (lbs/in^2)

CALCULATIONS:

Written by: C. Pendleton Date: 03/21/03 Reviewed by: D. Mandeville Date: 03/27/03

Client: DSWA Project: Cherry Island Proj./Proposal No.: ME0250 Task No.: 2.7

The factor of safety calculations for the 6" horizontal collector pipes are shown below.

$$FS_{wc} = \frac{2(1{,}500\ \text{lbs/in}^2)}{(17-1)99.8\text{lbs/in}^2} = \mathbf{1.9}$$

$$FS_{wb} = \frac{1.2}{99.8 lbs/in^2}\left[\frac{(3{,}000 lbs/in^2)(30{,}000 lbs/in^2)}{(17)^3}\right]^{1/2} = \mathbf{1.6}$$

$$\Delta_R = \frac{(99.8 lbs/in^2)}{(3{,}000\ \text{lbs/in}^2)} = \mathbf{3.3\%}$$

The results of all calculations are shown below for both types of pipe.

	6" Horizontal Collector	18" Header
FS – Wall Crushing	1.9	6.0
FS – Wall Buckling	1.6	5.2
Ring Deflection	3.3%	1.0%

CONCLUSIONS

The factors of safety computed for this calculation are all greater than 1, and the calculated ring deflection for both cases are smaller than the allowable ring deflection (i.e. 4.2 percent for both pipe sizes). Based on this result, the structural stability of the proposed landfill gas collection pipes are adequate for use in the CIL landfill.

REFERENCES

Chevron Chemical Company, "*Plexico/Spirolite Engineering Manual, 2. System Design*", Chevron Chemical Company, Bensennville, Il. 1992.

Phillips 66, "*Driscopipe System Design*", Manufactures Literature NO. 1089-91 A17, Phillips 66, 1991.

USEPA, "*Lining of Waste Impoundment and Disposal Facilities*", SW-870, U.S. Environmental Protection Agency, Washington, DC, March 1983, Revised Edition.

ATTACHMENT A

Written by: CHP Date: 03/03/21 (YY/MM/DD) Reviewed by: DTM Date: 03/03/27 (YY/MM/DD)

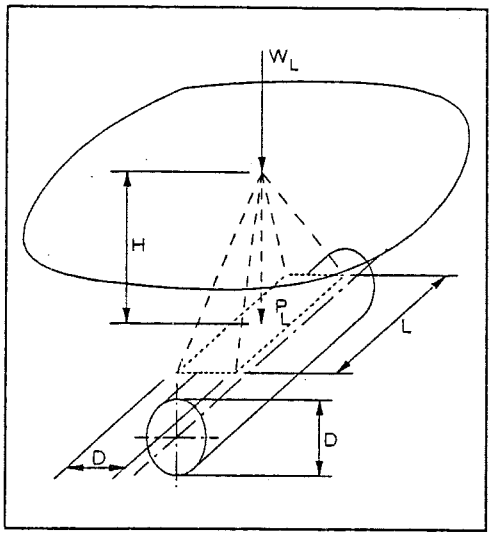
Client: DSWA Project: CIL Project/Proposal No.: MC0250 Task No.: 2.7

Load Coefficient, C_H, for Holl's Integration of Boussinesq's Equation

D=18" = 1.5'
L=3'
H=1'

$\frac{D}{2H} = 0.75$

$\frac{L}{2H} = 1.5$



D/2H	L/2H						
	0.1	0.2	0.3	0.4	0.5	0.6	0.7
0.1	0.019	0.037	0.053	0.067	0.079	0.089	0.097
0.2	0.037	0.072	0.103	0.131	0.155	0.174	0.189
0.3	0.053	0.103	0.149	0.190	0.224	0.252	0.274
0.4	0.067	0.131	0.190	0.241	0.284	0.320	0.349
0.5	0.079	0.155	0.224	0.284	0.336	0.379	0.414
0.6	0.089	0.174	0.252	0.320	0.379	0.428	0.467
0.7	0.097	0.189	0.274	0.349	0.414	0.467	0.511
0.8	0.103	0.202	0.292	0.373	0.441	0.499	0.546
0.9	0.108	0.211	0.306	0.391	0.463	0.524	0.574
1.0	0.112	0.219	0.318	0.405	0.481	0.544	0.597
1.2	0.117	0.229	0.333	0.425	0.505	0.572	0.628
1.5	0.121	0.238	0.346	0.442	0.525	0.596	0.655
2.0	0.124	0.244	0.355	0.454	0.540	0.613	0.674
20.0	0.127	0.248	0.361	0.462	0.550	0.625	0.688

D/2H	L/2H						
	0.8	0.9	1.0	1.2	1.5	2.0	20.0
0.1	0.103	0.108	0.112	0.117	0.121	0.124	0.127
0.2	0.202	0.211	0.219	0.229	0.238	0.244	0.248
0.3	0.292	0.306	0.318	0.333	0.346	0.355	0.361
0.4	0.373	0.391	0.405	0.425	0.442	0.454	0.462
0.5	0.441	0.463	0.481	0.505	0.525	0.540	0.550
0.6	0.499	0.524	0.544	0.572	0.596	0.613	0.625
0.7	0.546	0.574	0.597	0.628	0.655	0.674	0.688
0.8	0.584	0.615	0.639	0.674	0.703	0.725	0.740
0.9	0.615	0.647	0.673	0.711	0.743	0.766	0.783
1.0	0.639	0.673	0.701	0.740	0.775	0.800	0.818
1.2	0.674	0.711	0.740	0.783	0.821	0.849	0.871
1.5	0.703	0.743	0.775	0.821	0.863	0.895	0.920
2.0	0.725	0.766	0.800	0.849	0.895	0.930	0.960
20.0	0.740	0.783	0.818	0.871	0.920	0.960	1.000

0.679

Simplified Burial Design: A conservative estimate of the ability of Driscopipe pipelines to perform in a buried environment is found in Chart 24. It is based on a minimum 2:1 safety factor and 50 year design service life. A detailed burial design starts on page 37. The detailed design should be used for critical or marginal applications or whenever a more precise solution is desired.

Detailed Burial Design:
Design by Wall Crushing: Wall crushing would theoretically occur when the stress in a pipe wall, due to the external vertical pressure, exceeded the long-term compressive strength of the pipe material. To ensure that the Driscopipe wall is strong enough to endure the external pressure the following check should be made:

$$S_A = \frac{(SDR - 1)}{2} P_T$$

Values of E′

Based on Soil Type (ASTM D2321) and Degree of Compaction

Soil Type of Initial Backfill Embedment Material	Description	E′ (psi) for Degree of Compaction (Proctor Density, %)			
		Loose	Slight (70-85%)	Moderate (85-95%)	High (95%)
I	Manufactured angular, granular materials (crushed stone or rock, broken coral, cinders, etc.)	1,000	3,000	3,000	3,000
II	Coarse grained soils with little or no fines	N.R.	1,000	2,000	3,000
III	Coarse grained soils with fines	N.R.	N.R.	1,000	2,000
IV	Fine-grained soils	N.R.	N.R.	N.R.	N.R.
V	Organic soils (peat, muck, clay, etc.)	N.R.	N.R.	N.R.	N.R.

N.R. = Not Recommended for use by ASTM D2321 for pipe wall support

Chart 24

SDR	Maximum Burial Depth, ft. in dry soil of 100 lbs/cu. ft.			Maximum External Pressure psi			Maximum Deflection, % after installation		
	Soil Modulus, psi*			Soil Modulus, psi*			Soil Modulus, psi*		
	1000	2000	3000	1000	2000	3000	1000	2000	3000
32.5	25	32	37	17	22	26	1.7	0.9	0.6
26	33	45	52	23	31	36	2.3	1.2	0.8
21	46	61	71	32	42	49	3.2	1.6	1.1
19	52	69	81	36	48	56	3.6	1.8	1.2
17	61	121	181	42	84	126	4.2	2.1	1.4
15.5	56	112	168	39	78	117	3.9	2.0	1.3
13.5	49	98	147	34	68	102	3.4	1.7	1.1
11	39	78	117	27	54	81	2.7	1.4	0.9
9.3	33	68	101	23	47	70	2.3	1.2	0.8
8.3	30	61	89	21	42	62	2.1	1.1	0.7
7.3	26	52	79	18	36	55	1.8	0.9	0.6

*assumes no external loads

3/4" (1.050 OD)

SDR 11	160 psi	0.12 lbs./ft.	0.860 ID	.095 wall

1" (1.315 OD)

SDR 11	160 psi	0.19 lbs./ft.	1.075 ID	.120 wall

1-1/4" (1.660 OD)

SDR 11	160 psi	0.30 lbs./ft.	1.358 ID	.151 wall

1-1/2" (1.900 OD)

SDR 11	160 psi	0.40 lbs./ft.	1.554 ID	.173 wall

2" (2.375 OD)

SDR 7	267 psi	0.92 lbs/ft	1.697 ID	.339 wall
SDR 9	200 psi	0.74	1.847	.264
SDR 11 ●	**160 psi**	**0.62**	**1.943**	**.216**
SDR 13.5	128 psi	0.52	2.023	.176
SDR 15.5	110 psi	0.45	2.069	.153
SDR 17	100 psi	0.42	2.095	.140

3" (3.500 OD)

SDR 7	267 psi	2.00 lbs/ft.	2.500 ID	.500 wall
SDR 9	200 psi	1.62	2.722	.389
SDR 11 ●	**160 psi**	**1.35**	**2.864**	**.318**
SDR 13.5	128 psi	1.12	2.982	.259
SDR 15.5	110 psi	0.99	3.048	.226
SDR 17 ●	**100 psi**	**0.91**	**3.088**	**.206**
SDR 19	89 psi	0.82	3.132	.184
SDR 21	80 psi	0.74	3.166	.167
SDR 26	64 psi	0.61	3.230	.135
SDR 32.5	51 psi	0.49	3.284	.108

4" (4.500 OD)

SDR 7	267 psi	3.31 lbs/ft.	3.214 ID	.643 wall
SDR 9	200 psi	2.67	3.500	.500
SDR 11 ●	**160 psi**	**2.23**	**3.682**	**.409**
SDR 13.3	128 psi	1.85	3.834	.333
SDR 15.5	110 psi	1.63	3.020	.290
SDR 17 ●	**100 psi**	**1.50**	**3.970**	**.265**
SDR 19	89 psi	1.35	4.026	.237
SDR 21	80 psi	1.23	4.072	.214
SDR 26 ●	**64 psi**	**1.00**	**4.154**	**.173**
SDR 32.5	51 psi	0.81	4.224	.138

5-3/8" (5.375 OD)

SDR 17	100 psi	2.14 lbs./ft.	4.743 ID	.316 wall
SDR 21	80 psi	1.75	4.863	.256
SDR 26	64 psi	1.43	4.961	.207
SDR 32.5	51 psi	1.15	5.045	.165

5" (5.563 OD)

SDR 7	267 psi	5.05 lbs/ft.	3.973 ID	.795 wall
SDR 9	200 psi	4.08	4.327	.618
SDR 11	160 psi	3.42	4.551	.506
SDR 13.5	128 psi	2.84	4.739	.412
SDR 15.5	110 psi	2.50	4.845	.359
SDR 17	100 psi	2.29	4.909	.327
SDR 19	89 psi	2.07	4.977	.293
SDR 21	80 psi	1.88	5.033	.265
SDR 26	64 psi	1.53	5.135	.214
SDR 32.5	51 psi	1.23	5.221	.171

6" (6.625 OD)

SDR 7	267 psi	7.16 lbs./ft.	4.733 ID	.946 wall
SDR 9	200 psi	5.78	5.153	.736
SDR 11 ●	**160 psi**	**4.84**	**5.421**	**.602**
SDR 13.5	128 psi	4.03	5.643	.491
SDR 15.5	110 psi	3.54	5.771	.427
SDR 17 ●	**100 psi**	**3.25**	**5.845**	**.390**
SDR 19	89 psi	2.93	5.927	.349
SDR 21 ●	**80 psi**	**2.66**	**5.995**	**.315**
SDR 26 ●	**64 psi**	**2.17**	**6.115**	**.255**
SDR 32.5 ●	**51 psi**	**1.75**	**6.217**	**.204**

7" (7.125 OD)

SDR 7	267 psi	8.29 lbs./ft.	5.089 ID	1.018 wall
SDR 9	200 psi	6.69	5.541	.792
SDR 11	160 psi	5.61	5.829	.648
SDR 13.5	128 psi	4.66	6.069	.528
SDR 15.5	110 psi	4.10	6.205	.460
SDR 19	89 psi	3.39	6.375	.375
SDR 17	100 psi	3.76	6.287	.419
SDR 21	80 psi	3.08	6.445	.340
SDR 26 ●	**64 psi**	**2.51**	**6.577**	**.274**
SDR 32.5	51 psi	2.02	6.685	.220

8" (8.625 OD)

SDR 7	267 psi	12.14 lbs./ft.	6.161 ID	1.232 wall
SDR 9	200 psi	9.80	6.709	.958
SDR 11 ●	**160 psi**	**8.21**	**7.057**	**.784**
SDR 13.5	128 psi	6.82	7.347	.639
SDR 15.5	110 psi	6.00	7.513	.556
SDR 17 ●	**100 psi**	**5.50**	**7.611**	**.507**
SDR 19	89 psi	4.96	7.717	.454
SDR 21 ●	**80 psi**	**4.52**	**7.803**	**.411**
SDR 26 ●	**64 psi**	**3.68**	**7.961**	**.332**
SDR 32.5 ●	**51 psi**	**2.97**	**8.095**	**.265**

● denotes standard sizes

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DRISCOPIPE

Dimensions & Pressure Ratings
1 0 0 0 Series Pipe

Size	SDR	PSI @73.4	Weight lbs.	Dimensions · inches Nominal O D	Approx. I D	Min. Wall	Packaging per truckload
	9	200	42.71	18.000	14.000	2.000	
	11	160	35.76	.	14.728	1.636	27 jts.per loose load
	13.5	128	29.69	.	15.334	1.333	
	15.5	110	26.14		15.678	1.161	
18"	17	100	23.99	.	15.882	1.059	20 jts.per strip load
	19	89	21.60	.	16.106	0.947	
	21	80	19.65	.	16.286	0.857	
	26	64	16.03	.	16.616	0.692	
	32.5	51	12.94	.	16.892	0.554	
	11	160	44.15	20.000	16.364	1.818	20 jts.per loose load
	13.5	128	36.66	.	17.038	1.481	
	15.5	110	32.27	.	17.420	1.290	
20"	17	100	29.60	.	17.648	1.176	16 jts.per strip load
	19	89	26.68	.	17.894	1.053	
	21	80	24.26	.	18.096	0.952	
	26	64	19.79	.	18.462	0.769	
	32.5	51	15.96	.	18.770	0.615	
	11	160	51.04	21.500	17.590	1.955	18 jts.per loose load
	13.5	128	42.38	.	18.314	1.593	
	15.5	110	37.30	.	18.726	1.387	
21.5	17	100	34.23	.	18.970	1.265	16 jts.per strip load
	19	89	30.84	.	19.236	1.132	
	21	80	28.05	.	19.452	1.024	
	26	64	22.88	.	19.846	0.827	
	32.5	51	18.46	.	20.176	0.662	
	11	160	53.43	22.000	18.000	2.000	
	13.5	128	44.38	.	18.740	1.630	
	15.5	110	39.04	.	19.162	1.419	
22"	17	100	35.83	.	19.412	1.294	
	19	89	32.28	.	19.684	1.158	
	21	80	29.37	.	19.904	1.048	
	26	64	23.95	.	20.308	0.846	16 jts.per loose load
	32.5	51	19.32	.	20.646	0.677	
	11	160	63.59	24.000	19.636	2.182	12 jts.per strip load
	13.5	128	52.81	.	20.444	1.778	
	15.5	110	46.47	.	20.904	1.548	
24"	17	100	42.65	.	21.176	1.412	
	19	89	38.41	.	21.474	1.263	
	21	80	34.95	.	21.714	1.143	
	26	64	28.50	.	22.154	0.923	
	32.5	51	22.98	.	22.524	0.738	
	13.5	128	61.97	26.000	22.148	1.926	12 jts.per loose load
	15.5	110	54.55	.	22.646	1.677	
	17	100	50.03	.	22.942	1.529	
26"	19	89	45.07	.	23.264	1.368	9 jts.per strip load
	21	80	41.01	.	23.524	1.238	
	26	64	33.45	.	24.000	1.000	
	32.5	51	26.98	.	24.400	0.800	

Size	SDR	PSI @73.4	Weight lbs.	Dimensions · inches Nominal O D	Approx. I D	Min. Wall	Packaging per truckload
	13.5	128	71.86	28.000	23.852	2.074	10 jts.per loose load
	15.5	110	63.26	.	24.388	1.806	
	17	100	58.04	.	24.706	1.647	
28"	19	89	52.29	.	25.052	1.474	9 jts.per strip load
	21	80	47.55	.	25.334	1.333	
	26	64	38.80	.	25.846	1.077	
	32.5	51	31.31	.	26.276	0.862	
	13.5	128	82.50	30.000	25.556	2.222	9 jts.per loose load
	15.5	110	72.62	.	26.130	1.935	
30"	17	100	66.64	.	26.470	1.765	
	19	89	60.02	.	26.842	1.579	9 jts.per strip load
	21	80	54.61	.	27.142	1.429	
	26	64	44.54	.	27.692	1.154	
	32.5	51	35.92	.	28.154	0.923	
	15.5	110	80.04	31.496	27.432	2.032	
	17	100	73.45	.	27.790	1.853	
800	19	89	66.17	.	28.180	1.658	
mm	21	80	60.19	.	28.496	1.500	
	26	64	49.07	.	29.074	1.211	9 jts.per loose load
	32.5	51	39.59	.	29.558	0.969	
	15.5	110	82.64	32.000	27.870	2.065	6 jts.per strip load
	17	100	75.79	.	28.236	1.882	
32"	19	89	68.28	.	28.632	1.684	
	21	80	62.13	.	28.952	1.524	
	26	64	50.68	.	29.538	1.231	
	32.5	51	40.89	.	30.030	0.985	
	17	100	85.58	34.000	30.000	2.000	
	19	89	77.07	.	30.422	1.789	
34"	21	80	70.13	.	30.762	1.619	
	26	64	57.22	.	31.384	1.308	6 jts.per loose load
	32.5	51	46.14	.	31.908	1.046	
	17	100	95.96	36.000	31.764	2.118	4 jts.per strip load
	19	89	86.44	.	32.210	1.895	
36"	21	80	78.61	.	32.572	1.714	
	26	64	64.15	.	33.230	1.385	
	32.5	51	51.74	.	33.784	1.108	
	19	89	103.36	39.370	35.226	2.072	
1000	21	80	94.04	.	35.620	1.875	
mm	26	64	76.69	.	36.342	1.514	4 jts.per loose load
	32.5	51	61.85	.	36.948	1.211	
42"	26	64	87.27	42.000	38.770	1.615	4 jts.per strip load
	32.5	51	70.39	.	39.416	1.292	
1200	26	64	110.45	47.244	43.610	1.817	
mm	32.5	51	89.11	.	44.336	1.454	
54"	26	64	144.30	54.000	49.846	2.077	1 joint per trk.
	32.5	51	116.42	.	50.676	1.662	

■ For SIZEs and/or SDRs not listed, contact your Phillips Driscopipe representative.

Approximate ID = Nominal OD -- (2 times Min.Wall)

SDR (Standard Dimension Ratio) = $\frac{OD}{\text{min. wall}}$

Pressure rating = $\frac{2\,s}{SDR-1}$ @ 73.4 deg. F

s = hydrostatic design stress (800 psi)

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Where: S_A = Actual compressive stress, psi
SDR = Standard Dimension Ratio
P_T = External Pressure, psi

Safety Factor = 1500 psi ÷ S_A where 1500 psi is the Compressive Yield Strength of Driscopipe.

Design by Wall Buckling: Local wall buckling is a longitudinal wrinkling of the pipe wall. Tests of *non-pressurized* Driscopipe show that buckling and collapse do not occur when the soil envelope is in full contact with the pipe and is compacted to a dense state. However, it can be forced to occur over the long term in *non-pressurized* pipe if the total external soil pressure, P_t, is allowed to exceed the pipe-soil system's critical buckling pressure, P_{cb}. If $P_t > P_{cb}$, gradual collapse may occur over the long term. A calculated, conservative value for the critical buckling pressure may be obtained by the following approximate formula. All pipe diameters with the same SDR in the same burial situation have the same critical collapse and critical buckling endurance

$$P_{cb} = 0.8\sqrt{E' \times P_c}$$

Where:

P_t = Total vertical soil pressure at the top of the pipe, psi

P_{cb} = Critical buckling soil pressure at the top of the pipe, psi

E' = Soil modulus in psi calculated as the ratio of the vertical soil pressure to vertical soil strain at a specified density

P_C = Hydrostatic, critical-collapse differential pressure, psi

$$P_C = \frac{2E\,(t/D)^3\,(D_{MIN}/D_{MAX})^3}{(1-\mu^2)}$$

$$P_c = \frac{2.32\,E}{(SDR)^3}$$

Where: (D_{MIN}/D_{MAX}) = .95
μ = Poission's Ratio
μ = .45 for Driscopipe
E = stress and time dependent tensile modulus of elasticity, psi

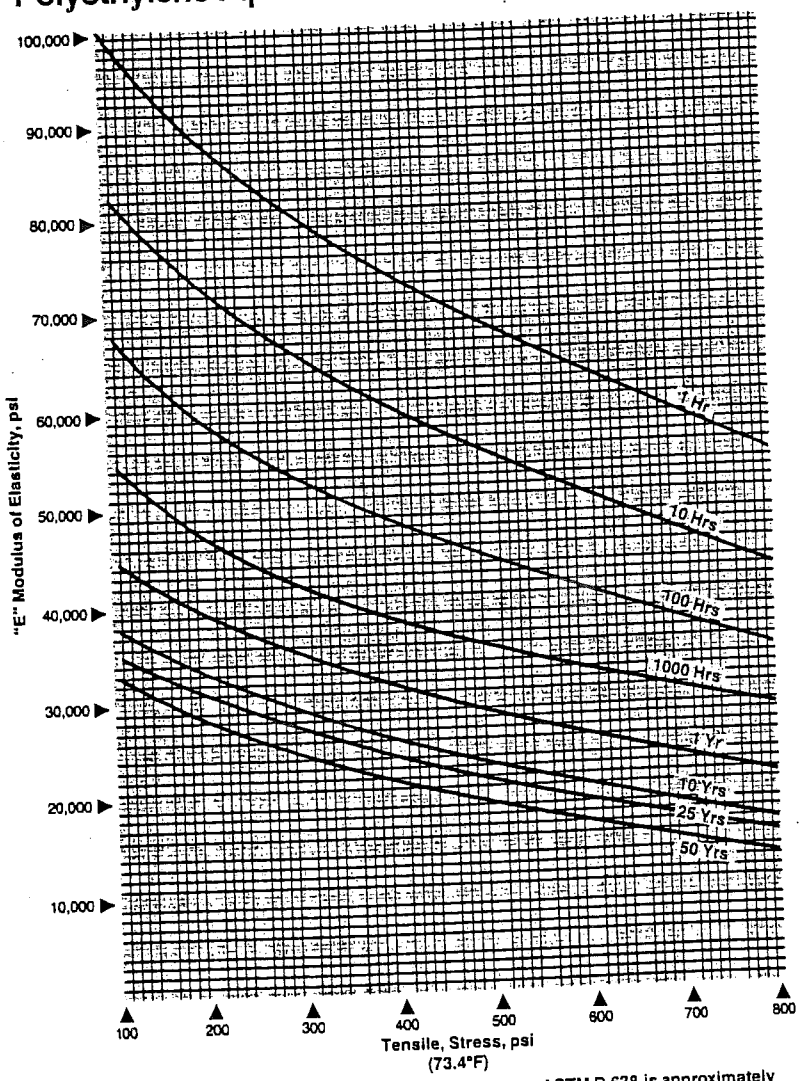
In a direct burial pressurized pipeline, the internal pressure is usually great enough to exceed the external critical-buckling soil pressure. When a pressurized line is to be shut down for a period, wall buckling should be examined.

Design by Wall Buckling Guidelines:
Although wall buckling is seldom the limiting factor in the design of a Driscopipe system, a check of non-pressurized pipelines can be made according to the following steps to insure $P_t < P_{cb}$.

1. Calculate or estimate the total soil pressure, P_t, at the top of the pipe.
2. Calculate the stress "S_A" in the pipe wall according to the formula:
$$S_A = \frac{(SDR - 1)\,P_t}{2}$$
3. Based upon the stress "S_A" and the estimated time duration of non-pressurization, use Chart 25 to find the value of the pipe's modulus of elasticity, E, in psi.

Chart 25

Time Dependent Modulus of Elasticity for Polyethylene Pipe vs. Stress Intensity (73.4°F)



NOTE: The short term modulus of elasticity of Driscopipe per ASTM D 638 is approximately 100,000 psi. Due to the cold flow (creep) characteristic of the pipe material, this modulus is dependent upon the stress intensity and the time duration of the applied stress.

DRISCOPIPE

4. Based upon the pipe SDR and the value of the polyethylene modulus of elasticity, E, calculate the pipe's hydrostatic, critical-collapse differential pressure, P_C:

$$P_C = \frac{2.32\,(E)}{(SDR)^3}$$

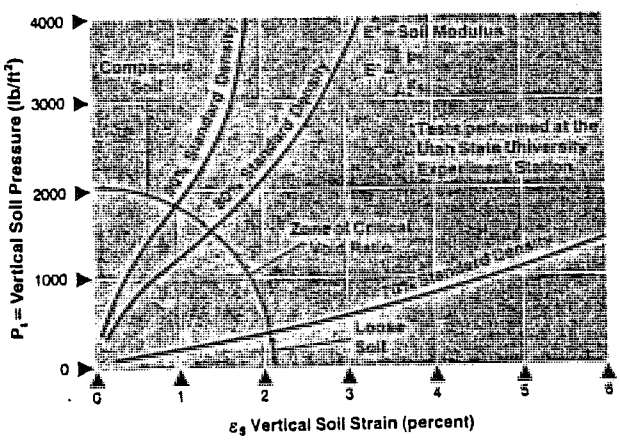
5. Calculate the soil modulus, E', by plotting the total external soil pressure, P_t, against a specified soil density to derive the soil strain as shown in the example problem on Chart 26.
6. Calculate the critical buckling pressure at the top of the pipe by the formula:

$$P_{cb} = 0.8\sqrt{E' \times P_c}$$

7. Calculate the Safety Factor: S.F. = $P_{CB} \div P_t$
   In burial applications, a safety factor of 1.0 may be considered a minimum because of the margin of safety provided by the arching action of the soil. However, Driscopipe endorses using a more conservative value approaching or exceeding a 2.0 safety factor.
8. The above procedures could be reversed to derive the minimum pipe SDR required for a given soil pressure and an estimated soil density. However, this procedure should permit the engineer to optimize the system design quickly by examining several combinations.

Chart 26

Plot of Vertical Stress-Strain Data for Typical Trench Backfill (Except Clay) from Actual Tests*



EXAMPLE
Find: E' @ 2000 PSF and 80% Density
Formula: $E' = P_t/\varepsilon_s$
Calculations: E' = 2000 PSF / .018 = 111111 PSF = 771 psi

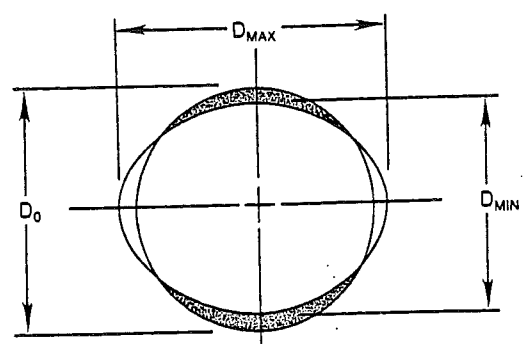
Note: The curves shown on this chart are sample curves for a granular soil. If other types of soil are used for backfill, such as clay or clay loam, curves should be developed from laboratory test data for the material used. Soil pressures greater than 4000 psf may be examined by extrapolating the slope of the curve or by generating curves by testing at those higher soil pressures. Probable error of curves is about half the distance between adjacent lines.

Design by Ring Deflection: Ring deflection is defined as the ratio of the vertical change in diameter to the original diameter. It is often expressed as a percentage. Ring deflection for buried Driscopipe is conservatively the same as (no more than) the vertical compression of the soil envelope around the pipe. Design by ring deflection matches the ability of Driscopipe to accommodate, without structural distress, the vertical compression of the soil enveloping the buried pipeline. *Design by ring deflection comprises a calculation of vertical soil strain to ensure it will be less than the allowable ring deflection of the pipe.* See Chart 27. The tabulation shows that with lower values of SDR, the allowable deflection is less. For installations which require this thicker wall to resist the external soil pressure, actual ring deflection can easily be limited to the tabular values by proper compaction of the backfill around the pipe. The recommended allowable deflection for the various SDR s are:

Chart 27

SDR	Allowable Ring Deflection
32.5	8.1%
26.0	6.5%
21.0	5.2%
19.0	4.7%
17.0	4.2%
15.5	3.9%
13.5	3.4%
11.0	2.7%

The allowable ring deflection of polyethylene pipe is a function of the allowable tangential strain in the outer surface of the pipe wall. A conservative limit of 1-1½% tangential strain in the outer surface of the pipe wall due to vertical deflection of the pipe "ring" by soil compression can be understood by comparing two pipes of the same diameter but different wall thickness.



$$\% \text{ Ring Deflection} = \left(1 - \frac{D_{MIN}}{D_0}\right) \times 100\%$$

NOTE: 5% deflection decreases flow-area by ¼%. 10% deflection decreases flow-area by 1%.

APPENDIX VIb-I

STORMWATER MANAGEMENT CALCULATIONS

Appendix VIb-I.1

Selection of Post-Development Hydrologic Parameters

1/13

GEOSYNTEC CONSULTANTS

COMPUTATION COVER SHEET

Client: DSWA Project: Cherry Island Landfill Project/Proposal #: ME0250 Task #: 2.9.2

TITLE OF COMPUTATIONS APPENDIX VIb-I.1: SELECTION OF POST-DEVELOPMENT HYDROLOGIC PARAMETERS

COMPUTATIONS BY:
Signature
Printed Name and Title: William M. Steier, P.E. Project Engineer
26 March 2003 DATE

ASSUMPTIONS AND PROCEDURES CHECKED BY:
(Peer Reviewer)
Signature
Printed Name and Title: Eric. S. Steinhauser, P.E. Associate
26 March 2003 DATE

COMPUTATIONS CHECKED BY:
Signature
Printed Name and Title: Eric. S. Steinhauser, P.E. Associate
26 March 2003 DATE

COMPUTATIONS BACKCHECKED BY:
(Originator)
Signature
Printed Name and Title: William M. Steier, P.E. Project Engineer
26 March 2003 DATE

APPROVED BY:
(PM or Designate)
Signature
Printed Name and Title: David Espinoza, P.E. Senior Engineer
3/31/03 DATE

APPROVAL NOTES: The calculations presented herein are suitable for a landfill elevation of 195 ft-msl. As shown in this calculation package, the design was performed for a more conservative grading configuration than that shown in Drawing 78 entitled "Landfill Final Development and Grading Plan" (Appendix VIb-A).

RDE 9/10/04

REVISIONS (Number and initial all revisions)

NO.	SHEET	DATE	BY	CHECKED BY	APPROVAL

APPENDIX VIb-I.1
SELECTION OF POST-DEVELOPMENT HYDROLOGIC PARAMETERS

PURPOSE

The purpose of this calculation package is to select watershed and subcatchment hydrologic parameters used for post-development watershed analysis of the Cherry Island Landfill (CIL) Expansion Project. The input parameters described in this calculation are integral to estimating the peak discharge associated with each post-development subcatchment area of the CIL. In turn, the peak discharge is a design input for each of the stormwater management features for the project, including: (i) sideslope terraces; (ii) downchutes; (iii) perimeter drainage channels (inside of the perimeter access road); (iv) drop inlet structures; and (v) outlet culverts and channels to the Delaware and Christina Rivers. The parameters described in this calculation are used as input in Appendices VIb-I.2 and VIb-I.3, which present the post-development watershed analysis and stormwater routing.

METHOD

Post-development watershed analyses are performed in Appendices VIb-I.2 and VIb-I.3 using procedures described in the documents, "*Urban Hydrology for Small Watersheds, Technical Release 55*", [USDA-SCS, 1986] and "*Computer Program for Project Formulation Hydrology, Technical Release 20*", [USDA –SCS, 1982].

CALCULATION PARAMETERS

The following describes the selection of the various hydrologic parameters used for watershed analysis.

- **Rainfall Distribution:** Attachment 1, from TR-55, illustrates the location of CIL on a rainfall distribution map of the United States. CIL, which is located in New Castle County, Delaware, falls under SCS Type II Rainfall Distribution.

- **Design Rainfall:** Attachments 2-1, 2-2, and 2-3, also from TR-55, illustrates the 24-hour rainfall depths for the 2-year, 25-year, and 100-year design storms, respectively. The rainfall depths are summarized in the following table.

Return Period (years)	Rainfall Depth (in.)
2	3.3
25	5.8
100	7.4

- **Hydrologic Soil Groups:** It is assumed that the soil used to construct the final cover system will come from multiple offsite sources, which, in addition to natural soil, may include manufactured or processed soils. In general, the final cover soil is anticipated to exhibit characteristics of Hydrologic Soils Group C.

- **Curve Number (CN):** The CN value for the post-development condition for Hydrologic Soil Group C is obtained from Attachment 3, which is taken from TR-55. The final cover system of the landfill will be treated as "Open Spaces in Good Condition" (grass cover greater than 75 percent). Hence, a CN value of 74 was selected.

- **Time of Concentration T_c:** The various parameters used to calculate the T_c for each subarea are summarized in Attachment 4. The T_c value represents the total time for stormwater runoff to ravel from the hydraulically most distant point of a watershed or drainage area to a point of interest. Factors affecting T_c include surface roughness, channel shape and flow patterns, and slope. The calculation of T_c evaluates the impact of three different types of stormwater runoff flow:

  - **sheet flow** – flow over plane surfaces, which is limited to a maximum length of 300 ft.;
  - **shallow concentrated flow** – after about 300 ft., sheet flow will begin to concentrate, but not necessarily defined in a specific channel; and
  - **open channel flow** – flow that is confined to a defined channel.

  The T_c value for a drainage area is the sum of the individual various travel time (T_t) values of the above flow types. The equations for calculating the T_t are presented below

  - **Sheet Flow:** $$T_t = \frac{0.007\,(nL)^{0.8}}{(P_2)^{0.5}\,s^{0.4}}$$

  - **Shallow Concentrated Flow:** $$T_t = \frac{L}{3{,}600\,V}$$

- **Open Channel Flow:** $$T_t = \frac{nL}{3{,}600\,(1.49)\,r^{2/3}\,s^{1/2}}$$

where: T_t = travel time (hours);
n = Mannings roughness coefficient (dimensionless);
- n = 0.15 for sheet flow;
- n = 0.03 for grass and erosion control mats on sideslope terraces; and
- n = 0.028 for revert mattresses;

L = length of flow (ft.);
P_2 = rainfall from a 2-year, 24-hour storm (in.);
s = Bed or surface slope in the flow direction (ft/ft);
V = velocity (ft/sec); and
r = hydraulic radius (ft.).

TR-55 provides a graphical solution for T_t for shallow concentrated flow over "paved" and "unpaved areas". The "*National Engineering Handbook, Section 4 Hydrology (NEH-4)*", [SCS, 1985] provides the following equation for V:

$$V = K_v \sqrt{s}$$

Where K_v is a velocity factor based on various surface conditions (i.e., pave, unpaved, grassed waterway, short grass pasture) and s is the slope of the land surface. "*HydroCAD® Stormwater Modeling System*", version 6 [Applied Microcomputer Systems, 2001] (HydroCAD®) provides a table of velocity factors (K_v), which are used to calculate V in the above equation. For this design, a K_v value of 7ft/sec (corresponding to "Short Grass Pasture") is selected [Applied Microcomputer Systems, 2002].

The symbols used in Attachment 4, which are not previously defined, are defined below:

- b = channel bottom width (ft.);
- d = maximum flow depth in channel (ft.); and
- z = inclination of channel slope (dimensionless).

The parameters listed in Attachment 4 were used as input into the computer program HydroCAD®.

RESULTS

The output files for the post-development watershed analysis performed by the HydroCAD®, are presented in:

- Appendix VIb-I.2 for the 24-hour, 25-year design storm; and
- Appendix VIb-I.3 for the 24-hour, 100-year design storm.

REFERENCES

Applied Microcomputer Systems, "*HydroCAD® Stormwater Modeling System*", Version 6, Chocorua, New Hampshire 2002.

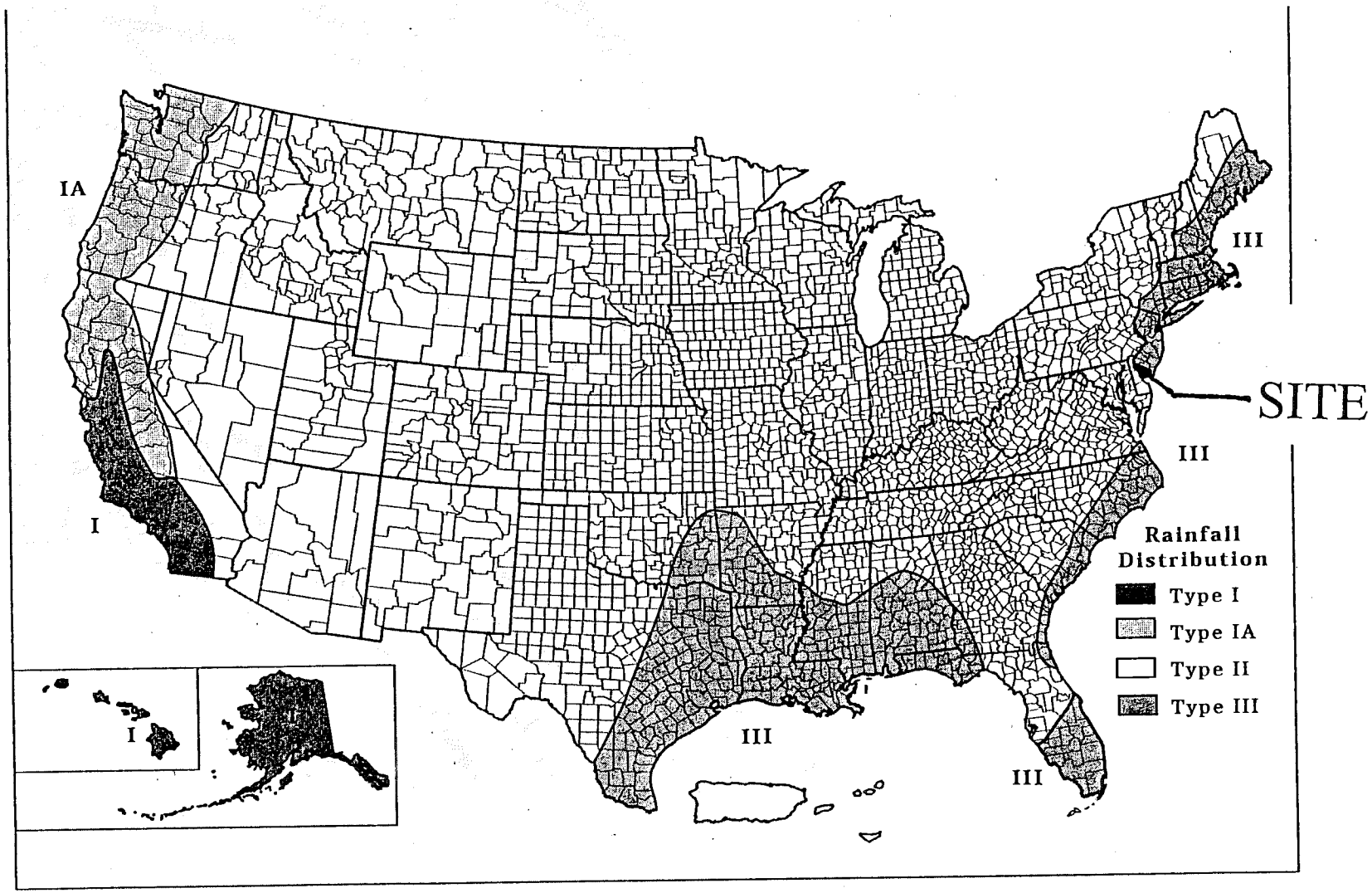
United States Department of Agriculture, Soil Conservation Service, "*Computer Program for Project Formulation Hydrology, Technical Release 20*", Washington D.C., 1982.

United States Department of Agriculture, Soil Conservation Service, *"National Engineering Handbook, Section 4 Hydrology (NEH-4)"*, National Technical Information Service, 1985.

United States Department of Agriculture, Soil Conservation Service, "*Urban Hydrology for Small Watersheds, Technical Release 55*", 2nd ed., Washington, D.C., 1986.

ATTACHMENT 1

Rainfall Distributions Ref USDA [1986]



LWMS 3/26/03
RSS 3/26/03

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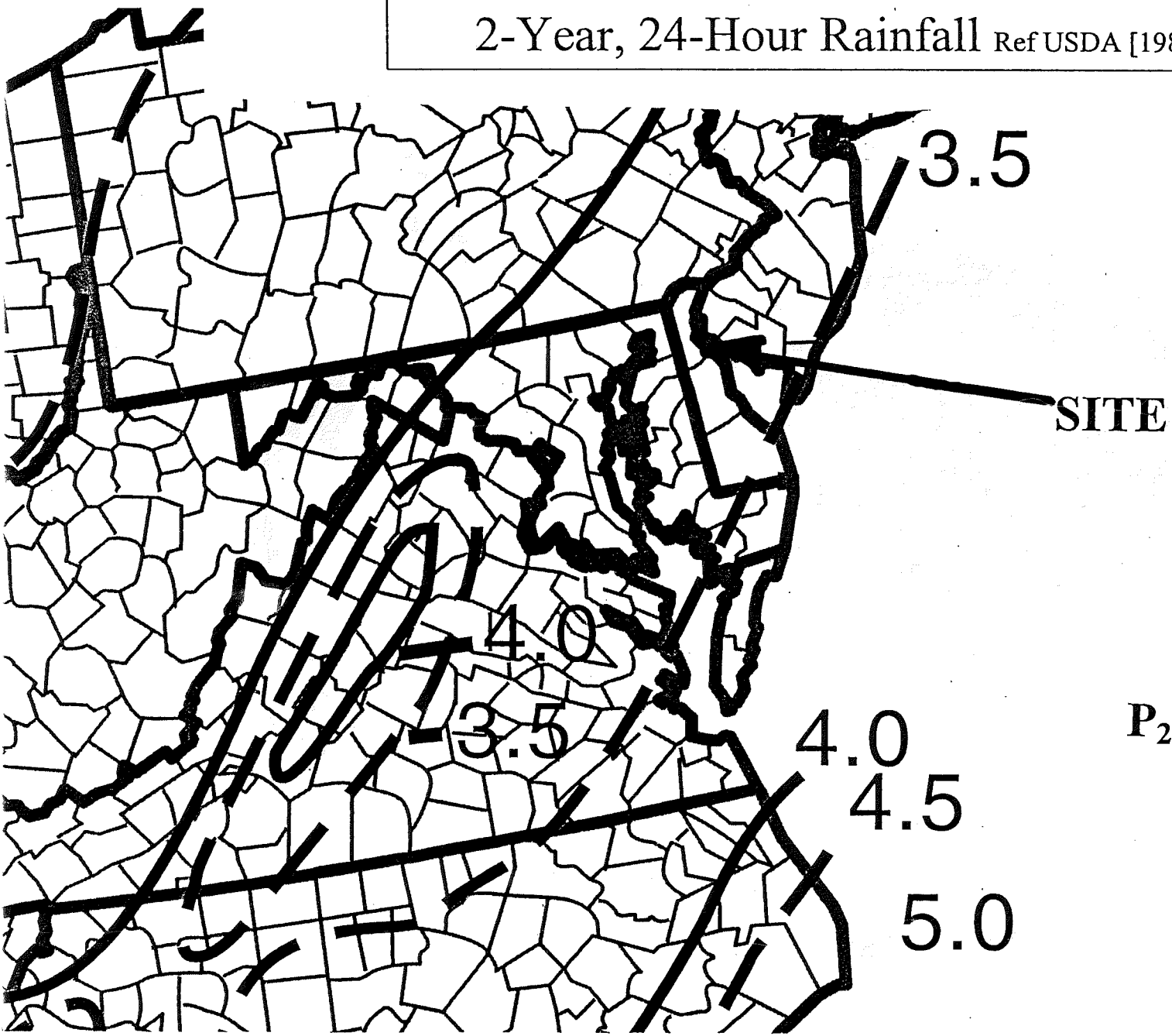
ATTACHMENT 2-1
2-Year, 24-Hour Rainfall Ref USDA [1986]

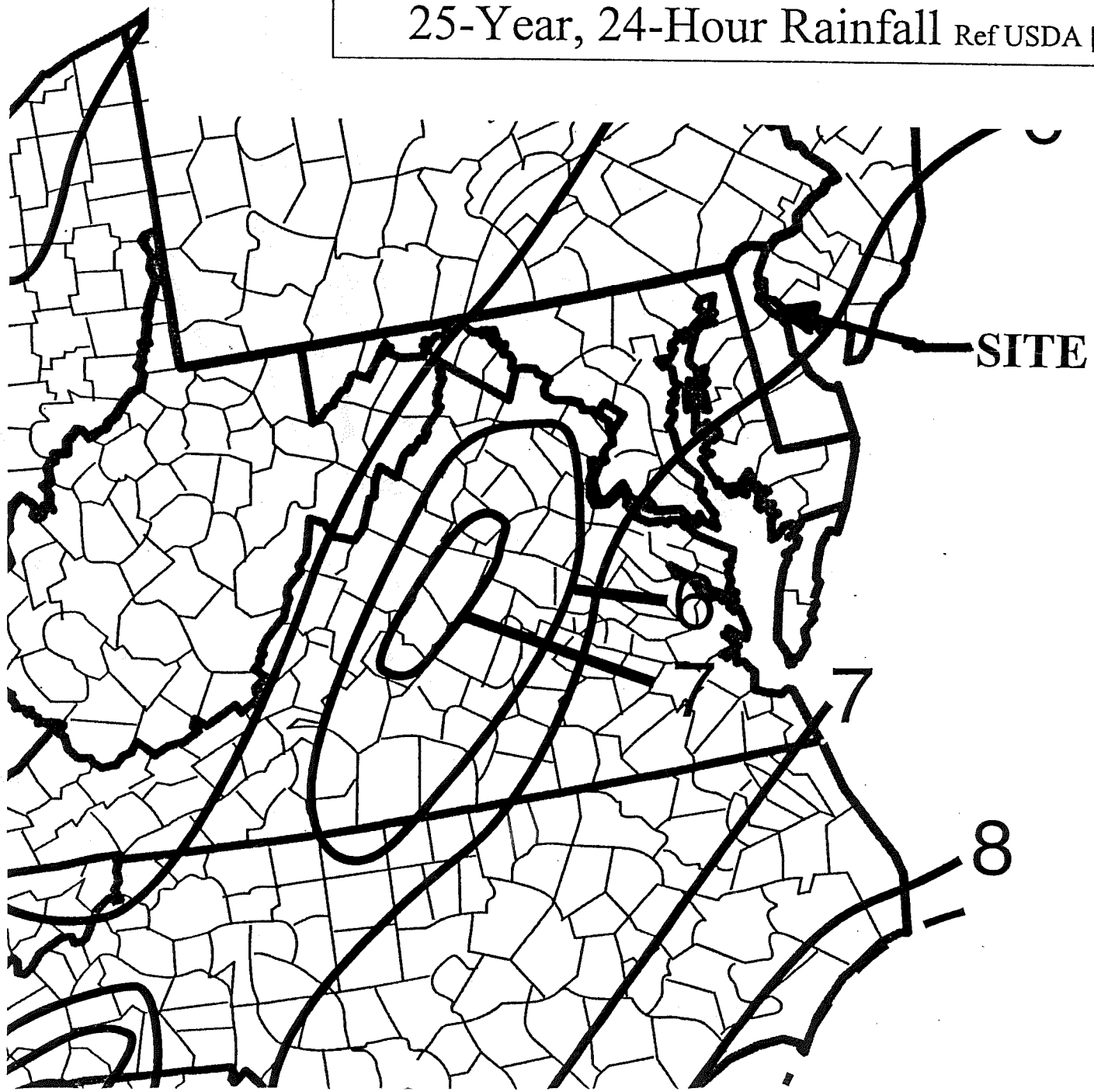


$P_2 = 3.3$ in.

WMB 3/26/03 JSS 3/26/03

7/13

ATTACHMENT 2-2
25-Year, 24-Hour Rainfall Ref USDA [1986]



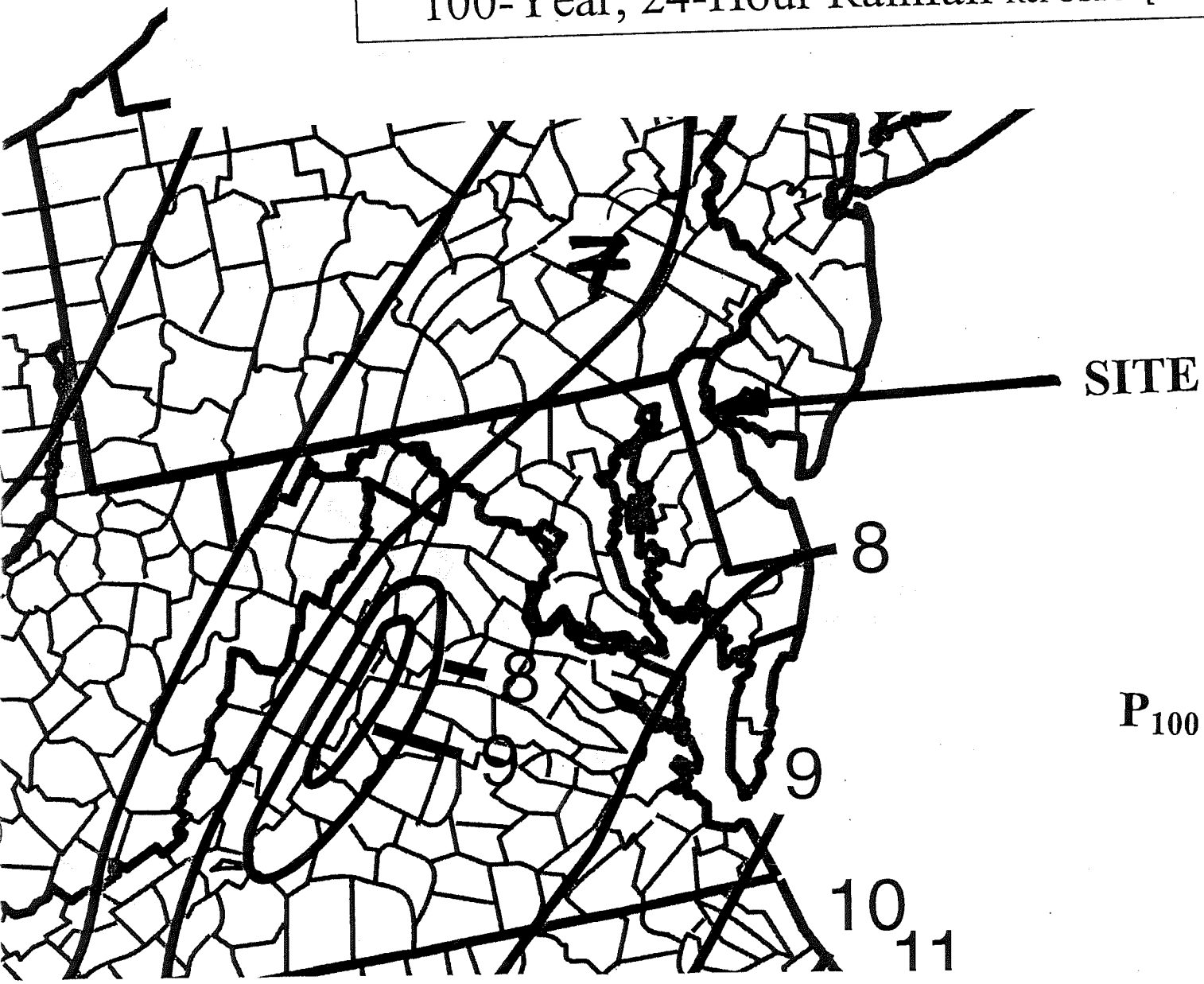
P_{25} = 5.8 in.

WMS 3/26/03 BSS 3/26/03

8/13

ATTACHMENT 2-3

100-Year, 24-Hour Rainfall Ref USDA [1986]



P_{100} = 7.4 in.

WMB 3/26/03 BSS 3/26/03

9/13

ATTACHMENT 3
Runoff Curve Numbers for Urban Areas
Ref USDA [1986]

10/13
WMS 3/26/03
SSS 3/24/03

Runoff curve numbers for urban areas [1]

Cover description: Cover type and hydrologic condition	Average percent impervious area [2]	Curve numbers for hydrologic soil group: A	B	C	D
Fully developed urban areas (vegetation established)					
Open space (lawns, parks, golf courses, cemeteries, etc.) [3]:					
Poor condition (grass cover < 50%)		68	79	86	89
Fair condition (grass cover 50% to 75%)		49	69	79	84
Good condition (grass cover > 75%)		39	61	74	80
Impervious areas:					
Paved parking lots, roofs, driveways, etc. (excluding right-of-way)		98	98	98	98
Streets and roads:					
Paved; curbs and storm sewers (excluding right-of-way)		98	98	98	98
Paved; open ditches (including right-of-way)		83	89	92	93
Gravel (including right-of-way)		76	85	89	91
Dirt (including right-of-way)		72	82	87	89
Western desert urban areas:					
Natural desert landscaping (pervious areas only) [4]		63	77	85	88
Artificial desert landscaping (impervious weed barrier, desert shrub with 1- to 2-inch sand or gravel mulch and basin borders)		96	96	96	96
Urban districts:					
Commercial and business	85	89	92	94	95
Industrial	72	81	88	91	93
Residential districts by average lot size:					
1/8 acre or less (town houses)	65	77	85	90	92
1/4 acre	38	61	75	83	87
1/3 acre	30	57	72	81	86
1/2 acre	25	54	70	80	85
1 acre	20	51	68	79	84
2 acres	12	46	65	77	82
Developing urban areas					
Newly graded areas (pervious areas only, no vegetation) [5]		77	86	91	94
Idle lands (CN's are determined using cover types similar to those in table 2-2c).					

1 Average runoff condition, and $I_a = 0.2S$.
2 The average percent impervious area shown was used to develop the composite CN's. Other assumptions are as follows: impervious areas are directly connected to the drainage system, impervious areas have a CN of 98, and pervious areas are considered equivalent to open space in good hydrologic condition. CN's for other combinations of conditions may be computed using figure 2-3 or 2-4.
3 CN's shown are equivalent to those of pasture. Composite CN's may be computed for other combinations of open space cover type.
4 Composite CN's for natural desert landscaping should be computed using figures 2-3 or 2-4 based on the impervious area percentage (CN = 98) and the pervious area CN. The pervious area CN's are assumed equivalent to desert shrub in poor hydrologic condition.
5 Composite CN's to use for the design of temporary measures during grading and construction should be computed using figure 2-3 or 2-4 based on the degree of development (impervious area percentage) and the CN's for the newly graded pervious areas.

ATTACHMENT 4

SUMMARY OF CALCULATION PARAMETERS FOR TIME OF CONCENTRATION

Subareas	Area	Curve	Sheet Flow				Shallow Concentrated Flow			Channel Flow/Pipe Flow						
ID	(acres)	Number	L	n	s	P_2	L	K_v	s	L	n	s	b	d	z_1	z_2
		(CN)	(ft.)		(ft/ft)	(in.)	(ft.)	(ft/sec)	(ft/ft)	(ft.)		(ft/ft)	(ft.)	(ft.)		
S1-1	9.56	74	300	0.15	0.05	3.3	150	7	0.05	380	0.030	0.020	0	0.25	3	50
S1-1a	---	---	---	---	---	---	90	7	0.33	---	---	---	---	---	---	---
S1-2	1.96	74	90	0.15	0.33	3.3	---	---	---	880	0.030	0.030	0	1.5	3	6
S1-3	3.11	74	90	0.15	0.33	3.3	---	---	---	880	0.030	0.030	0	1.5	3	6
S1-4	3.33	74	90	0.15	0.33	3.3	---	---	---	830	0.030	0.030	0	1.5	3	6
S1-5	6.66	74	140	0.15	0.33	3.3	---	---	---	50	0.030	0.005	6	2.0	2	2
S1-5a[1]	---	---	---	---	---	---	---	---	---	750	0.012	0.005	0.5	---	---	---
Total	24.62															
S2-1	2.78	74	200	0.15	0.05	3.3	---	---	---	---	---	---	---	---	---	---
S2-2	6.84	74	300	0.15	0.05	3.3	40	7	0.33	770	0.030	0.030	0	1.5	3	6
S2-3	5.91	74	70	0.15	0.33	3.3	---	---	---	780	0.030	0.005	0	0.25	2	20
S2-3a	---	---	200	0.15	0.05	3.3	---	---	---	---	---	---	---	---	---	---
S2-4	7.82	74	300	0.15	0.02	3.3	---	---	---	760	0.030	0.030	0	1.5	3	6
S2-5	5.80	74	90	0.15	0.33	3.3	---	---	---	760	0.030	0.030	0	1.5	3	6
S2-6	5.58	74	90	0.15	0.33	3.3	---	---	---	50	0.030	0.005	6	2.0	2	2
S2-6a[1]	---	---	---	---	---	---	---	---	---	710	0.012	0.005	0.5	---	---	---
Total	34.73															
S3-1	1.65	74	60	0.15	0.05	3.3	---	---	---	710	0.030	0.007	0	0.25	2	20
S3-2	4.82	74	300	0.15	0.05	3.3	40	7	0.33	770	0.030	0.030	0	1.5	3	6
S3-3	5.88	74	70	0.15	0.33	3.3	---	---	---	790	0.030	0.005	0	0.25	2	20
S3-3a	---	---	200	0.15	0.05	3.3	---	---	---	---	---	---	---	---	---	---
S3-4	7.27	74	300	0.15	0.02	3.3	---	---	---	800	0.030	0.030	0	1.5	3	6
S3-5	4.94	74	90	0.15	0.33	3.3	---	---	---	800	0.030	0.030	0	1.5	3	6
S3-6	5.54	74	90	0.15	0.33	3.3	---	---	---	50	0.030	0.005	6	2.0	2	2
S3-6a[1]	---	---	---	---	---	---	---	---	---	740	0.012	0.005	0.5	---	---	---
Total	30.10															
S4-1	5.81	74	300	0.15	0.05	3.3	130	7	0.0500	500	0.030	0.030	0	1.5	3	6
S4-1a							30	7	0.33	---	---	---	---	---	---	---
S4-2	2.72	74	90	0.15	0.33	3.3	---	---	---	650	0.030	0.030	0	1.5	3	6
S4-3	2.96	74	90	0.15	0.33	3.3	---	---	---	690	0.030	0.030	0	1.5	3	6
S4-4	4.09	74	60	0.15	0.33	3.3	---	---	---	50	0.030	0.005	6	2.0	2	2
S4-4a[1]	---	---	---	---	---	---	---	---	---	710	0.012	0.005	0.5	---	---	---
Total	15.58															

11/13
3/20/03
3/20/03

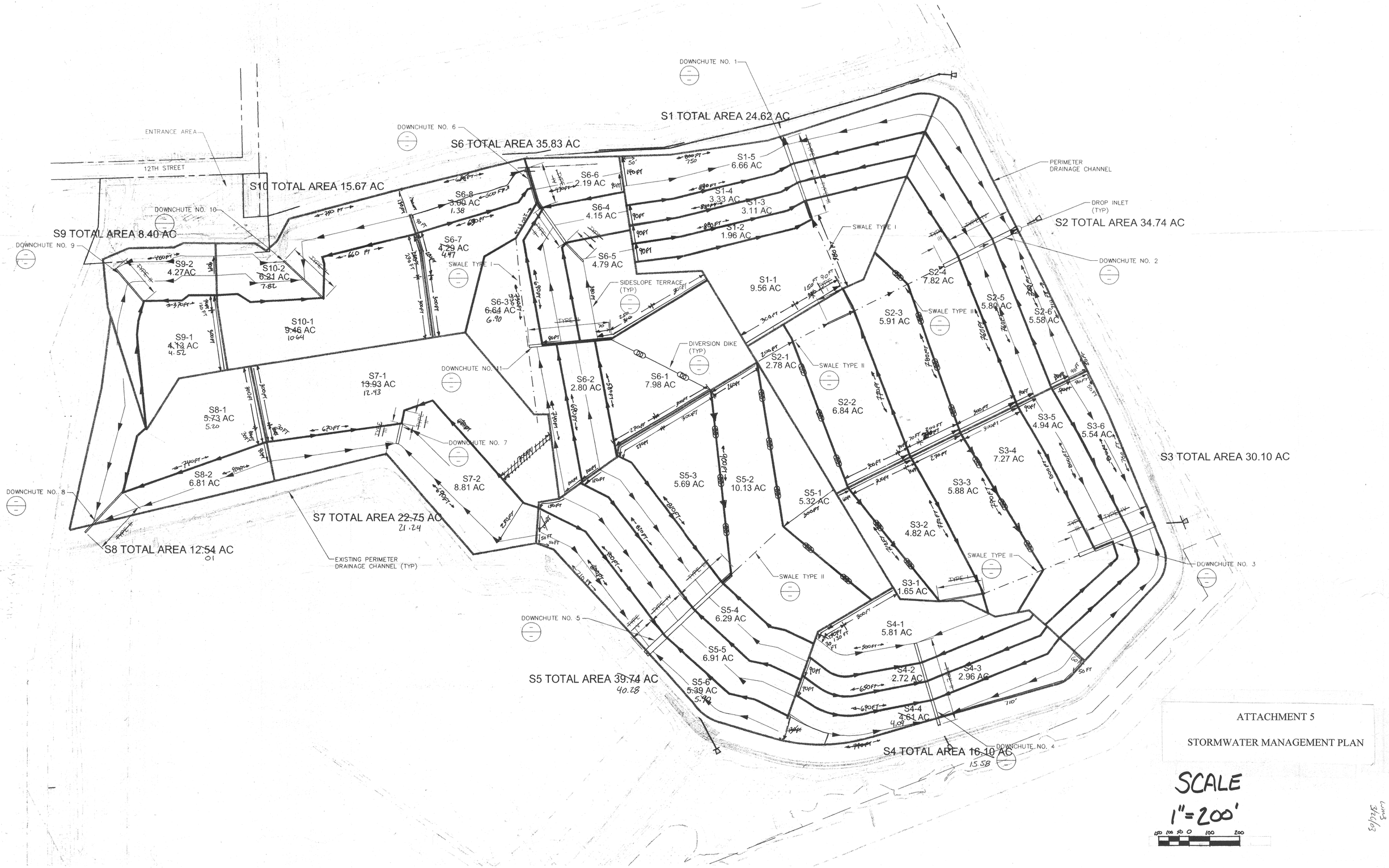
ATTACHMENT 4

SUMMARY OF CALCULATION PARAMETERS FOR TIME OF CONCENTRATION

Subareas	Area	Curve	Sheet Flow				Shallow Concentrated Flow			Channel Flow/Pipe Flow						
ID	(acres)	Number	L	n	s	P_2	L	K_v	s	L	n	s	b	d	z_1	z_2
		(CN)	(ft.)		(ft/ft)	(in.)	(ft.)	(ft/sec)	(ft/ft)	(ft.)		(ft/ft)	(ft.)	(ft.)		
S5-1	5.32	74	300	0.15	0.05	3.3	---	---	---	---	---	---	---	---	---	---
S5-2	10.13	74	260	0.15	0.05	3.3	---	---	---	900	0.030	0.030	0	0.25	2	20
S5-3	5.69	74	300	0.15	0.05	3.3	270	7	0.05	810	0.030	0.030	0	1.5	3	6
S5-4	6.29	74	110	0.15	0.33	3.3	---	---	---	820	0.030	0.030	0	1.5	3	6
S5-5	6.91	74	150	0.15	0.33	3.3	---	---	---	900	0.030	0.030	0	1.5	3	6
S5-6	5.90	74	50	0.15	0.33	3.3	---	---	---	50	0.030	0.005	6	2.0	2	2
S5-6a[1]	---	---	---	---	---	---	---	---	---	710	0.012	0.005	0.5	---	---	---
Total	40.24															
S6-1	7.98	74	300	0.15	0.05	3.3	270	7	0.05	580	0.030	0.030	0	1.5	3	6
S6-2	2.80	74	100	0.15	0.33	3.3	---	---	---	690	0.030	0.030	0	1.5	3	6
S6-3	6.90	74	100	0.15	0.33	3.3	---	---	---	740	0.030	0.030	0	1.5	3	6
S6-3a	---	---	---	---	---	---	---	---	---	530	0.030	0.012	12	2.0	3	3
S6-3b	---	---	---	---	---	---	---	---	---	200	0.030	0.030	12	2.0	3	3
S6-4	4.15	74	90	0.15	0.33	3.3	---	---	---	690	0.030	0.030	0	1.5	3	6
S6-5	4.79	74	300	0.15	0.05	3.3	250	7	0.05	380	0.030	0.030	0	1.5	3	6
S6-5a	---	---	---	---	---	---	70	7	0.33	---	---	---	---	---	---	---
S6-6	2.19	74	90	0.15	0.33	3.3	---	---	---	430	0.030	0.030	0	1.5	3	6
S6-7	4.47	74	300	0.15	0.02	3.3	220	7	0.09	630	0.030	0.030	0	1.5	3	6
S6-8	1.38	74	90	0.15	0.33	3.3	---	---	---	600	0.030	0.030	0	1.5	3	6
Total	34.66															
S7-1	12.43	74	300	0.15	0.02	3.3	30	7	0.33	670	0.030	0.030	0	1.5	3	6
S7-2	8.81	74	230	0.15	0.13	3.3	---	---	---	690	0.030	0.030	0	1.5	3	6
Total	21.24															
S8-1	5.20	74	300	0.15	0.02	3.3	30	7	0.33	740	0.030	0.030	0	1.5	3	6
S8-2	6.81	74	90	0.15	0.33	3.3	---	---	---	920	0.030	0.030	0	1.5	3	6
Total	12.01															
S9-1	4.52	74	300	0.15	0.02	3.3	120	7	0.33	370	0.030	0.030	0	1.5	3	6
S9-2	4.27	74	90	0.15	0.33	3.3	---	---	---	480	0.030	0.030	0	1.5	3	6
Total	8.79															
S10-1	10.64	74	300	0.15	0.05	3.3	270	7	0.13	660	0.030	0.030	0	1.5	3	6
S10-2	7.82	74	130	0.15	0.33	3.3	---	---	---	750	0.030	0.005	6	2.0	2	2
Total	18.46															

Note
1. Segment is modeled as pipe flow.

12/13
LWM 3/26/03
BSS 3/26/03



ATTACHMENT 5

STORMWATER MANAGEMENT PLAN

SCALE

1"=200'

150 100 50 0 100 200

13/13

WMS 3/26/03

Appendix VIb-I.2

Stormwater Routing Analysis: 25-yr, 24-hour Design Storm

GEOSYNTEC CONSULTANTS

COMPUTATION COVER SHEET

Client: DSWA Project: Cherry Island Landfill Project/Proposal #: ME0250 Task #: 2.9.2

TITLE OF COMPUTATIONS APPENDIX VIb-I.2: STORMWATER ROUTING ANALYSIS: 25-YEAR, 24-HOUR DESIGN STORM

COMPUTATIONS BY:
Signature
Printed Name and Title: William M. Steier, P.E., Project Engineer
26 March 2003 DATE

ASSUMPTIONS AND PROCEDURES CHECKED BY: (Peer Reviewer)
Signature
Printed Name and Title: Eric. S. Steinhauser, P.E., Associate
26 March 2003 DATE

COMPUTATIONS CHECKED BY:
Signature
Printed Name and Title: Eric. S. Steinhauser, P.E., Associate
26 March 2003 DATE

COMPUTATIONS BACKCHECKED BY: (Originator)
Signature
Printed Name and Title: William M. Steier, P.E., Project Engineer
26 March 2003 DATE

APPROVED BY: (PM or Designate)
Signature
Printed Name and Title: David Espinoza, P.E., Senior Engineer
29 March 2003 DATE

APPROVAL NOTES: The calculations presented herein are suitable for a landfill elevation of 195 ft-msl. As shown in this calculation package, the design was performed for a more conservative grading configuration than that shown in Drawing 78 entitled "Landfill Final Development and Grading Plan" (Appendix VIb-A).

RDS 6/10/04

REVISIONS (Number and initial all revisions)

NO.	SHEET	DATE	BY	CHECKED BY	APPROVAL

APPENDIX VIb-I.2
STORMWATER ROUTING ANALYSIS: 25-YEAR, 24-HOUR DESIGN STORM

PURPOSE

The purpose of this calculation package is to present the "*HydroCAD® Stormwater Modeling System*", version 6 [Applied Microcomputer Systems, 2001] (HydroCAD®) computer output files for the design of the various components of the stormwater management features of the Cherry Island Landfill (CIL). The output files of this calculation present stormwater routing analysis using the 25-year, 24-hour design storm, and other input parameters described in Appendix Vib-I.1 (Selection of Post-Development Hydrologic Parameters). The stormwater management features for the project include: (i) sideslope terraces; (ii) downchutes; (iii) perimeter drainage channels inside of the perimeter access road); (iv) drop inlet structures; and (v) outlet culverts and channels to the Delaware and Christina Rivers.

HydroCAD® routes stormwater runoff through the defined modeling using the procedures defined in "*Urban Hydrology for Small Watersheds, Technical Release 55*", [USDA-SCS, 1986] and "*Computer Program for Project Formulation Hydrology, Technical Release 20*", [USDA – SCS, 1982]. The routing model is presented on Attachment 1, and is presented schematically on Attachments 2-1 and 2-2. The results of this output file will be used to verify the geometric sizing and lining of the stormwater management features, which are addressed in other calculation packages.

REFERENCE

Applied Microcomputer Systems, "*HydroCAD® Stormwater Modeling System*", Version 6, Chocorua, New Hampshire 2002.

United States Department of Agriculture, Soil Conservation Service, "*Computer Program for Project Formulation Hydrology, Technical Release 20*", Washington, D.C., 1982.

United States Department of Agriculture, Soil Conservation Service, "*Urban Hydrology for Small Watersheds, Technical Release 55*", 2nd ed., Washington, D.C., 1986.

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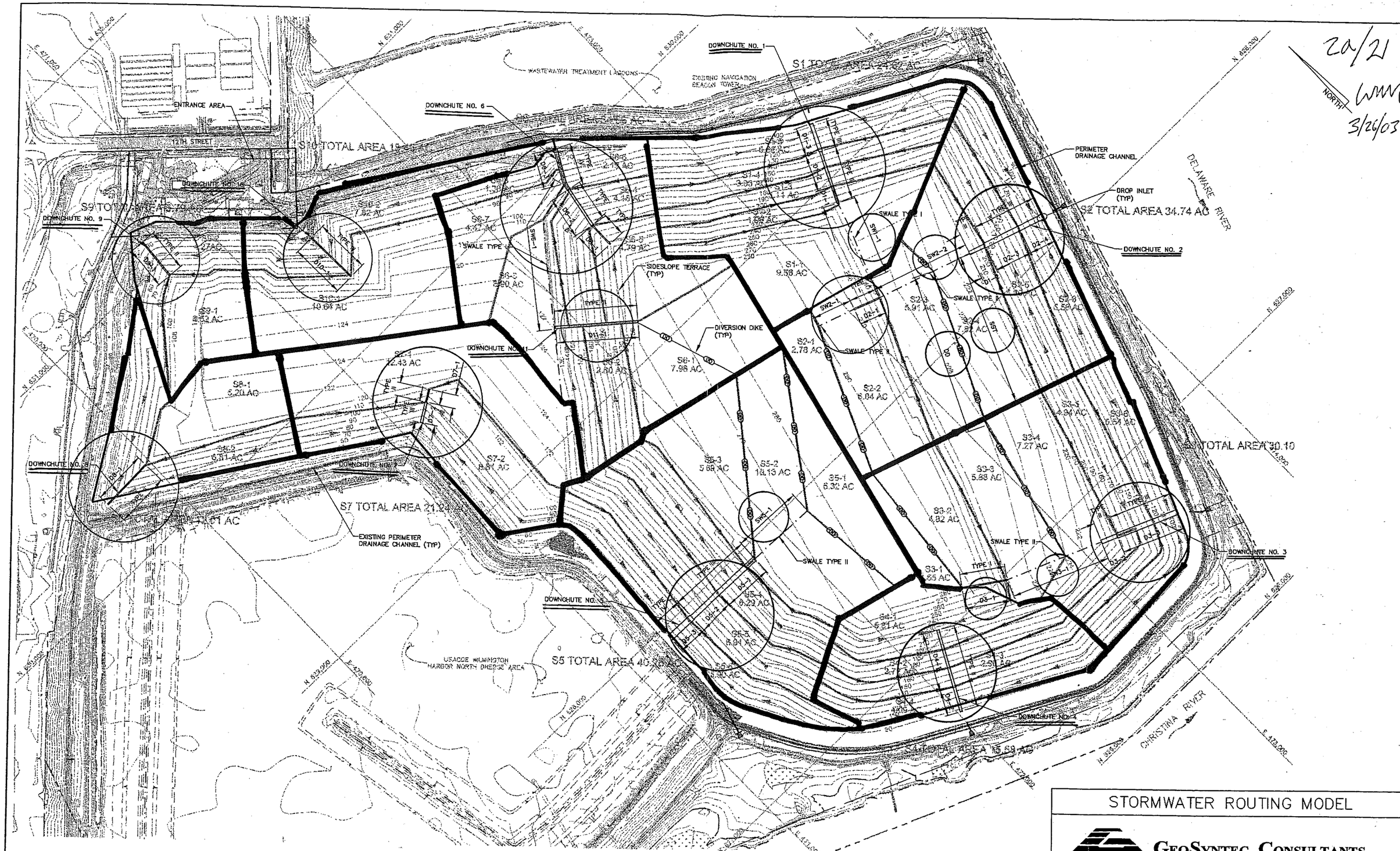
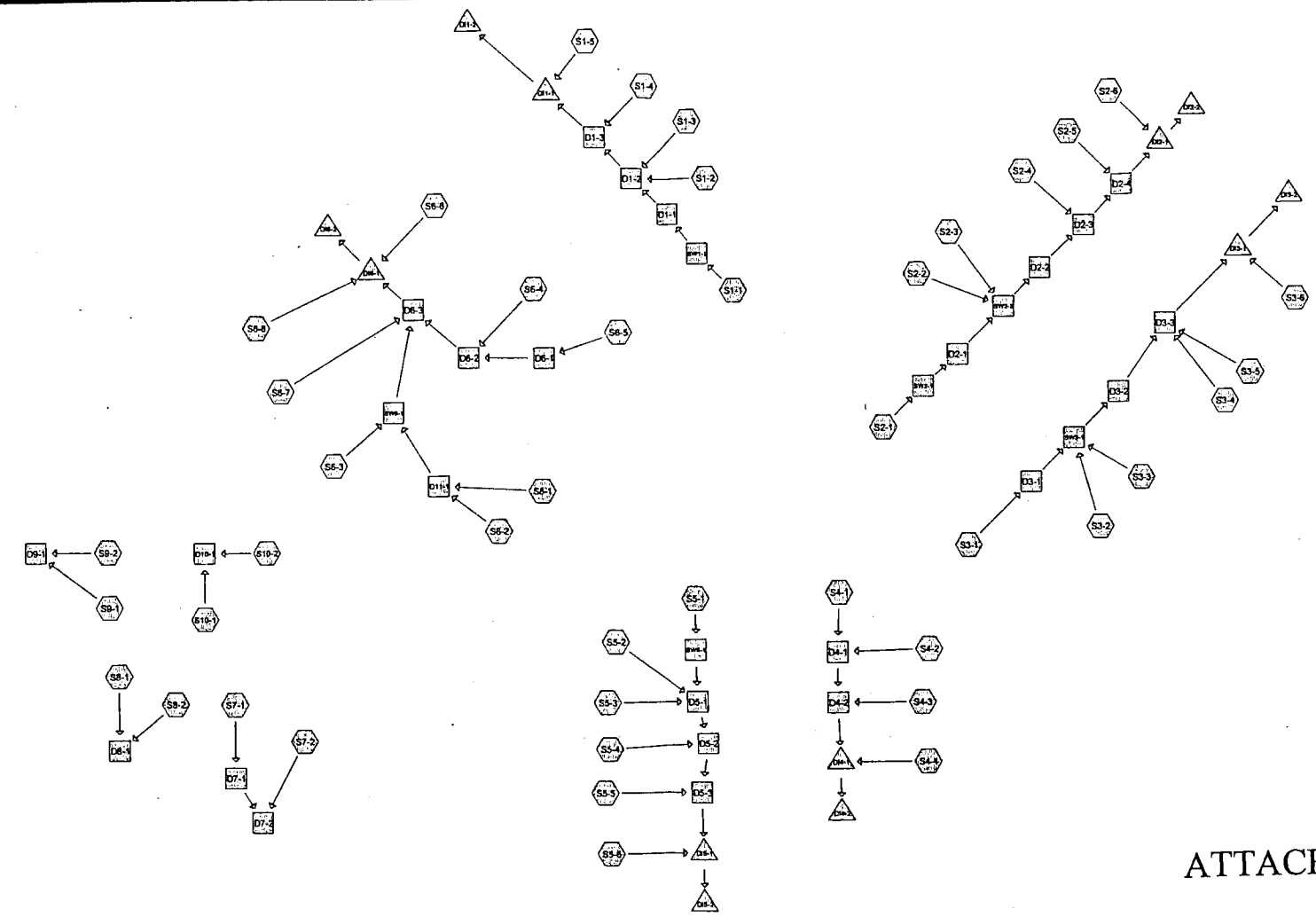


NOT TO SCALE

STORMWATER ROUTING MODEL

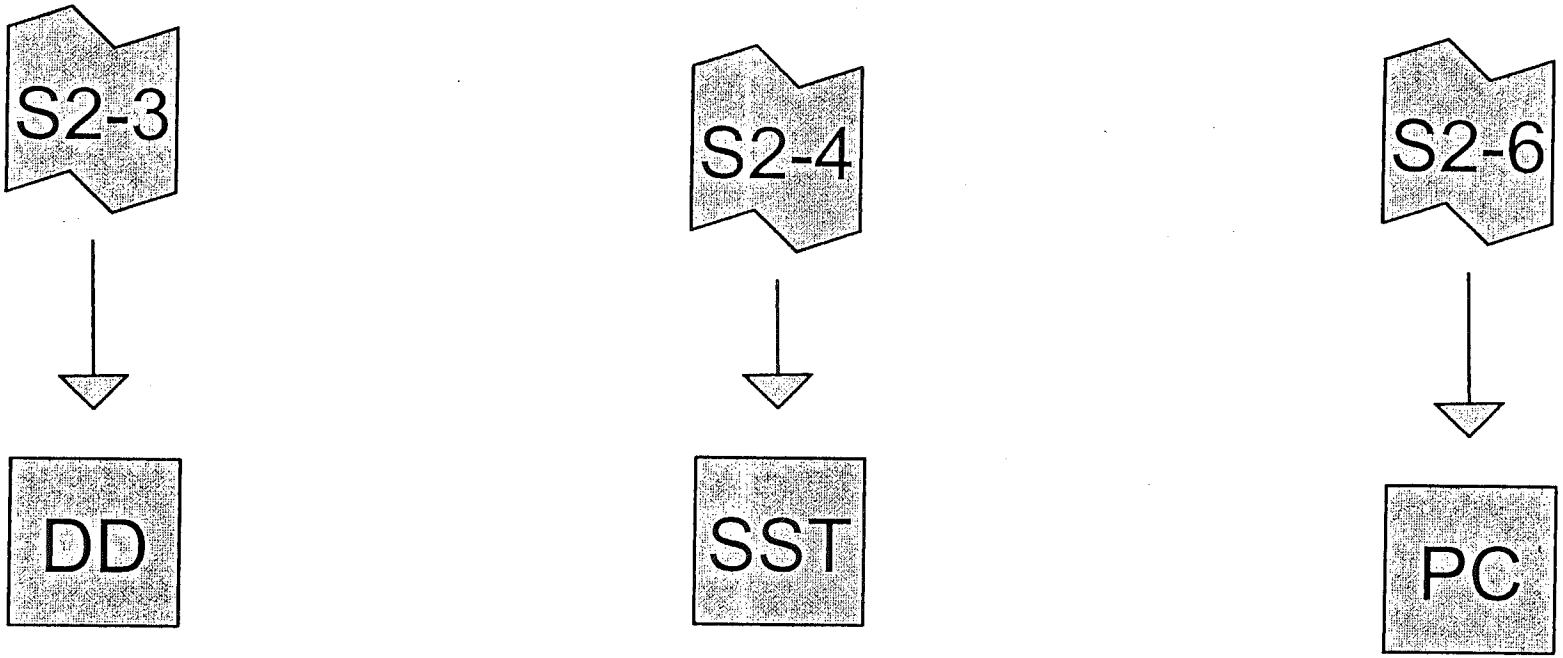
GEOSYNTEC CONSULTANTS
COLUMBIA, MARYLAND

PROJECT NO.	ME0250	FILE NO.	0250F713
DOCUMENT NO.		ATTACHMENT NO.	1

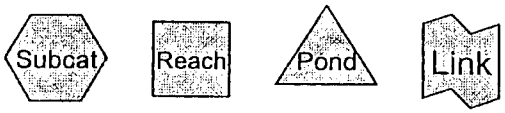


ATTACHMENT 2-1

Drainage Diagram for Post-Devlopment
Prepared by GeoSyntec Consultants 3/19/2003
HydroCAD® 6.00 s/n 000663 © 1986-2001 Applied Microcomputer Systems



ATTACHMENT 2-2



Drainage Diagram for Terrace Channel Dike Design
Prepared by GeoSyntec Consultants 3/19/2003
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LWS 3/26/03

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Subcatchment S1-1: Subcatchment 1

Runoff = 30.44 cfs @ 12.15 hrs, Volume= 2.391 af

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=5.80"

Area (ac)	CN	Description
9.560	74	>75% Grass cover, Good, HSG C

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.1	300	0.0500	0.3		**Sheet Flow, Top of Landfill** Grass: Short n= 0.150 P2= 3.30"
1.6	150	0.0500	1.6		**Shallow Concentrated Flow, Top of Landfill** Short Grass Pasture Kv= 7.0 fps
0.4	90	0.3300	4.0		**Shallow Concentrated Flow, Side Slope** Short Grass Pasture Kv= 7.0 fps
3.6	380	0.0200	1.7	2.89	**Trap/Vee/Rect Channel Flow, Swale Type I** Bot.W=0.00' D=0.25' Z= 3.0 & 50.0 '/' n= 0.030
21.7	920	Total			

Subcatchment S1-2: Subcatchment 1

Runoff = 10.61 cfs @ 11.96 hrs, Volume= 0.492 af

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=5.80"

Area (ac)	CN	Description
1.960	74	>75% Grass cover, Good, HSG C

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.9	90	0.3300	0.5		**Sheet Flow, Sideslope** Grass: Short n= 0.150 P2= 3.30"
2.1	880	0.0300	7.0	70.43	**Trap/Vee/Rect Channel Flow, Terrace** Bot.W=0.00' D=1.50' Z= 3.0 & 6.0 '/' n= 0.030
5.0	970	Total			

Subcatchment S1-3: Subcatchment 1

Runoff = 16.84 cfs @ 11.96 hrs, Volume= 0.781 af

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=5.80"

Area (ac)	CN	Description
3.110	74	>75% Grass cover, Good, HSG C

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.9	90	0.3300	0.5		**Sheet Flow, Sideslope** Grass: Short n= 0.150 P2= 3.30"
2.1	880	0.0300	7.0	70.43	**Trap/Vee/Rect Channel Flow, Terrace** Bot.W=0.00' D=1.50' Z= 3.0 & 6.0 '/' n= 0.030
5.0	970	Total			

Subcatchment S1-4: Subcatchment 1

Runoff = 18.12 cfs @ 11.96 hrs, Volume= 0.837 af

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=5.80"

Area (ac)	CN	Description
3.330	74	>75% Grass cover, Good, HSG C

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.9	90	0.3300	0.5		**Sheet Flow, Sideslope** Grass: Short n= 0.150 P2= 3.30"
2.0	830	0.0300	7.0	70.43	**Trap/Vee/Rect Channel Flow, Terrace** Bot.W=0.00' D=1.50' Z= 3.0 & 6.0 '/' n= 0.030
4.9	920	Total			

Subcatchment S1-5: Subcatchment 1

Runoff = 30.43 cfs @ 12.02 hrs, Volume= 1.671 af

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=5.80"

Area (ac)	CN	Description
6.660	74	>75% Grass cover, Good, HSG C

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.1	140	0.3300	0.6		**Sheet Flow, Sideslope** Grass: Short n= 0.150 P2= 3.30"
0.2	50	0.0050	4.3	85.07	**Trap/Vee/Rect Channel Flow, Perimeter Drianage Channel** Bot.W=6.00' D=2.00' Z= 2.0 '/' n= 0.030
5.7	750	0.0050	2.2	0.43	**Circular Channel (pipe), Drain** Diam= 6.0" Area= 0.2 sf Perim= 1.6' r= 0.13' n= 0.012
10.0	940	Total			

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SSS 3/26/03

Subcatchment S10-1: Subcatchment 10

Runoff = 36.02 cfs @ 12.12 hrs, Volume= 2.662 af

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=5.80"

Area (ac)	CN	Description
10.640	74	>75% Grass cover, Good, HSG C

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.1	300	0.0500	0.3		**Sheet Flow, Top of Landfill** Grass: Short n= 0.150 P2= 3.30"
1.8	270	0.1300	2.5		**Shallow Concentrated Flow, Sideisope** Short Grass Pasture Kv= 7.0 fps
1.6	660	0.0300	7.0	70.43	**Trap/Vee/Rect Channel Flow, Terrace** Bot.W=0.00' D=1.50' Z= 3.0 & 6.0 '/' n= 0.030
19.5	1,230	Total			

Subcatchment S10-2: Subcatchment 10

Runoff = 40.04 cfs @ 11.98 hrs, Volume= 1.964 af

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=5.80"

Area (ac)	CN	Description
7.820	74	>75% Grass cover, Good, HSG C

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.9	130	0.3300	0.6		**Sheet Flow, Landfill Sideslope** Grass: Short n= 0.150 P2= 3.30"
2.9	750	0.0050	4.3	85.07	**Trap/Vee/Rect Channel Flow, Perimeter Channel** Bot.W=6.00' D=2.00' Z= 2.0 '/' n= 0.030
6.8	880	Total			

Subcatchment S2-1: Subcatchment 2

Runoff = 12.06 cfs @ 12.04 hrs, Volume= 0.697 af

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=5.80"

Area (ac)	CN	Description
2.780	74	>75% Grass cover, Good, HSG C

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.6	200	0.0500	0.3		**Sheet Flow, Top of Landfill** Grass: Short n= 0.150 P2= 3.30"

Subcatchment S2-2: Subcatchment 2

Runoff = 24.15 cfs @ 12.11 hrs, Volume= 1.712 af

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=5.80"

Area (ac)	CN	Description
6.840	74	>75% Grass cover, Good, HSG C

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.1	300	0.0500	0.3		**Sheet Flow, Top of Landfill** Grass: Short n= 0.150 P2= 3.30"
0.2	40	0.3300	4.0		**Shallow Concentrated Flow, Sideslope** Short Grass Pasture Kv= 7.0 fps
1.8	770	0.0300	7.0	70.43	**Trap/Vee/Rect Channel Flow, Terrace** Bot.W=0.00' D=1.50' Z= 3.0 & 6.0 '/' n= 0.030
18.1	1,110	Total			

Subcatchment S2-3: Subcatchment 2

Runoff = 15.72 cfs @ 12.23 hrs, Volume= 1.475 af

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=5.80"

Area (ac)	CN	Description
5.910	74	>75% Grass cover, Good, HSG C

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.4	70	0.3300	0.5		**Sheet Flow, Sideslope** Grass: Short n= 0.150 P2= 3.30"
11.6	200	0.0500	0.3		**Sheet Flow, Top of Landfill** Grass: Short n= 0.150 P2= 3.30"
15.0	780	0.0050	0.9	0.60	**Trap/Vee/Rect Channel Flow, Dike** Bot.W=0.00' D=0.25' Z= 2.0 & 20.0 '/' n= 0.030
29.0	1,050	Total			

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Subcatchment S2-4: Subcatchment 2

Runoff = 22.85 cfs @ 12.19 hrs, Volume= 1.954 af

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=5.80"

Area (ac)	CN	Description
7.820	74	>75% Grass cover, Good, HSG C

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
23.2	300	0.0200	0.2		**Sheet Flow, Top of Landfill** Grass: Short n= 0.150 P2= 3.30"
1.8	760	0.0300	7.0	70.43	**Trap/Vee/Rect Channel Flow, Terrace** Bot.W=0.00' D=1.50' Z= 3.0 & 6.0 '/' n= 0.030
25.0	1,060	Total			

Subcatchment S2-5: Subcatchment 2

Runoff = 31.84 cfs @ 11.95 hrs, Volume= 1.457 af

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=5.80"

Area (ac)	CN	Description
5.800	74	>75% Grass cover, Good, HSG C

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.9	90	0.3300	0.5		**Sheet Flow, Sideslope** Grass: Short n= 0.150 P2= 3.30"
1.8	760	0.0300	7.0	70.43	**Trap/Vee/Rect Channel Flow, Terrace** Bot.W=0.00' D=1.50' Z= 3.0 & 6.0 '/' n= 0.030
4.7	850	Total			

Subcatchment S2-6: Subcatchment 2

Runoff = 27.02 cfs @ 12.00 hrs, Volume= 1.400 af

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=5.80"

Area (ac)	CN	Description
5.580	74	>75% Grass cover, Good, HSG C

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.9	90	0.3300	0.5		**Sheet Flow, Sideslope** Grass: Short n= 0.150 P2= 3.30"
0.2	50	0.0050	4.3	85.07	**Trap/Vee/Rect Channel Flow, Perimeter Drainage Channel** Bot.W=6.00' D=2.00' Z= 2.0 '/' n= 0.030
5.4	710	0.0050	2.2	0.43	**Circular Channel (pipe), Drain** Diam= 6.0" Area= 0.2 sf Perim= 1.6' r= 0.13' n= 0.012
8.5	850	Total			

Subcatchment S3-1: Subcatchment 3

Runoff = 6.21 cfs @ 12.08 hrs, Volume= 0.413 af

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=5.80"

Area (ac)	CN	Description
1.650	74	>75% Grass cover, Good, HSG C

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.4	60	0.0500	0.2		**Sheet Flow, Top of Landfill** Grass: Short n= 0.150 P2= 3.30"
11.5	710	0.0070	1.0	0.71	**Trap/Vee/Rect Channel Flow, Dike** Bot.W=0.00' D=0.25' Z= 2.0 & 20.0 '/' n= 0.030
15.9	770	Total			

Subcatchment S3-2: Subcatchment 3

Runoff = 17.02 cfs @ 12.11 hrs, Volume= 1.207 af

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=5.80"

Area (ac)	CN	Description
4.820	74	>75% Grass cover, Good, HSG C

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.1	300	0.0500	0.3		**Sheet Flow, Top of Landfill** Grass: Short n= 0.150 P2= 3.30"
0.2	40	0.3300	4.0		**Shallow Concentrated Flow, Side slope** Short Grass Pasture Kv= 7.0 fps
1.8	770	0.0300	7.0	70.43	**Trap/Vee/Rect Channel Flow, Terrace** Bot.W=0.00' D=1.50' Z= 3.0 & 6.0 '/' n= 0.030
18.1	1,110	Total			

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Subcatchment S3-3: Subcatchment 3

Runoff = 15.56 cfs @ 12.24 hrs, Volume= 1.467 af

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=5.80"

Area (ac)	CN	Description
5.880	74	>75% Grass cover, Good, HSG C

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.4	70	0.3300	0.5		**Sheet Flow, Top of Landfill** Grass: Short n= 0.150 P2= 3.30"
11.6	200	0.0500	0.3		**Sheet Flow, Top of Landfill** Grass: Short n= 0.150 P2= 3.30"
15.2	790	0.0050	0.9	0.60	**Trap/Vee/Rect Channel Flow, Dike** Bot.W=0.00' D=0.25' Z= 2.0 & 20.0 '/' n= 0.030
29.2	1,060	Total			

Subcatchment S3-4: Subcatchment 3

Runoff = 21.20 cfs @ 12.19 hrs, Volume= 1.816 af

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=5.80"

Area (ac)	CN	Description
7.270	74	>75% Grass cover, Good, HSG C

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
23.2	300	0.0200	0.2		**Sheet Flow, Top of Landfill** Grass: Short n= 0.150 P2= 3.30"
1.9	800	0.0300	7.0	70.43	**Trap/Vee/Rect Channel Flow, Terrace** Bot.W=0.00' D=1.50' Z= 3.0 & 6.0 '/' n= 0.030
25.1	1,100	Total			

Subcatchment S3-5: Subcatchment 3

Runoff = 27.00 cfs @ 11.96 hrs, Volume= 1.241 af

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=5.80"

Area (ac)	CN	Description
4.940	74	>75% Grass cover, Good, HSG C

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.9	90	0.3300	0.5		**Sheet Flow, Sideslope** Grass: Short n= 0.150 P2= 3.30"
1.9	800	0.0300	7.0	70.43	**Trap/Vee/Rect Channel Flow, Terrace** Bot.W=0.00' D=1.50' Z= 3.0 & 6.0 '/' n= 0.030
4.8	890	Total			

Subcatchment S3-6: Subcatchment 3

Runoff = 26.63 cfs @ 12.00 hrs, Volume= 1.390 af

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=5.80"

Area (ac)	CN	Description
5.540	74	>75% Grass cover, Good, HSG C

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.9	90	0.3300	0.5		**Sheet Flow, Sideslope** Grass: Short n= 0.150 P2= 3.30"
0.2	50	0.0050	4.3	85.07	**Trap/Vee/Rect Channel Flow, Perimeter Drainage Channel** Bot.W=6.00' D=2.00' Z= 2.0 '/' n= 0.030
5.6	740	0.0050	2.2	0.43	**Circular Channel (pipe), Drain** Diam= 6.0" Area= 0.2 sf Perim= 1.6' r= 0.13' n= 0.012
8.7	880	Total			

Subcatchment S4-1: Subcatchment 4

Runoff = 20.09 cfs @ 12.12 hrs, Volume= 1.454 af

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=5.80"

Area (ac)	CN	Description
5.810	74	>75% Grass cover, Good, HSG C

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.1	300	0.0500	0.3		**Sheet Flow, Top of Landfill** Grass: Short n= 0.150 P2= 3.30"
1.4	130	0.0500	1.6		**Shallow Concentrated Flow, Top of Landfill** Short Grass Pasture Kv= 7.0 fps
0.1	30	0.3300	4.0		**Shallow Concentrated Flow, Side Slope** Short Grass Pasture Kv= 7.0 fps
1.2	500	0.0300	7.0	70.43	**Trap/Vee/Rect Channel Flow, Terrace** Bot.W=0.00' D=1.50' Z= 3.0 & 6.0 '/' n= 0.030
18.8	960	Total			

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Subcatchment S4-2: Subcatchment 4

Runoff = 15.06 cfs @ 11.95 hrs, Volume= 0.683 af

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=5.80"

Area (ac)	CN	Description
2.720	74	>75% Grass cover, Good, HSG C

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.9	90	0.3330	0.5		**Sheet Flow, Sideslope** Grass: Short n= 0.150 P2= 3.30"
1.6	650	0.0300	7.0	70.43	**Trap/Vee/Rect Channel Flow, Terrace** Bot.W=0.00' D=1.50' Z= 3.0 & 6.0 '/' n= 0.030
4.5	740	Total			

Subcatchment S4-3: Subcatchment 4

Runoff = 16.32 cfs @ 11.95 hrs, Volume= 0.744 af

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=5.80"

Area (ac)	CN	Description
2.960	74	>75% Grass cover, Good, HSG C

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.9	90	0.3300	0.5		**Sheet Flow, Sideslope** Grass: Short n= 0.150 P2= 3.30"
1.7	690	0.0300	7.0	70.43	**Trap/Vee/Rect Channel Flow, Terrace** Bot.W=0.00' D=1.50' Z= 3.0 & 6.0 '/' n= 0.030
4.6	780	Total			

Subcatchment S4-4: Subcatchment 4

Runoff = 20.38 cfs @ 11.99 hrs, Volume= 1.027 af

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=5.80"

Area (ac)	CN	Description
4.090	74	>75% Grass cover, Good, HSG C

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.1	60	0.3330	0.5		**Sheet Flow, Sideslope** Grass: Short n= 0.150 P2= 3.30"
0.2	50	0.0050	4.3	85.07	**Trap/Vee/Rect Channel Flow, Perimeter Drainage Channel** Bot.W=6.00' D=2.00' Z= 2.0 '/' n= 0.030
5.4	710	0.0050	2.2	0.43	**Circular Channel (pipe), Drain** Diam= 6.0" Area= 0.2 sf Perim= 1.6' r= 0.13' n= 0.012
7.7	820	Total			

Subcatchment S5-1: Subcatchment 5

Runoff = 19.92 cfs @ 12.09 hrs, Volume= 1.332 af

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=5.80"

Area (ac)	CN	Description
5.320	74	>75% Grass cover, Good, HSG C

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.1	300	0.0500	0.3		**Sheet Flow, Top of Landfill** Grass: Short n= 0.150 P2= 3.30"

Subcatchment S5-2: Subcatchment 5

Runoff = 32.53 cfs @ 12.15 hrs, Volume= 2.533 af

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=5.80"

Area (ac)	CN	Description
10.130	74	>75% Grass cover, Good, HSG C

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
14.4	260	0.0500	0.3		**Sheet Flow, Top of Landfill** Grass: Short n= 0.150 P2= 3.30"
7.0	900	0.0300	2.1	1.46	**Trap/Vee/Rect Channel Flow, Dike** Bot.W=0.00' D=0.25' Z= 2.0 & 20.0 '/' n= 0.030
21.4	1,160	Total			

Subcatchment S5-3: Subcatchment 5

Runoff = 18.51 cfs @ 12.14 hrs, Volume= 1.423 af

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=5.80"

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Area (ac)	CN	Description
5.690	74	>75% Grass cover, Good, HSG C

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.1	300	0.0500	0.3		**Sheet Flow, Top of Landfill** Grass: Short n= 0.150 P2= 3.30"
2.9	270	0.0500	1.6		**Shallow Concentrated Flow, Top of Landfill** Short Grass Pasture Kv= 7.0 fps
1.9	810	0.0300	7.0	70.43	**Trap/Vee/Rect Channel Flow, Terrace** Bot.W=0.00' D=1.50' Z= 3.0 & 6.0 '/' n= 0.030
20.9	1,380	Total			

Subcatchment S5-4: Subcatchment 5

Runoff = 33.46 cfs @ 11.96 hrs, Volume= 1.580 af

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=5.80"

Area (ac)	CN	Description
6.290	74	>75% Grass cover, Good, HSG C

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.4	110	0.3300	0.5		**Sheet Flow, Sideslope** Grass: Short n= 0.150 P2= 3.30"
2.0	820	0.0300	7.0	70.43	**Trap/Vee/Rect Channel Flow, Terrace** Bot.W=0.00' D=1.50' Z= 3.0 & 6.0 '/' n= 0.030
5.4	930	Total			

Subcatchment S5-5: Subcatchment 5

Runoff = 35.66 cfs @ 11.98 hrs, Volume= 1.735 af

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=5.80"

Area (ac)	CN	Description
6.910	74	>75% Grass cover, Good, HSG C

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.3	150	0.3300	0.6		**Sheet Flow, Sideslope** Grass: Short n= 0.150 P2= 3.30"
2.2	900	0.0300	7.0	70.43	**Trap/Vee/Rect Channel Flow, Terrace** Bot.W=0.00' D=1.50' Z= 3.0 & 6.0 '/' n= 0.030
6.5	1,050	Total			

Subcatchment S5-6: Subcatchment 5

Runoff = 29.68 cfs @ 11.99 hrs, Volume= 1.481 af

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=5.80"

Area (ac)	CN	Description
5.900	74	>75% Grass cover, Good, HSG C

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.8	50	0.3300	0.5		**Sheet Flow, Sideslope** Grass: Short n= 0.150 P2= 3.30"
0.2	50	0.0050	4.3	85.07	**Trap/Vee/Rect Channel Flow, Perimeter Drainage Channel** Bot.W=6.00' D=2.00' Z= 2.0 '/' n= 0.030
5.4	710	0.0050	2.2	0.43	**Circular Channel (pipe), Drain** Diam= 6.0" Area= 0.2 sf Perim= 1.6' r= 0.13' n= 0.012
7.4	810	Total			

Subcatchment S6-1: Subcatchment 6

Runoff = 26.30 cfs @ 12.13 hrs, Volume= 1.996 af

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=5.80"

Area (ac)	CN	Description
7.980	74	>75% Grass cover, Good, HSG C

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.1	300	0.0500	0.3		**Sheet Flow, Top of Landfill** Grass: Short n= 0.150 P2= 3.30"
2.9	270	0.0500	1.6		**Shallow Concentrated Flow, Top of Landfill** Short Grass Pasture Kv= 7.0 fps
1.4	580	0.0300	7.0	70.43	**Trap/Vee/Rect Channel Flow, Terrace** Bot.W=0.00' D=1.50' Z= 3.0 & 6.0 '/' n= 0.030
20.4	1,150	Total			

Subcatchment S6-2: Subcatchment 6

Runoff = 15.30 cfs @ 11.96 hrs, Volume= 0.703 af

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=5.80"

Area (ac)	CN	Description
2.800	74	>75% Grass cover, Good, HSG C

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Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.1	100	0.3300	0.5		**Sheet Flow, Side Slope** Grass: Short n= 0.150 P2= 3.30"
1.7	690	0.0300	7.0	70.43	**Trap/Vee/Rect Channel Flow, Terrace** Bot.W=0.00' D=1.50' Z= 3.0 & 6.0 '/' n= 0.030
4.8	790	Total			

Subcatchment S6-3: Subcatchment 6

Runoff = 35.78 cfs @ 11.97 hrs, Volume= 1.733 af

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=5.80"

Area (ac)	CN	Description
6.900	74	>75% Grass cover, Good, HSG C

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.1	100	0.3300	0.5		**Sheet Flow, Side Slope** Grass: Short n= 0.150 P2= 3.30"
1.8	740	0.0300	7.0	70.43	**Trap/Vee/Rect Channel Flow, Terrace** Bot.W=0.00' D=1.50' Z= 3.0 & 6.0 '/' n= 0.030
0.8	530	0.0300	11.0	397.58	**Trap/Vee/Rect Channel Flow, Swale Type II** Bot.W=12.00' D=2.00' Z= 3.0 '/' n= 0.030
0.3	200	0.0300	11.0	397.58	**Trap/Vee/Rect Channel Flow, Swale Type II** Bot.W=12.00' D=2.00' Z= 3.0 '/' n= 0.030
6.0	1,570	Total			

Subcatchment S6-4: Subcatchment 6

Runoff = 22.88 cfs @ 11.95 hrs, Volume= 1.043 af

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=5.80"

Area (ac)	CN	Description
4.150	74	>75% Grass cover, Good, HSG C

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.9	90	0.3300	0.5		**Sheet Flow, Top of Landfill** Grass: Short n= 0.150 P2= 3.30"
1.7	690	0.0300	7.0	70.43	**Trap/Vee/Rect Channel Flow, Terrace** Bot.W=0.00' D=1.50' Z= 3.0 & 6.0 '/' n= 0.030
4.6	780	Total			

Subcatchment S6-5: Subcatchment 6

Runoff = 15.96 cfs @ 12.13 hrs, Volume= 1.198 af

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=5.80"

Area (ac)	CN	Description
4.790	74	>75% Grass cover, Good, HSG C

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.1	300	0.0500	0.3		**Sheet Flow, Top of Landfill** Grass: Short n= 0.150 P2= 3.30"
2.7	250	0.0500	1.6		**Shallow Concentrated Flow, Top of Landfill** Short Grass Pasture Kv= 7.0 fps
0.3	70	0.3300	4.0		**Shallow Concentrated Flow, Sideslope** Short Grass Pasture Kv= 7.0 fps
0.9	380	0.0300	7.0	70.43	**Trap/Vee/Rect Channel Flow, Terrace** Bot.W=0.00' D=1.50' Z= 3.0 & 6.0 '/' n= 0.030
20.0	1,000	Total			

Subcatchment S6-6: Subcatchment 6

Runoff = 12.42 cfs @ 11.95 hrs, Volume= 0.550 af

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=5.80"

Area (ac)	CN	Description
2.190	74	>75% Grass cover, Good, HSG C

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.9	90	0.3300	0.5		**Sheet Flow, Sideslope** Grass: Short n= 0.150 P2= 3.30"
1.0	430	0.0300	7.0	70.43	**Trap/Vee/Rect Channel Flow, Terrace** Bot.W=0.00' D=1.50' Z= 3.0 & 6.0 '/' n= 0.030
3.9	520	Total			

Subcatchment S6-7: Subcatchment 6

Runoff = 12.63 cfs @ 12.20 hrs, Volume= 1.116 af

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=5.80"

Area (ac)	CN	Description
4.470	74	>75% Grass cover, Good, HSG C

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Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
23.2	300	0.0200	0.2		**Sheet Flow, Top of Landfill** Grass: Short n= 0.150 P2= 3.30"
1.7	220	0.0900	2.1		**Shallow Concentrated Flow, Top of Landfill** Short Grass Pasture Kv= 7.0 fps
1.5	630	0.0300	7.0	70.43	**Trap/Vee/Rect Channel Flow, Terrace** Bot.W=0.00' D=1.50' Z= 3.0 & 6.0 '/' n= 0.030
26.4	1,150	Total			

Subcatchment S6-8: Subcatchment 6

Runoff = 7.71 cfs @ 11.95 hrs, Volume= 0.347 af

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=5.80"

Area (ac)	CN	Description
1.380	74	>75% Grass cover, Good, HSG C

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.9	90	0.3300	0.5		**Sheet Flow, Top of Landfill** Grass: Short n= 0.150 P2= 3.30"
1.4	600	0.0300	7.0	70.43	**Trap/Vee/Rect Channel Flow, Perimeter Drainage Channel** Bot.W=0.00' D=1.50' Z= 3.0 & 6.0 '/' n= 0.030
4.3	690	Total			

Subcatchment S7-1: Subcatchment 7

Runoff = 36.38 cfs @ 12.19 hrs, Volume= 3.106 af

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=5.80"

Area (ac)	CN	Description
12.430	74	>75% Grass cover, Good, HSG C

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
23.2	300	0.0200	0.2		**Sheet Flow, Top of Landfill** Grass: Short n= 0.150 P2= 3.30"
0.1	30	0.3300	4.0		**Shallow Concentrated Flow, Sideslope** Short Grass Pasture Kv= 7.0 fps
1.6	670	0.0300	7.0	70.43	**Trap/Vee/Rect Channel Flow, Terrace** Bot.W=0.00' D=1.50' Z= 3.0 & 6.0 '/' n= 0.030
24.9	1,000	Total			

Subcatchment S7-2: Subcatchment 7

Runoff = 39.35 cfs @ 12.02 hrs, Volume= 2.210 af

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=5.80"

Area (ac)	CN	Description
8.810	74	>75% Grass cover, Good, HSG C

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.9	230	0.1300	0.4		**Sheet Flow, Top of Landfill** Grass: Short n= 0.150 P2= 3.30"
1.7	690	0.0300	7.0	70.43	**Trap/Vee/Rect Channel Flow, Terrace** Bot.W=0.00' D=1.50' Z= 3.0 & 6.0 '/' n= 0.030
10.6	920	Total			

Subcatchment S8-1: Subcatchment 8

Runoff = 15.17 cfs @ 12.19 hrs, Volume= 1.299 af

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=5.80"

Area (ac)	CN	Description
5.200	74	>75% Grass cover, Good, HSG C

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
23.2	300	0.0200	0.2		**Sheet Flow, Top of Landfill** Grass: Short n= 0.150 P2= 3.30"
0.1	30	0.3300	4.0		**Shallow Concentrated Flow, Sideslope** Short Grass Pasture Kv= 7.0 fps
1.8	740	0.0300	7.0	70.43	**Trap/Vee/Rect Channel Flow, Terrace** Bot.W=0.00' D=1.50' Z= 3.0 & 6.0 '/' n= 0.030
25.1	1,070	Total			

Subcatchment S8-2: Subcatchment 8

Runoff = 36.72 cfs @ 11.96 hrs, Volume= 1.711 af

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=5.80"

Area (ac)	CN	Description
6.810	74	>75% Grass cover, Good, HSG C

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Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.9	90	0.3300	0.5		**Sheet Flow, Sideslope** Grass: Short n= 0.150 P2= 3.30"
2.2	920	0.0300	7.0	70.43	**Trap/Vee/Rect Channel Flow, Terrace** Bot.W=0.00' D=1.50' Z= 3.0 & 6.0 '/' n= 0.030
5.1	1,010	Total			

Subcatchment S9-1: Subcatchment 9

Runoff = 13.34 cfs @ 12.18 hrs, Volume= 1.129 af

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=5.80"

Area (ac)	CN	Description
4.520	74	>75% Grass cover, Good, HSG C

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
23.2	300	0.0200	0.2		**Sheet Flow, Landfill Top** Grass: Short n= 0.150 P2= 3.30"
0.5	120	0.3300	4.0		**Shallow Concentrated Flow, Top of Landfill** Short Grass Pasture Kv= 7.0 fps
0.9	370	0.0300	7.0	70.43	**Trap/Vee/Rect Channel Flow, Terrace** Bot.W=0.00' D=1.50' Z= 3.0 & 6.0 '/' n= 0.030
24.6	790	Total			

Subcatchment S9-2: Subcatchment 9

Runoff = 24.03 cfs @ 11.95 hrs, Volume= 1.073 af

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=5.80"

Area (ac)	CN	Description
4.270	74	>75% Grass cover, Good, HSG C

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.9	90	0.3300	0.5		**Sheet Flow, Sideslope** Grass: Short n= 0.150 P2= 3.30"
1.2	480	0.0300	7.0	70.43	**Trap/Vee/Rect Channel Flow, Terrace** Bot.W=0.00' D=1.50' Z= 3.0 & 6.0 '/' n= 0.030
4.1	570	Total			

Reach D1-1: Downchute 1

Inflow = 29.74 cfs @ 12.21 hrs, Volume= 2.385 af
Outflow = 29.67 cfs @ 12.21 hrs, Volume= 2.385 af, Atten= 0%, Lag= 0.2 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 11.0 fps, Min. Travel Time= 0.1 min
Avg. Velocity = 3.1 fps, Avg. Travel Time= 0.5 min

Peak Depth= 0.23'
Capacity at bank full= 958.79 cfs
12.00' x 2.00' deep channel, n= 0.028 Length= 90.0' Slope= 0.3300 '/'

Reach D1-2: Downchute 1

Inflow = 36.94 cfs @ 11.98 hrs, Volume= 3.658 af
Outflow = 36.77 cfs @ 11.99 hrs, Volume= 3.657 af, Atten= 0%, Lag= 0.6 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 12.0 fps, Min. Travel Time= 0.3 min
Avg. Velocity = 3.7 fps, Avg. Travel Time= 0.9 min

Peak Depth= 0.26'
Capacity at bank full= 958.79 cfs
12.00' x 2.00' deep channel, n= 0.028 Length= 190.0' Slope= 0.3300 '/'

Reach D1-3: Downchute 1

Inflow = 54.18 cfs @ 11.97 hrs, Volume= 4.493 af
Outflow = 53.79 cfs @ 11.98 hrs, Volume= 4.492 af, Atten= 1%, Lag= 0.3 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 11.8 fps, Min. Travel Time= 0.1 min
Avg. Velocity = 3.4 fps, Avg. Travel Time= 0.4 min

Peak Depth= 0.25'
Capacity at bank full= 1,524.08 cfs
18.00' x 2.00' deep channel, n= 0.028 Length= 90.0' Slope= 0.3300 '/'

Reach D10-1: Downchute 10

Inflow = 64.04 cfs @ 12.01 hrs, Volume= 4.626 af
Outflow = 63.33 cfs @ 12.02 hrs, Volume= 4.623 af, Atten= 1%, Lag= 0.5 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 14.8 fps, Min. Travel Time= 0.3 min
Avg. Velocity = 4.0 fps, Avg. Travel Time= 1.1 min

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Peak Depth= 0.36'
Capacity at bank full= 958.79 cfs
12.00' x 2.00' deep channel, n= 0.028 Length= 270.0' Slope= 0.3300 '/'

Reach D11-1: Downchute 11

Inflow = 30.44 cfs @ 12.01 hrs, Volume= 2.700 af
Outflow = 30.20 cfs @ 12.02 hrs, Volume= 2.697 af, Atten= 1%, Lag= 0.9 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 11.1 fps, Min. Travel Time= 0.6 min
Avg. Velocity = 3.3 fps, Avg. Travel Time= 2.0 min

Peak Depth= 0.23'
Capacity at bank full= 958.79 cfs
12.00' x 2.00' deep channel, n= 0.028 Length= 400.0' Slope= 0.3300 '/'

Reach D2-1: Downchute 2

Inflow = 11.75 cfs @ 12.06 hrs, Volume= 0.696 af
Outflow = 11.65 cfs @ 12.06 hrs, Volume= 0.696 af, Atten= 1%, Lag= 0.3 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 9.9 fps, Min. Travel Time= 0.2 min
Avg. Velocity = 2.7 fps, Avg. Travel Time= 0.8 min

Peak Depth= 0.20'
Capacity at bank full= 413.13 cfs
6.00' x 2.00' deep channel, n= 0.028 Length= 130.0' Slope= 0.3300 '/'

Reach D2-2: Downchute 2

Inflow = 46.43 cfs @ 12.16 hrs, Volume= 3.872 af
Outflow = 46.35 cfs @ 12.17 hrs, Volume= 3.871 af, Atten= 0%, Lag= 0.2 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 13.1 fps, Min. Travel Time= 0.1 min
Avg. Velocity = 3.8 fps, Avg. Travel Time= 0.4 min

Peak Depth= 0.30'
Capacity at bank full= 958.79 cfs
12.00' x 2.00' deep channel, n= 0.028 Length= 80.0' Slope= 0.3300 '/'

Reach D2-3: Downchute 2

Inflow = 69.10 cfs @ 12.17 hrs, Volume= 5.825 af
Outflow = 68.63 cfs @ 12.18 hrs, Volume= 5.822 af, Atten= 1%, Lag= 0.5 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 11.7 fps, Min. Travel Time= 0.3 min
Avg. Velocity = 3.4 fps, Avg. Travel Time= 0.9 min

Peak Depth= 0.24'
Capacity at bank full= 2,096.11 cfs
24.00' x 2.00' deep channel, n= 0.028 Length= 190.0' Slope= 0.3300 '/'

Reach D2-4: Downchute 2

Inflow = 73.24 cfs @ 12.17 hrs, Volume= 7.280 af
Outflow = 73.10 cfs @ 12.18 hrs, Volume= 7.278 af, Atten= 0%, Lag= 0.2 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 13.4 fps, Min. Travel Time= 0.1 min
Avg. Velocity = 4.1 fps, Avg. Travel Time= 0.4 min

Peak Depth= 0.30'
Capacity at bank full= 1,524.08 cfs
18.00' x 2.00' deep channel, n= 0.028 Length= 90.0' Slope= 0.3300 '/'

Reach D3-1: Downchute 3

Inflow = 6.21 cfs @ 12.08 hrs, Volume= 0.413 af
Outflow = 6.15 cfs @ 12.10 hrs, Volume= 0.413 af, Atten= 1%, Lag= 0.8 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 7.2 fps, Min. Travel Time= 0.5 min
Avg. Velocity = 2.2 fps, Avg. Travel Time= 1.6 min

Peak Depth= 0.14'
Capacity at bank full= 366.70 cfs
6.00' x 2.00' deep channel, n= 0.028 Length= 220.0' Slope= 0.2600 '/'

Reach D3-2: Downchute 3

Inflow = 35.32 cfs @ 12.19 hrs, Volume= 3.077 af
Outflow = 35.27 cfs @ 12.20 hrs, Volume= 3.077 af, Atten= 0%, Lag= 0.2 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 11.8 fps, Min. Travel Time= 0.1 min
Avg. Velocity = 3.5 fps, Avg. Travel Time= 0.4 min

Peak Depth= 0.25'
Capacity at bank full= 958.79 cfs
12.00' x 2.00' deep channel, n= 0.028 Length= 80.0' Slope= 0.3300 '/'

Reach D3-3: Downchute 3

Inflow = 60.23 cfs @ 12.19 hrs, Volume= 6.134 af
Outflow = 59.98 cfs @ 12.20 hrs, Volume= 6.130 af, Atten= 0%, Lag= 0.6 min

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Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 12.5 fps, Min. Travel Time= 0.4 min
Avg. Velocity = 3.8 fps, Avg. Travel Time= 1.3 min

Peak Depth= 0.27'
Capacity at bank full= 1,524.08 cfs
18.00' x 2.00' deep channel, n= 0.028 Length= 300.0' Slope= 0.3300 '/'

Reach D4-1: Downchute 4

Inflow = 26.56 cfs @ 11.99 hrs, Volume= 2.137 af
Outflow = 26.45 cfs @ 12.01 hrs, Volume= 2.136 af, Atten= 0%, Lag= 0.8 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 10.6 fps, Min. Travel Time= 0.5 min
Avg. Velocity = 3.0 fps, Avg. Travel Time= 1.6 min

Peak Depth= 0.21'
Capacity at bank full= 958.79 cfs
12.00' x 2.00' deep channel, n= 0.028 Length= 290.0' Slope= 0.3300 '/'

Reach D4-2: Downchute 4

Inflow = 41.28 cfs @ 11.97 hrs, Volume= 2.879 af
Outflow = 40.90 cfs @ 11.98 hrs, Volume= 2.879 af, Atten= 1%, Lag= 0.4 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 12.4 fps, Min. Travel Time= 0.2 min
Avg. Velocity = 3.3 fps, Avg. Travel Time= 0.6 min

Peak Depth= 0.27'
Capacity at bank full= 958.79 cfs
12.00' x 2.00' deep channel, n= 0.028 Length= 130.0' Slope= 0.3300 '/'

Reach D5-1: Downchute 5

Inflow = 70.20 cfs @ 12.14 hrs, Volume= 5.286 af
Outflow = 69.85 cfs @ 12.14 hrs, Volume= 5.283 af, Atten= 0%, Lag= 0.5 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 13.2 fps, Min. Travel Time= 0.3 min
Avg. Velocity = 3.6 fps, Avg. Travel Time= 1.2 min

Peak Depth= 0.29'
Capacity at bank full= 1,524.08 cfs
18.00' x 2.00' deep channel, n= 0.028 Length= 250.0' Slope= 0.3300 '/'

Reach D5-2: Downchute 5

Inflow = 76.36 cfs @ 12.13 hrs, Volume= 6.863 af
Outflow = 76.25 cfs @ 12.13 hrs, Volume= 6.861 af, Atten= 0%, Lag= 0.2 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 13.6 fps, Min. Travel Time= 0.2 min
Avg. Velocity = 4.0 fps, Avg. Travel Time= 0.8 min

Peak Depth= 0.31'
Capacity at bank full= 1,524.08 cfs
18.00' x 2.00' deep channel, n= 0.028 Length= 190.0' Slope= 0.3300 '/'

Reach D5-3: Downchute 5

Inflow = 107.11 cfs @ 12.00 hrs, Volume= 8.596 af
Outflow = 106.79 cfs @ 12.01 hrs, Volume= 8.594 af, Atten= 0%, Lag= 0.2 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 14.0 fps, Min. Travel Time= 0.1 min
Avg. Velocity = 3.9 fps, Avg. Travel Time= 0.4 min

Peak Depth= 0.32'
Capacity at bank full= 2,096.11 cfs
24.00' x 2.00' deep channel, n= 0.028 Length= 90.0' Slope= 0.3300 '/'

Reach D6-1: Downchute 6

Inflow = 15.96 cfs @ 12.13 hrs, Volume= 1.198 af
Outflow = 15.91 cfs @ 12.13 hrs, Volume= 1.198 af, Atten= 0%, Lag= 0.4 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 11.1 fps, Min. Travel Time= 0.2 min
Avg. Velocity = 3.1 fps, Avg. Travel Time= 0.7 min

Peak Depth= 0.24'
Capacity at bank full= 413.13 cfs
6.00' x 2.00' deep channel, n= 0.028 Length= 130.0' Slope= 0.3300 '/'

Reach D6-2: Downchute 6

Inflow = 30.92 cfs @ 11.97 hrs, Volume= 2.241 af
Outflow = 30.32 cfs @ 11.98 hrs, Volume= 2.239 af, Atten= 2%, Lag= 0.6 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 11.0 fps, Min. Travel Time= 0.3 min
Avg. Velocity = 3.1 fps, Avg. Travel Time= 1.1 min

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Peak Depth= 0.23'
Capacity at bank full= 958.79 cfs
12.00' x 2.00' deep channel, n= 0.028 Length= 200.0' Slope= 0.3300 '/'

Reach D6-3: Downchute 6

Inflow = 94.32 cfs @ 12.03 hrs, Volume= 7.771 af
Outflow = 93.92 cfs @ 12.04 hrs, Volume= 7.768 af, Atten= 0%, Lag= 0.5 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 13.3 fps, Min. Travel Time= 0.3 min
Avg. Velocity = 3.7 fps, Avg. Travel Time= 0.9 min

Peak Depth= 0.30'
Capacity at bank full= 2,096.11 cfs
24.00' x 2.00' deep channel, n= 0.028 Length= 200.0' Slope= 0.3300 '/'

Reach D7-1: Downchute 7

Inflow = 36.38 cfs @ 12.19 hrs, Volume= 3.106 af
Outflow = 36.34 cfs @ 12.19 hrs, Volume= 3.105 af, Atten= 0%, Lag= 0.2 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 11.9 fps, Min. Travel Time= 0.1 min
Avg. Velocity = 3.5 fps, Avg. Travel Time= 0.3 min

Peak Depth= 0.25'
Capacity at bank full= 958.79 cfs
12.00' x 2.00' deep channel, n= 0.028 Length= 70.0' Slope= 0.3300 '/'

Reach D7-2: Downchute 7

Inflow = 64.11 cfs @ 12.06 hrs, Volume= 5.315 af
Outflow = 63.96 cfs @ 12.06 hrs, Volume= 5.314 af, Atten= 0%, Lag= 0.2 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 12.7 fps, Min. Travel Time= 0.1 min
Avg. Velocity = 3.6 fps, Avg. Travel Time= 0.4 min

Peak Depth= 0.28'
Capacity at bank full= 1,524.08 cfs
18.00' x 2.00' deep channel, n= 0.028 Length= 90.0' Slope= 0.3300 '/'

Reach D8-1: Downchute 8

Inflow = 43.10 cfs @ 11.97 hrs, Volume= 3.010 af
Outflow = 42.33 cfs @ 11.98 hrs, Volume= 3.008 af, Atten= 2%, Lag= 0.7 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 12.6 fps, Min. Travel Time= 0.4 min
Avg. Velocity = 3.4 fps, Avg. Travel Time= 1.3 min

Peak Depth= 0.28'
Capacity at bank full= 958.79 cfs
12.00' x 2.00' deep channel, n= 0.028 Length= 270.0' Slope= 0.3300 '/'

Reach D9-1: Downchute 9

Inflow = 29.38 cfs @ 11.96 hrs, Volume= 2.202 af
Outflow = 28.70 cfs @ 11.96 hrs, Volume= 2.201 af, Atten= 2%, Lag= 0.5 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 10.9 fps, Min. Travel Time= 0.3 min
Avg. Velocity = 3.1 fps, Avg. Travel Time= 1.1 min

Peak Depth= 0.22'
Capacity at bank full= 958.79 cfs
12.00' x 2.00' deep channel, n= 0.028 Length= 200.0' Slope= 0.3300 '/'

Reach SW1-1: Swale Type I

Inflow = 30.44 cfs @ 12.15 hrs, Volume= 2.391 af
Outflow = 29.74 cfs @ 12.21 hrs, Volume= 2.385 af, Atten= 2%, Lag= 3.6 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 3.2 fps, Min. Travel Time= 2.0 min
Avg. Velocity = 1.3 fps, Avg. Travel Time= 4.7 min

Peak Depth= 0.60'
Capacity at bank full= 760.18 cfs
0.00' x 2.00' deep channel, n= 0.030 Length= 380.0' Slope= 0.0211 '/'
Side Slope Z-value= 3.0 50.0 '/'

Reach SW2-1: Swale Type II

Inflow = 12.06 cfs @ 12.04 hrs, Volume= 0.697 af
Outflow = 11.75 cfs @ 12.06 hrs, Volume= 0.696 af, Atten= 3%, Lag= 1.3 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 4.0 fps, Min. Travel Time= 0.8 min
Avg. Velocity = 1.1 fps, Avg. Travel Time= 3.2 min

Peak Depth= 0.23'
Capacity at bank full= 513.28 cfs
12.00' x 2.00' deep channel, n= 0.030 Length= 200.0' Slope= 0.0500 '/'
Side Slope Z-value= 3.0 '/'

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Reach SW2-2: Swale Type II

Inflow	=	47.41 cfs @	12.11 hrs,	Volume=	3.883 af
Outflow	=	46.43 cfs @	12.16 hrs,	Volume=	3.872 af, Atten= 2%, Lag= 3.1 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 4.9 fps, Min. Travel Time= 1.7 min
Avg. Velocity = 1.5 fps, Avg. Travel Time= 5.7 min

Peak Depth= 0.68'
Capacity at bank full= 324.63 cfs
12.00' x 2.00' deep channel, n= 0.030 Length= 500.0' Slope= 0.0200 '/'
Side Slope Z-value= 3.0 '/'

Reach SW3-1: Swale Type II

Inflow	=	35.95 cfs @	12.14 hrs,	Volume=	3.087 af
Outflow	=	35.32 cfs @	12.19 hrs,	Volume=	3.077 af, Atten= 2%, Lag= 3.3 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 4.5 fps, Min. Travel Time= 1.9 min
Avg. Velocity = 1.3 fps, Avg. Travel Time= 6.2 min

Peak Depth= 0.58'
Capacity at bank full= 324.63 cfs
12.00' x 2.00' deep channel, n= 0.030 Length= 500.0' Slope= 0.0200 '/'
Side Slope Z-value= 3.0 '/'

Reach SW5-1: Swale Type II

Inflow	=	19.92 cfs @	12.09 hrs,	Volume=	1.332 af
Outflow	=	19.45 cfs @	12.12 hrs,	Volume=	1.330 af, Atten= 2%, Lag= 2.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 4.9 fps, Min. Travel Time= 1.2 min
Avg. Velocity = 1.3 fps, Avg. Travel Time= 4.4 min

Peak Depth= 0.31'
Capacity at bank full= 513.28 cfs
12.00' x 2.00' deep channel, n= 0.030 Length= 350.0' Slope= 0.0500 '/'
Side Slope Z-value= 3.0 '/'

Reach SW6-1: Swale Type II

Inflow	=	64.58 cfs @	11.99 hrs,	Volume=	4.430 af
Outflow	=	60.93 cfs @	12.04 hrs,	Volume=	4.415 af, Atten= 6%, Lag= 3.4 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 4.6 fps, Min. Travel Time= 1.9 min
Avg. Velocity = 1.3 fps, Avg. Travel Time= 6.8 min

Peak Depth= 0.93'
Capacity at bank full= 251.45 cfs
12.00' x 2.00' deep channel, n= 0.030 Length= 530.0' Slope= 0.0120 '/'
Side Slope Z-value= 3.0 '/'

Pond DI1-1: Drop Inlet 1

Inflow	=	82.86 cfs @	11.99 hrs,	Volume=	6.163 af
Outflow	=	82.86 cfs @	11.99 hrs,	Volume=	6.163 af, Atten= 0%, Lag= 0.0 min
Primary	=	82.86 cfs @	11.99 hrs,	Volume=	6.163 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Peak Elev= 1.27' Storage= 1 cf
Flood Elev= 3.00' Storage= 3 cf
Plug-Flow detention time=(not calculated: outflow precedes inflow)
Storage and wetted areas determined by Prismatic sections

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
0.00	0	0	0
1.00	1	1	1
2.00	1	1	2

Primary OutFlow (Free Discharge)
└─1=Broad-Crested Rectangular Weir

#	Routing	Invert	Outlet Devices
1	Primary	0.00'	**18.0' long x 0.7' breadth Broad-Crested Rectangular Weir**
			Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50
			Coef. (English) 2.76 2.82 2.93 3.09 3.18 3.22 3.27 3.30 3.32 3.31 3.32

Pond DI1-2: Drop Inlet 1

Inflow	=	82.86 cfs @	11.99 hrs,	Volume=	6.163 af
Outflow	=	82.77 cfs @	11.99 hrs,	Volume=	6.163 af, Atten= 0%, Lag= 0.0 min
Primary	=	82.77 cfs @	11.99 hrs,	Volume=	6.163 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs / 4

Peak Elev= 1.22' Storage= 164 cf
Plug-Flow detention time=(not calculated: outflow precedes inflow)
Storage and wetted areas determined by Prismatic sections

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
0.00	135	0	0
4.00	135	540	540

Primary OutFlow (Free Discharge)
└─1=Orifice/Grate

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#	Routing	Invert	Outlet Devices
1	Primary	0.00'	**72.0" Horiz. Orifice/Grate** Limited to weir flow C= 0.600

Pond DI2-1: Drop Inlet 2

Inflow = 89.26 cfs @ 12.01 hrs, Volume= 8.679 af
Outflow = 89.26 cfs @ 12.01 hrs, Volume= 8.679 af, Atten= 0%, Lag= 0.0 min
Primary = 89.26 cfs @ 12.01 hrs, Volume= 8.679 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Peak Elev= 1.33' Storage= 1 cf
Flood Elev= 3.00' Storage= 3 cf
Plug-Flow detention time=0.0 min calculated for 8.679 af (100% of inflow)
Storage and wetted areas determined by Prismatic sections

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
0.00	0	0	0
1.00	1	1	1
2.00	1	1	2

Primary OutFlow (Free Discharge)
└─1=Broad-Crested Rectangular Weir

#	Routing	Invert	Outlet Devices
1	Primary	0.00'	**18.0' long x 0.7' breadth Broad-Crested Rectangular Weir**
			Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50
			Coef. (English) 2.76 2.82 2.93 3.09 3.18 3.22 3.27 3.30 3.32 3.31 3.32

Pond DI2-2: Drop Inlet 2

Inflow = 89.26 cfs @ 12.01 hrs, Volume= 8.679 af
Outflow = 89.17 cfs @ 12.01 hrs, Volume= 8.679 af, Atten= 0%, Lag= 0.0 min
Primary = 89.17 cfs @ 12.01 hrs, Volume= 8.679 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs / 4

Peak Elev= 1.28' Storage= 173 cf
Plug-Flow detention time=0.0 min calculated for 8.661 af (100% of inflow)
Storage and wetted areas determined by Prismatic sections

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
0.00	135	0	0
4.00	135	540	540

Primary OutFlow (Free Discharge)
└─1=Orifice/Grate

#	Routing	Invert	Outlet Devices
1	Primary	0.00'	**72.0" Horiz. Orifice/Grate** Limited to weir flow C= 0.600

Pond DI3-1: Drop Inlet 3

Inflow = 77.25 cfs @ 12.01 hrs, Volume= 7.521 af
Outflow = 77.25 cfs @ 12.01 hrs, Volume= 7.521 af, Atten= 0%, Lag= 0.0 min
Primary = 77.25 cfs @ 12.01 hrs, Volume= 7.521 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Peak Elev= 1.21' Storage= 1 cf
Flood Elev= 3.00' Storage= 3 cf
Plug-Flow detention time=0.0 min calculated for 7.505 af (100% of inflow)
Storage and wetted areas determined by Prismatic sections

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
0.00	0	0	0
1.00	1	1	1
2.00	1	1	2

Primary OutFlow (Free Discharge)
└─1=Broad-Crested Rectangular Weir

#	Routing	Invert	Outlet Devices
1	Primary	0.00'	**18.0' long x 0.7' breadth Broad-Crested Rectangular Weir**
			Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50
			Coef. (English) 2.76 2.82 2.93 3.09 3.18 3.22 3.27 3.30 3.32 3.31 3.32

Pond DI3-2: Drop Inlet 3

Inflow = 77.25 cfs @ 12.01 hrs, Volume= 7.521 af
Outflow = 77.17 cfs @ 12.01 hrs, Volume= 7.520 af, Atten= 0%, Lag= 0.0 min
Primary = 77.17 cfs @ 12.01 hrs, Volume= 7.520 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs / 4

Peak Elev= 1.16' Storage= 157 cf
Plug-Flow detention time=0.0 min calculated for 7.505 af (100% of inflow)
Storage and wetted areas determined by Prismatic sections

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
0.00	135	0	0
4.00	135	540	540

Primary OutFlow (Free Discharge)
└─1=Orifice/Grate

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#	Routing	Invert	Outlet Devices
1	Primary	0.00'	**72.0" Horiz. Orifice/Grate** Limited to weir flow C= 0.600

Pond DI4-1: Drop Inlet 4

Inflow = 61.18 cfs @ 11.99 hrs, Volume= 3.905 af
Outflow = 61.18 cfs @ 11.99 hrs, Volume= 3.905 af, Atten= 0%, Lag= 0.0 min
Primary = 61.18 cfs @ 11.99 hrs, Volume= 3.905 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Peak Elev= 1.35' Storage= 1 cf
Flood Elev= 3.00' Storage= 3 cf
Plug-Flow detention time=(not calculated: outflow precedes inflow)
Storage and wetted areas determined by Prismatic sections

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
0.00	0	0	0
1.00	1	1	1
2.00	1	1	2

Primary OutFlow (Free Discharge)
└─1=Broad-Crested Rectangular Weir

#	Routing	Invert	Outlet Devices
1	Primary	0.00'	**12.0' long x 0.7' breadth Broad-Crested Rectangular Weir**
			Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50
			Coef. (English) 2.76 2.82 2.93 3.09 3.18 3.22 3.27 3.30 3.32 3.31 3.32

Pond DI4-2: Drop Inlet 4

Inflow = 61.18 cfs @ 11.99 hrs, Volume= 3.905 af
Outflow = 61.13 cfs @ 11.99 hrs, Volume= 3.905 af, Atten= 0%, Lag= 0.0 min
Primary = 61.13 cfs @ 11.99 hrs, Volume= 3.905 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs / 4

Peak Elev= 0.99' Storage= 90 cf
Plug-Flow detention time=(not calculated: outflow precedes inflow)
Storage and wetted areas determined by Prismatic sections

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
0.00	90	0	0
4.00	90	360	360

Primary OutFlow (Free Discharge)
└─1=Orifice/Grate

#	Routing	Invert	Outlet Devices
1	Primary	0.00'	**72.0" Horiz. Orifice/Grate** Limited to weir flow C= 0.600

Pond DI5-1: Drop Inlet 5

Inflow = 136.09 cfs @ 12.00 hrs, Volume= 10.075 af
Outflow = 136.09 cfs @ 12.00 hrs, Volume= 10.075 af, Atten= 0%, Lag= 0.0 min
Primary = 136.09 cfs @ 12.00 hrs, Volume= 10.075 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs / 3

Peak Elev= 1.44' Storage= 1 cf
Flood Elev= 3.00' Storage= 3 cf
Plug-Flow detention time=0.0 min calculated for 10.054 af (100% of inflow)
Storage and wetted areas determined by Prismatic sections

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
0.00	0	0	0
1.00	1	1	1
2.00	1	1	2

Primary OutFlow (Free Discharge)
└─1=Broad-Crested Rectangular Weir

#	Routing	Invert	Outlet Devices
1	Primary	0.00'	**24.0' long x 0.7' breadth Broad-Crested Rectangular Weir**
			Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50
			Coef. (English) 2.76 2.82 2.93 3.09 3.18 3.22 3.27 3.30 3.32 3.31 3.32

Pond DI5-2: Drop Inlet 5

Inflow = 136.09 cfs @ 12.00 hrs, Volume= 10.075 af
Outflow = 135.91 cfs @ 12.00 hrs, Volume= 10.075 af, Atten= 0%, Lag= 0.0 min
Primary = 135.91 cfs @ 12.00 hrs, Volume= 10.075 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs / 4

Peak Elev= 1.69' Storage= 305 cf
Plug-Flow detention time=(not calculated: outflow precedes inflow)
Storage and wetted areas determined by Prismatic sections

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
0.00	180	0	0
4.00	180	720	720

Primary OutFlow (Free Discharge)
└─1=Orifice/Grate

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#	Routing	Invert	Outlet Devices
1	Primary	0.00'	**72.0" Horiz. Orifice/Grate** Limited to weir flow C= 0.600

Pond DI6-1: Drop Inlet 6

Inflow = 106.35 cfs @ 12.01 hrs, Volume= 8.665 af
Outflow = 106.35 cfs @ 12.01 hrs, Volume= 8.665 af, Atten= 0%, Lag= 0.0 min
Primary = 106.35 cfs @ 12.01 hrs, Volume= 8.665 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Peak Elev= 1.24' Storage= 1 cf
Flood Elev= 3.00' Storage= 3 cf
Plug-Flow detention time=0.0 min calculated for 8.665 af (100% of inflow)
Storage and wetted areas determined by Prismatic sections

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
0.00	0	0	0
1.00	1	1	1
2.00	1	1	2

Primary OutFlow (Free Discharge)
└─1=Broad-Crested Rectangular Weir

#	Routing	Invert	Outlet Devices
1	Primary	0.00'	**24.0' long x 0.7' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 Coef. (English) 2.76 2.82 2.93 3.09 3.18 3.22 3.27 3.30 3.32 3.31 3.32

Pond DI6-2: Drop Inlet 6

Inflow = 106.35 cfs @ 12.01 hrs, Volume= 8.665 af
Outflow = 106.21 cfs @ 12.01 hrs, Volume= 8.665 af, Atten= 0%, Lag= 0.0 min
Primary = 106.21 cfs @ 12.01 hrs, Volume= 8.665 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs / 4

Peak Elev= 1.44' Storage= 259 cf
Plug-Flow detention time=0.1 min calculated for 8.647 af (100% of inflow)
Storage and wetted areas determined by Prismatic sections

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
0.00	180	0	0
4.00	180	720	720

Primary OutFlow (Free Discharge)
└─1=Orifice/Grate

#	Routing	Invert	Outlet Devices
1	Primary	0.00'	**72.0" Horiz. Orifice/Grate** Limited to weir flow C= 0.600

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Reach DD: Diversion Dike

Inflow = 15.72 cfs @ 12.23 hrs, Volume= 1.475 af
Outflow = 15.07 cfs @ 12.36 hrs, Volume= 1.468 af, Atten= 4%, Lag= 7.8 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 1.9 fps, Min. Travel Time= 4.3 min
Avg. Velocity = 0.9 fps, Avg. Travel Time= 9.7 min

Peak Depth= 0.84'
Capacity at bank full= 43.66 cfs
0.00' x 1.25' deep channel, n= 0.030 Length= 500.0' Slope= 0.0050 '/'
Side Slope Z-value= 20.0 2.0 '/'

Reach PC: Perimeter Drainage Channel

Inflow = 27.02 cfs @ 12.00 hrs, Volume= 1.400 af
Outflow = 26.60 cfs @ 12.01 hrs, Volume= 1.400 af, Atten= 2%, Lag= 0.4 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 3.1 fps, Min. Travel Time= 0.3 min
Avg. Velocity = 0.8 fps, Avg. Travel Time= 1.0 min

Peak Depth= 1.08'
Capacity at bank full= 85.07 cfs
6.00' x 2.00' deep channel, n= 0.030 Length= 50.0' Slope= 0.0050 '/'
Side Slope Z-value= 2.0 '/'

Reach SST: Sideslope Terrace

Inflow = 22.85 cfs @ 12.19 hrs, Volume= 1.954 af
Outflow = 22.40 cfs @ 12.26 hrs, Volume= 1.948 af, Atten= 2%, Lag= 4.4 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 5.2 fps, Min. Travel Time= 2.4 min
Avg. Velocity = 2.3 fps, Avg. Travel Time= 5.6 min

Peak Depth= 0.98'
Capacity at bank full= 70.43 cfs
0.00' x 1.50' deep channel, n= 0.030 Length= 760.0' Slope= 0.0300 '/'
Side Slope Z-value= 3.0 6.0 '/'

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JSS 3/26/03
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Appendix VIb-I.3

Stormwater Routing Analysis: 100-yr, 24-hour Design Storm

1/21

GEOSYNTEC CONSULTANTS

COMPUTATION COVER SHEET

Client: DSWA **Project:** Cherry Island Landfill **Project/Proposal #:** ME0250 **Task #:** 2.9.2

TITLE OF COMPUTATIONS **APPENDIX VIb-I.3: STORMWATER ROUTING ANALYSIS: 100-YEAR, 24-HOUR DESIGN STORM**

COMPUTATIONS BY:
Signature [signature] 26 March 2003 DATE
Printed Name and Title: William M. Steier, P.E. Project Engineer

ASSUMPTIONS AND PROCEDURES CHECKED BY:
(Peer Reviewer)
Signature [signature] 26 March 2003 DATE
Printed Name and Title: Eric. S. Steinhauser, P.E. Associate

COMPUTATIONS CHECKED BY:
Signature [signature] 26 March 2003 DATE
Printed Name and Title: Eric. S. Steinhauser, P.E. Associate

COMPUTATIONS BACKCHECKED BY:
(Originator)
Signature [signature] 26 March 2003 DATE
Printed Name and Title: William M. Steier, P.E. Project Engineer

APPROVED BY:
(PM or Designate)
Signature [signature] 3/31/03 DATE
Printed Name and Title: David Espinoza, P.E. Senior Engineer

APPROVAL NOTES: The calculations presented herein are suitable for a landfill elevation of 195 ft-msl. As shown in this calculation package, the design was performed for a more conservative grading configuration than that shown in Drawing 78 entitled "Landfill Final Development and Grading Plan" (Appendix VIb-A).
[initials] 6/10/04

REVISIONS (Number and initial all revisions)

NO.	SHEET	DATE	BY	CHECKED BY	APPROVAL

APPENDIX VIb-I.3
STORMWATER ROUTING ANALYSIS: 100-YEAR, 24-HOUR DESIGN STORM

PURPOSE

The purpose of this calculation package is to present the "*HydroCAD® Stormwater Modeling System*", version 6 [Applied Microcomputer Systems, 2001] (HydroCAD®) computer output files for the design of the various components of the stormwater management features of the Cherry Island Landfill (CIL). The output files of this calculation present stormwater routing analysis using the 100-year, 24-hour design storm, and other input parameters described in Appendix Vib-I.1 (Selection of Post-Development Hydrologic Parameter). The stormwater management features for the project include: (i) sideslope terraces; (ii) downchutes; (iii) perimeter drainage channels inside of the perimeter access road); (iv) drop inlet structures; and (v) outlet culverts and channels to the Delaware and Christina Rivers.

HydroCAD® routes stormwater runoff through the defined modeling using the procedures defined in "*Urban Hydrology for Small Watersheds, Technical Release 55*", [USDA-SCS, 1986] and "*Computer Program for Project Formulation Hydrology, Technical Release 20*", [USDA – SCS, 1982]. The routing model is presented on Attachment 1, and is presented schematically on Attachments 2-1 and 2-2. The results of this output file will be used to verify the geometric sizing and lining of the stormwater management features, which are addressed in other calculation packages.

REFERENCE

Applied Microcomputer Systems, "*HydroCAD® Stormwater Modeling System*", Version 6, Chocorua, New Hampshire 2002.

United States Department of Agriculture, Soil Conservation Service, "*Computer Program for Project Formulation Hydrology, Technical Release 20*", Washington, D.C., 1982.

United States Department of Agriculture, Soil Conservation Service, "*Urban Hydrology for Small Watersheds, Technical Release 55*", 2nd ed., Washington, D.C., 1986.

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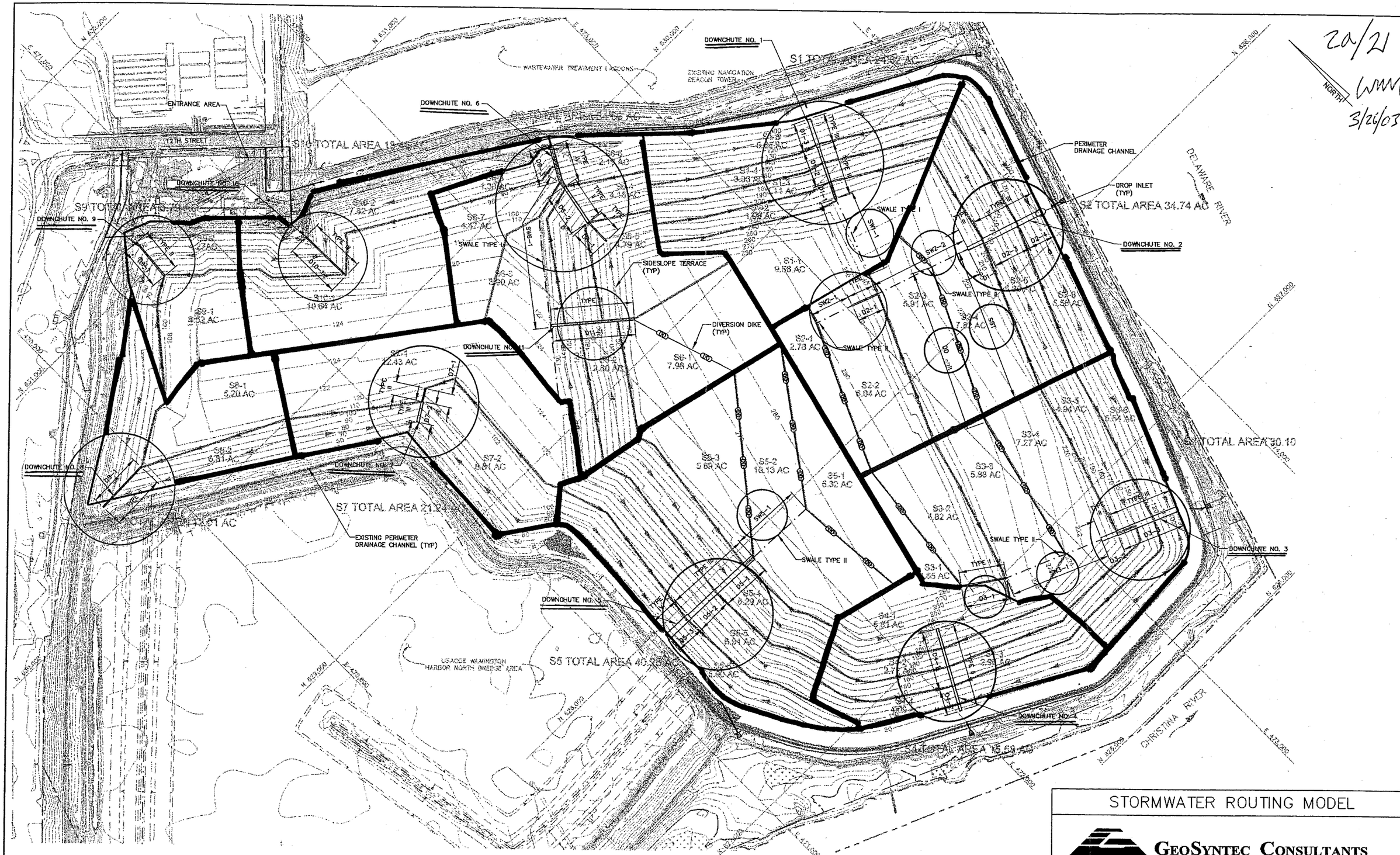


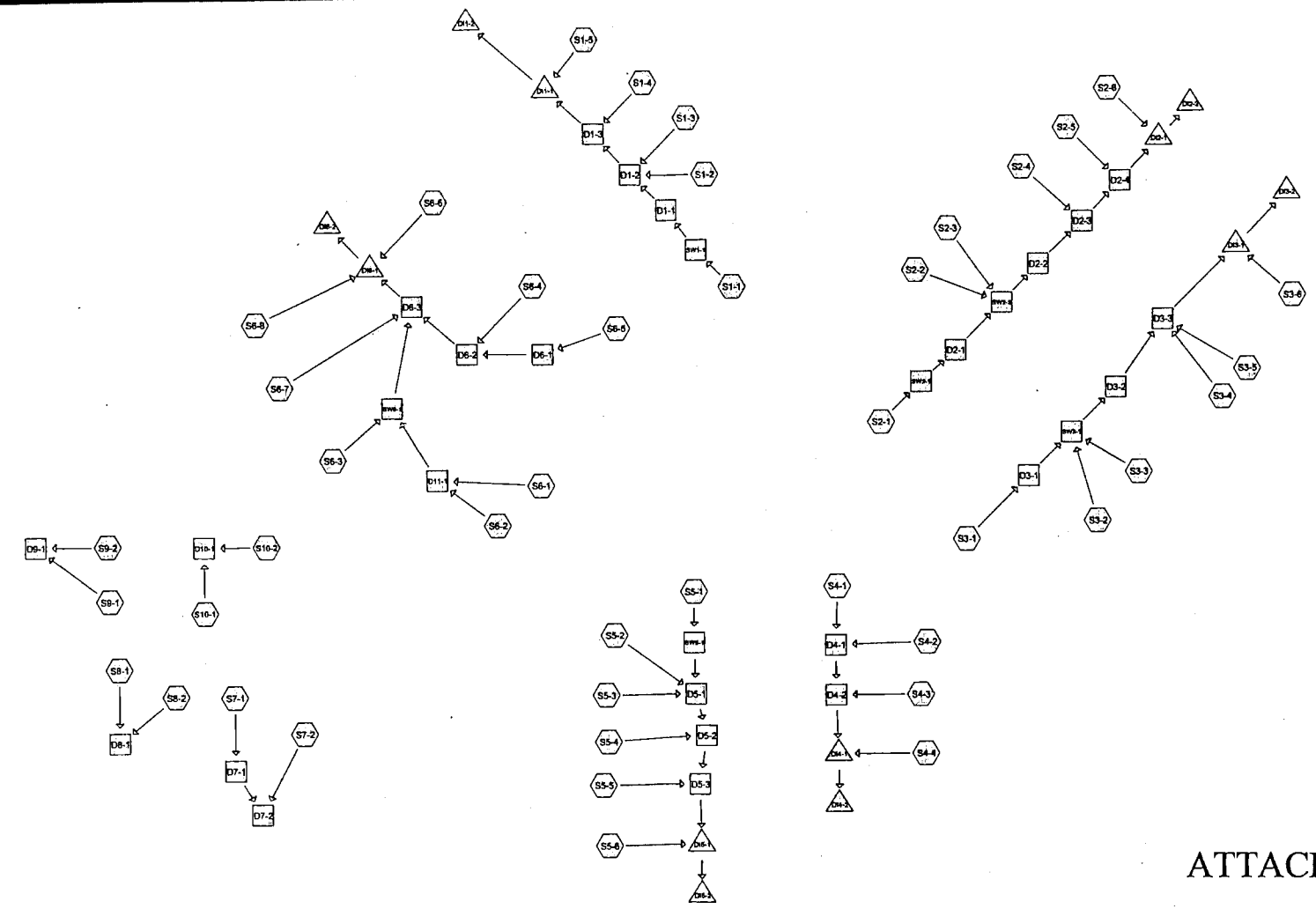
NOT TO SCALE

STORMWATER ROUTING MODEL

GEOSYNTEC CONSULTANTS
COLUMBIA, MARYLAND

PROJECT NO.	ME0250	FILE NO.	0250F713
DOCUMENT NO.		ATTACHMENT NO.	1

WM3 3/20/03 ASS 3/20/03 3/21



ATTACHMENT 2-1

Subcat Reach Pond Link

Drainage Diagram for Post-Devlopment

Prepared by GeoSyntec Consultants 3/19/2003

HydroCAD® 6.00 s/n 000663 © 1986-2001 Applied Microcomputer Systems

Reach DD: Diversion Dike

Inflow = 22.97 cfs @ 12.23 hrs, Volume= 2.148 af
Outflow = 22.17 cfs @ 12.35 hrs, Volume= 2.140 af, Atten= 3%, Lag= 7.2 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 2.1 fps, Min. Travel Time= 3.9 min
Avg. Velocity = 0.9 fps, Avg. Travel Time= 9.1 min

Peak Depth= 0.97'
Capacity at bank full= 43.66 cfs
0.00' x 1.25' deep channel, n= 0.030 Length= 500.0' Slope= 0.0050 '/'
Side Slope Z-value= 20.0 2.0 '/'

Reach PC: Perimeter Drainage Channel

Inflow = 39.00 cfs @ 12.00 hrs, Volume= 2.039 af
Outflow = 38.48 cfs @ 12.00 hrs, Volume= 2.038 af, Atten= 1%, Lag= 0.3 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 3.4 fps, Min. Travel Time= 0.2 min
Avg. Velocity = 0.9 fps, Avg. Travel Time= 0.9 min

Peak Depth= 1.32'
Capacity at bank full= 85.07 cfs
6.00' x 2.00' deep channel, n= 0.030 Length= 50.0' Slope= 0.0050 '/'
Side Slope Z-value= 2.0 '/'

Reach SST: Sideslope Terrace

Inflow = 33.34 cfs @ 12.18 hrs, Volume= 2.846 af
Outflow = 32.71 cfs @ 12.25 hrs, Volume= 2.839 af, Atten= 2%, Lag= 4.1 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 5.8 fps, Min. Travel Time= 2.2 min
Avg. Velocity = 2.4 fps, Avg. Travel Time= 5.3 min

Peak Depth= 1.13'
Capacity at bank full= 70.43 cfs
0.00' x 1.50' deep channel, n= 0.030 Length= 760.0' Slope= 0.0300 '/'
Side Slope Z-value= 3.0 6.0 '/'

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SSS 3/26/03
21/21

#	Routing	Invert	Outlet Devices
1	Primary	0.00'	**72.0" Horiz. Orifice/Grate** Limited to weir flow C= 0.600

Pond DI4-1: Drop Inlet 4

Inflow = 88.86 cfs @ 11.98 hrs, Volume= 5.687 af
Outflow = 88.86 cfs @ 11.98 hrs, Volume= 5.687 af, Atten= 0%, Lag= 0.0 min
Primary = 88.86 cfs @ 11.98 hrs, Volume= 5.687 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Peak Elev= 1.71' Storage= 1 cf
Flood Elev= 3.00' Storage= 3 cf
Plug-Flow detention time=0.0 min calculated for 5.675 af (100% of inflow)
Storage and wetted areas determined by Prismatic sections

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
0.00	0	0	0
1.00	1	1	1
2.00	1	1	2

Primary OutFlow (Free Discharge)
└1=Broad-Crested Rectangular Weir

#	Routing	Invert	Outlet Devices
1	Primary	0.00'	**12.0' long x 0.7' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 Coef. (English) 2.76 2.82 2.93 3.09 3.18 3.22 3.27 3.30 3.32 3.31 3.32

Pond DI4-2: Drop Inlet 4

Inflow = 88.86 cfs @ 11.98 hrs, Volume= 5.687 af
Outflow = 88.80 cfs @ 11.98 hrs, Volume= 5.687 af, Atten= 0%, Lag= 0.0 min
Primary = 88.80 cfs @ 11.98 hrs, Volume= 5.687 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs / 4

Peak Elev= 1.28' Storage= 115 cf
Plug-Flow detention time=(not calculated: outflow precedes inflow)
Storage and wetted areas determined by Prismatic sections

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
0.00	90	0	0
4.00	90	360	360

Primary OutFlow (Free Discharge)
└1=Orifice/Grate

#	Routing	Invert	Outlet Devices
1	Primary	0.00'	**72.0" Horiz. Orifice/Grate** Limited to weir flow C= 0.600

Pond DI5-1: Drop Inlet 5

Inflow = 199.50 cfs @ 12.00 hrs, Volume= 14.674 af
Outflow = 199.50 cfs @ 12.00 hrs, Volume= 14.674 af, Atten= 0%, Lag= 0.0 min
Primary = 199.50 cfs @ 12.00 hrs, Volume= 14.674 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs / 3

Peak Elev= 1.84' Storage= 1 cf
Flood Elev= 3.00' Storage= 3 cf
Plug-Flow detention time=0.0 min calculated for 14.674 af (100% of inflow)
Storage and wetted areas determined by Prismatic sections

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
0.00	0	0	0
1.00	1	1	1
2.00	1	1	2

Primary OutFlow (Free Discharge)
└1=Broad-Crested Rectangular Weir

#	Routing	Invert	Outlet Devices
1	Primary	0.00'	**24.0' long x 0.7' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 Coef. (English) 2.76 2.82 2.93 3.09 3.18 3.22 3.27 3.30 3.32 3.31 3.32

Pond DI5-2: Drop Inlet 5

Inflow = 199.50 cfs @ 12.00 hrs, Volume= 14.674 af
Outflow = 199.29 cfs @ 12.00 hrs, Volume= 14.674 af, Atten= 0%, Lag= 0.0 min
Primary = 199.29 cfs @ 12.00 hrs, Volume= 14.674 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs / 4

Peak Elev= 2.19' Storage= 394 cf
Plug-Flow detention time=(not calculated: outflow precedes inflow)
Storage and wetted areas determined by Prismatic sections

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
0.00	180	0	0
4.00	180	720	720

Primary OutFlow (Free Discharge)
└1=Orifice/Grate

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SS 3/26/03

#	Routing	Invert	Outlet Devices
1	Primary	0.00'	**72.0" Horiz. Orifice/Grate** Limited to weir flow C= 0.600

Pond DI6-1: Drop Inlet 6

Inflow = 157.91 cfs @ 12.00 hrs, Volume= 12.623 af
Outflow = 157.91 cfs @ 12.00 hrs, Volume= 12.623 af, Atten= 0%, Lag= 0.0 min
Primary = 157.91 cfs @ 12.00 hrs, Volume= 12.623 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Peak Elev= 1.58' Storage= 1 cf
Flood Elev= 3.00' Storage= 3 cf
Plug-Flow detention time=0.0 min calculated for 12.597 af (100% of inflow)
Storage and wetted areas determined by Prismatic sections

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
0.00	0	0	0
1.00	1	1	1
2.00	1	1	2

Primary OutFlow (Free Discharge)
└─1=Broad-Crested Rectangular Weir

#	Routing	Invert	Outlet Devices
1	Primary	0.00'	**24.0' long x 0.7' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 Coef. (English) 2.76 2.82 2.93 3.09 3.18 3.22 3.27 3.30 3.32 3.31 3.32

Pond DI6-2: Drop Inlet 6

Inflow = 157.91 cfs @ 12.00 hrs, Volume= 12.623 af
Outflow = 157.74 cfs @ 12.00 hrs, Volume= 12.623 af, Atten= 0%, Lag= 0.0 min
Primary = 157.74 cfs @ 12.00 hrs, Volume= 12.623 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs / 4

Peak Elev= 1.87' Storage= 337 cf
Plug-Flow detention time=(not calculated: outflow precedes inflow)
Storage and wetted areas determined by Prismatic sections

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
0.00	180	0	0
4.00	180	720	720

Primary OutFlow (Free Discharge)
└─1=Orifice/Grate

#	Routing	Invert	Outlet Devices
1	Primary	0.00'	**72.0" Horiz. Orifice/Grate** Limited to weir flow C= 0.600

20/21 WMS 3/26/03 SSS 3/26/03

Reach SW2-2: Swale Type II

Inflow = 68.99 cfs @ 12.11 hrs, Volume= 5.655 af
Outflow = 67.63 cfs @ 12.15 hrs, Volume= 5.642 af, Atten= 2%, Lag= 2.7 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 5.5 fps, Min. Travel Time= 1.5 min
Avg. Velocity = 1.6 fps, Avg. Travel Time= 5.2 min

Peak Depth= 0.84'
Capacity at bank full= 324.63 cfs
12.00' x 2.00' deep channel, n= 0.030 Length= 500.0' Slope= 0.0200 '/'
Side Slope Z-value= 3.0 '/'

Reach SW3-1: Swale Type II

Inflow = 52.46 cfs @ 12.13 hrs, Volume= 4.496 af
Outflow = 51.55 cfs @ 12.18 hrs, Volume= 4.485 af, Atten= 2%, Lag= 2.9 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 5.1 fps, Min. Travel Time= 1.6 min
Avg. Velocity = 1.5 fps, Avg. Travel Time= 5.7 min

Peak Depth= 0.72'
Capacity at bank full= 324.63 cfs
12.00' x 2.00' deep channel, n= 0.030 Length= 500.0' Slope= 0.0200 '/'
Side Slope Z-value= 3.0 '/'

Reach SW5-1: Swale Type II

Inflow = 28.93 cfs @ 12.08 hrs, Volume= 1.940 af
Outflow = 28.34 cfs @ 12.11 hrs, Volume= 1.937 af, Atten= 2%, Lag= 1.7 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 5.6 fps, Min. Travel Time= 1.0 min
Avg. Velocity = 1.4 fps, Avg. Travel Time= 4.0 min

Peak Depth= 0.39'
Capacity at bank full= 513.28 cfs
12.00' x 2.00' deep channel, n= 0.030 Length= 350.0' Slope= 0.0500 '/'
Side Slope Z-value= 3.0 '/'

Reach SW6-1: Swale Type II

Inflow = 94.04 cfs @ 11.98 hrs, Volume= 6.451 af
Outflow = 88.83 cfs @ 12.03 hrs, Volume= 6.434 af, Atten= 6%, Lag= 3.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 5.2 fps, Min. Travel Time= 1.7 min
Avg. Velocity = 1.4 fps, Avg. Travel Time= 6.2 min

Peak Depth= 1.16'
Capacity at bank full= 251.45 cfs
12.00' x 2.00' deep channel, n= 0.030 Length= 530.0' Slope= 0.0120 '/'
Side Slope Z-value= 3.0 '/'

Pond DI1-1: Drop Inlet 1

Inflow = 121.29 cfs @ 11.99 hrs, Volume= 8.976 af
Outflow = 121.29 cfs @ 11.99 hrs, Volume= 8.976 af, Atten= 0%, Lag= 0.0 min
Primary = 121.29 cfs @ 11.99 hrs, Volume= 8.976 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Peak Elev= 1.61' Storage= 1 cf
Flood Elev= 3.00' Storage= 3 cf
Plug-Flow detention time=0.0 min calculated for 8.958 af (100% of Inflow)
Storage and wetted areas determined by Prismatic sections

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
0.00	0	0	0
1.00	1	1	1
2.00	1	1	2

Primary OutFlow: (Free Discharge)
└1=Broad-Crested Rectangular Weir

#	Routing	Invert	Outlet Devices
1	Primary	0.00'	**18.0' long x 0.7' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 Coef. (English) 2.76 2.82 2.93 3.09 3.18 3.22 3.27 3.30 3.32 3.31 3.32

Pond DI1-2: Drop Inlet 1

Inflow = 121.29 cfs @ 11.99 hrs, Volume= 8.976 af
Outflow = 121.17 cfs @ 11.99 hrs, Volume= 8.977 af, Atten= 0%, Lag= 0.0 min
Primary = 121.17 cfs @ 11.99 hrs, Volume= 8.977 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs / 4

Peak Elev= 1.57' Storage= 212 cf
Plug-Flow detention time=(not calculated: outflow precedes Inflow)
Storage and wetted areas determined by Prismatic sections

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
0.00	135	0	0
4.00	135	540	540

Primary OutFlow (Free Discharge)
└1=Orifice/Grate

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FSS 3/26/03
17/21

#	Routing	Invert	Outlet Devices
1	Primary	0.00'	**72.0" Horiz. Orifice/Grate** Limited to weir flow C= 0.600

Pond DI2-1: Drop Inlet 2

Inflow = 133.32 cfs @ 12.01 hrs, Volume= 12.643 af
Outflow = 133.32 cfs @ 12.01 hrs, Volume= 12.643 af, Atten= 0%, Lag= 0.0 min
Primary = 133.32 cfs @ 12.01 hrs, Volume= 12.643 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Peak Elev= 1.71' Storage= 1 cf
Flood Elev= 3.00' Storage= 3 cf
Plug-Flow detention time=0.0 min calculated for 12.616 af (100% of inflow)
Storage and wetted areas determined by Prismatic sections

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
0.00	0	0	0
1.00	1	1	1
2.00	1	1	2

Primary OutFlow (Free Discharge)
└─1=Broad-Crested Rectangular Weir

#	Routing	Invert	Outlet Devices
1	Primary	0.00'	**18.0' long x 0.7' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 Coef. (English) 2.76 2.82 2.93 3.09 3.18 3.22 3.27 3.30 3.32 3.31 3.32

Pond DI2-2: Drop Inlet 2

Inflow = 133.32 cfs @ 12.01 hrs, Volume= 12.643 af
Outflow = 133.22 cfs @ 12.01 hrs, Volume= 12.643 af, Atten= 0%, Lag= 0.0 min
Primary = 133.22 cfs @ 12.01 hrs, Volume= 12.643 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs / 4

Peak Elev= 1.67' Storage= 226 cf
Plug-Flow detention time=(not calculated: outflow precedes inflow)
Storage and wetted areas determined by Prismatic sections

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
0.00	135	0	0
4.00	135	540	540

Primary OutFlow (Free Discharge)
└─1=Orifice/Grate

#	Routing	Invert	Outlet Devices
1	Primary	0.00'	**72.0" Horiz. Orifice/Grate** Limited to weir flow C= 0.600

Pond DI3-1: Drop Inlet 3

Inflow = 114.80 cfs @ 12.01 hrs, Volume= 10.956 af
Outflow = 114.80 cfs @ 12.01 hrs, Volume= 10.956 af, Atten= 0%, Lag= 0.0 min
Primary = 114.80 cfs @ 12.01 hrs, Volume= 10.956 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Peak Elev= 1.55' Storage= 1 cf
Flood Elev= 3.00' Storage= 3 cf
Plug-Flow detention time=0.0 min calculated for 10.933 af (100% of inflow)
Storage and wetted areas determined by Prismatic sections

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
0.00	0	0	0
1.00	1	1	1
2.00	1	1	2

Primary OutFlow (Free Discharge)
└─1=Broad-Crested Rectangular Weir

#	Routing	Invert	Outlet Devices
1	Primary	0.00'	**18.0' long x 0.7' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 Coef. (English) 2.76 2.82 2.93 3.09 3.18 3.22 3.27 3.30 3.32 3.31 3.32

Pond DI3-2: Drop Inlet 3

Inflow = 114.80 cfs @ 12.01 hrs, Volume= 10.956 af
Outflow = 114.70 cfs @ 12.01 hrs, Volume= 10.956 af, Atten= 0%, Lag= 0.0 min
Primary = 114.70 cfs @ 12.01 hrs, Volume= 10.956 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs / 4

Peak Elev= 1.51' Storage= 204 cf
Plug-Flow detention time=(not calculated: outflow precedes inflow)
Storage and wetted areas determined by Prismatic sections

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
0.00	135	0	0
4.00	135	540	540

Primary OutFlow (Free Discharge)
└─1=Orifice/Grate

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Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 14.4 fps, Min. Travel Time= 0.3 min
Avg. Velocity = 4.2 fps, Avg. Travel Time= 1.2 min

Peak Depth= 0.34'
Capacity at bank full= 1,524.08 cfs
18.00' x 2.00' deep channel, n= 0.028 Length= 300.0' Slope= 0.3300 '/'

Reach D4-1: Downchute 4

Inflow = 38.83 cfs @ 11.99 hrs, Volume= 3.113 af
Outflow = 38.70 cfs @ 12.00 hrs, Volume= 3.110 af, Atten= 0%, Lag= 0.8 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 12.2 fps, Min. Travel Time= 0.4 min
Avg. Velocity = 3.3 fps, Avg. Travel Time= 1.5 min

Peak Depth= 0.27'
Capacity at bank full= 958.79 cfs
12.00' x 2.00' deep channel, n= 0.028 Length= 290.0' Slope= 0.3300 '/'

Reach D4-2: Downchute 4

Inflow = 60.30 cfs @ 11.97 hrs, Volume= 4.193 af
Outflow = 59.67 cfs @ 11.98 hrs, Volume= 4.192 af, Atten= 1%, Lag= 0.3 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 14.3 fps, Min. Travel Time= 0.2 min
Avg. Velocity = 3.7 fps, Avg. Travel Time= 0.6 min

Peak Depth= 0.35'
Capacity at bank full= 958.79 cfs
12.00' x 2.00' deep channel, n= 0.028 Length= 130.0' Slope= 0.3300 '/'

Reach D5-1: Downchute 5

Inflow = 102.12 cfs @ 12.13 hrs, Volume= 7.699 af
Outflow = 101.69 cfs @ 12.14 hrs, Volume= 7.696 af, Atten= 0%, Lag= 0.5 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 15.3 fps, Min. Travel Time= 0.3 min
Avg. Velocity = 4.0 fps, Avg. Travel Time= 1.0 min

Peak Depth= 0.37'
Capacity at bank full= 1,524.08 cfs
18.00' x 2.00' deep channel, n= 0.028 Length= 250.0' Slope= 0.3300 '/'

Reach D5-2: Downchute 5

Inflow = 110.89 cfs @ 12.10 hrs, Volume= 9.996 af
Outflow = 110.71 cfs @ 12.10 hrs, Volume= 9.993 af, Atten= 0%, Lag= 0.2 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 15.8 fps, Min. Travel Time= 0.2 min
Avg. Velocity = 4.4 fps, Avg. Travel Time= 0.7 min

Peak Depth= 0.39'
Capacity at bank full= 1,524.08 cfs
18.00' x 2.00' deep channel, n= 0.028 Length= 190.0' Slope= 0.3300 '/'

Reach D5-3: Downchute 5

Inflow = 157.62 cfs @ 12.00 hrs, Volume= 12.519 af
Outflow = 157.26 cfs @ 12.00 hrs, Volume= 12.517 af, Atten= 0%, Lag= 0.1 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 16.3 fps, Min. Travel Time= 0.1 min
Avg. Velocity = 4.3 fps, Avg. Travel Time= 0.4 min

Peak Depth= 0.40'
Capacity at bank full= 2,096.11 cfs
24.00' x 2.00' deep channel, n= 0.028 Length= 90.0' Slope= 0.3300 '/'

Reach D6-1: Downchute 6

Inflow = 23.24 cfs @ 12.13 hrs, Volume= 1.745 af
Outflow = 23.17 cfs @ 12.13 hrs, Volume= 1.745 af, Atten= 0%, Lag= 0.3 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 12.8 fps, Min. Travel Time= 0.2 min
Avg. Velocity = 3.5 fps, Avg. Travel Time= 0.6 min

Peak Depth= 0.30'
Capacity at bank full= 413.13 cfs
6.00' x 2.00' deep channel, n= 0.028 Length= 130.0' Slope= 0.3300 '/'

Reach D6-2: Downchute 6

Inflow = 45.10 cfs @ 11.97 hrs, Volume= 3.263 af
Outflow = 44.25 cfs @ 11.98 hrs, Volume= 3.261 af, Atten= 2%, Lag= 0.5 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 12.8 fps, Min. Travel Time= 0.3 min
Avg. Velocity = 3.4 fps, Avg. Travel Time= 1.0 min

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Peak Depth= 0.29'
Capacity at bank full= 958.79 cfs
12.00' x 2.00' deep channel, n= 0.028 Length= 200.0' Slope= 0.3300 '/'

Reach D6-3: Downchute 6

Inflow = 139.90 cfs @ 12.02 hrs, Volume= 11.321 af
Outflow = 138.01 cfs @ 12.03 hrs, Volume= 11.317 af, Atten= 1%, Lag= 0.4 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 15.4 fps, Min. Travel Time= 0.2 min
Avg. Velocity = 4.1 fps, Avg. Travel Time= 0.8 min

Peak Depth= 0.38'
Capacity at bank full= 2,096.11 cfs
24.00' x 2.00' deep channel, n= 0.028 Length= 200.0' Slope= 0.3300 '/'

Reach D7-1: Downchute 7

Inflow = 53.08 cfs @ 12.18 hrs, Volume= 4.523 af
Outflow = 53.03 cfs @ 12.19 hrs, Volume= 4.523 af, Atten= 0%, Lag= 0.2 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 13.8 fps, Min. Travel Time= 0.1 min
Avg. Velocity = 3.8 fps, Avg. Travel Time= 0.3 min

Peak Depth= 0.32'
Capacity at bank full= 958.79 cfs
12.00' x 2.00' deep channel, n= 0.028 Length= 70.0' Slope= 0.3300 '/'

Reach D7-2: Downchute 7

Inflow = 93.73 cfs @ 12.06 hrs, Volume= 7.740 af
Outflow = 93.54 cfs @ 12.06 hrs, Volume= 7.739 af, Atten= 0%, Lag= 0.2 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 14.8 fps, Min. Travel Time= 0.1 min
Avg. Velocity = 4.0 fps, Avg. Travel Time= 0.4 min

Peak Depth= 0.35'
Capacity at bank full= 1,524.08 cfs
18.00' x 2.00' deep channel, n= 0.028 Length= 90.0' Slope= 0.3300 '/'

Reach D8-1: Downchute 8

Inflow = 62.60 cfs @ 11.97 hrs, Volume= 4.383 af
Outflow = 61.51 cfs @ 11.98 hrs, Volume= 4.381 af, Atten= 2%, Lag= 0.6 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 14.6 fps, Min. Travel Time= 0.3 min
Avg. Velocity = 3.8 fps, Avg. Travel Time= 1.2 min

Peak Depth= 0.35'
Capacity at bank full= 958.79 cfs
12.00' x 2.00' deep channel, n= 0.028 Length= 270.0' Slope= 0.3300 '/'

Reach D9-1: Downchute 9

Inflow = 42.72 cfs @ 11.96 hrs, Volume= 3.207 af
Outflow = 41.89 cfs @ 11.96 hrs, Volume= 3.206 af, Atten= 2%, Lag= 0.4 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 12.6 fps, Min. Travel Time= 0.3 min
Avg. Velocity = 3.4 fps, Avg. Travel Time= 1.0 min

Peak Depth= 0.28'
Capacity at bank full= 958.79 cfs
12.00' x 2.00' deep channel, n= 0.028 Length= 200.0' Slope= 0.3300 '/'

Reach SW1-1: Swale Type I

Inflow = 44.36 cfs @ 12.15 hrs, Volume= 3.482 af
Outflow = 43.39 cfs @ 12.20 hrs, Volume= 3.475 af, Atten= 2%, Lag= 3.3 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 3.5 fps, Min. Travel Time= 1.8 min
Avg. Velocity = 1.4 fps, Avg. Travel Time= 4.4 min

Peak Depth= 0.69'
Capacity at bank full= 760.18 cfs
0.00' x 2.00' deep channel, n= 0.030 Length= 380.0' Slope= 0.0211 '/'
Side Slope Z-value= 3.0 50.0 '/'

Reach SW2-1: Swale Type II

Inflow = 17.45 cfs @ 12.03 hrs, Volume= 1.015 af
Outflow = 17.07 cfs @ 12.05 hrs, Volume= 1.014 af, Atten= 2%, Lag= 1.1 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 4.6 fps, Min. Travel Time= 0.7 min
Avg. Velocity = 1.1 fps, Avg. Travel Time= 2.9 min

Peak Depth= 0.29'
Capacity at bank full= 513.28 cfs
12.00' x 2.00' deep channel, n= 0.030 Length= 200.0' Slope= 0.0500 '/'
Side Slope Z-value= 3.0 '/'

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Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.9	90	0.3300	0.5		**Sheet Flow, Sideslope** Grass: Short n= 0.150 P2= 3.30"
2.2	920	0.0300	7.0	70.43	**Trap/Vee/Rect Channel Flow, Terrace** Bot.W=0.00' D=1.50' Z= 3.0 & 6.0 '/' n= 0.030
5.1	1,010	Total			

Subcatchment S9-1: Subcatchment 9

Runoff = 19.46 cfs @ 12.18 hrs, Volume= 1.645 af

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=7.40"

Area (ac)	CN	Description
4.520	74	>75% Grass cover, Good, HSG C

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
23.2	300	0.0200	0.2		**Sheet Flow, Landfill Top** Grass: Short n= 0.150 P2= 3.30"
0.5	120	0.3300	4.0		**Shallow Concentrated Flow, Top of Landfill** Short Grass Pasture Kv= 7.0 fps
0.9	370	0.0300	7.0	70.43	**Trap/Vee/Rect Channel Flow, Terrace** Bot.W=0.00' D=1.50' Z= 3.0 & 6.0 '/' n= 0.030
24.6	790	Total			

Subcatchment S9-2: Subcatchment 9

Runoff = 34.54 cfs @ 11.95 hrs, Volume= 1.562 af

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=7.40"

Area (ac)	CN	Description
4.270	74	>75% Grass cover, Good, HSG C

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.9	90	0.3300	0.5		**Sheet Flow, Sideslope** Grass: Short n= 0.150 P2= 3.30"
1.2	480	0.0300	7.0	70.43	**Trap/Vee/Rect Channel Flow, Terrace** Bot.W=0.00' D=1.50' Z= 3.0 & 6.0 '/' n= 0.030
4.1	570	Total			

Reach D1-1: Downchute 1

Inflow = 43.39 cfs @ 12.20 hrs, Volume= 3.475 af
Outflow = 43.31 cfs @ 12.20 hrs, Volume= 3.474 af, Atten= 0%, Lag= 0.2 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 12.8 fps, Min. Travel Time= 0.1 min
Avg. Velocity = 3.5 fps, Avg. Travel Time= 0.4 min

Peak Depth= 0.28'
Capacity at bank full= 958.79 cfs
12.00' x 2.00' deep channel, n= 0.028 Length= 90.0' Slope= 0.3300 '/'

Reach D1-2: Downchute 1

Inflow = 54.91 cfs @ 11.98 hrs, Volume= 5.329 af
Outflow = 54.71 cfs @ 11.99 hrs, Volume= 5.327 af, Atten= 0%, Lag= 0.5 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 13.9 fps, Min. Travel Time= 0.2 min
Avg. Velocity = 4.0 fps, Avg. Travel Time= 0.8 min

Peak Depth= 0.33'
Capacity at bank full= 958.79 cfs
12.00' x 2.00' deep channel, n= 0.028 Length= 190.0' Slope= 0.3300 '/'

Reach D1-3: Downchute 1

Inflow = 79.87 cfs @ 11.97 hrs, Volume= 6.545 af
Outflow = 79.34 cfs @ 11.97 hrs, Volume= 6.544 af, Atten= 1%, Lag= 0.2 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 13.8 fps, Min. Travel Time= 0.1 min
Avg. Velocity = 3.8 fps, Avg. Travel Time= 0.4 min

Peak Depth= 0.32'
Capacity at bank full= 1,524.08 cfs
18.00' x 2.00' deep channel, n= 0.028 Length= 90.0' Slope= 0.3300 '/'

Reach D10-1: Downchute 10

Inflow = 93.29 cfs @ 12.01 hrs, Volume= 6.736 af
Outflow = 92.44 cfs @ 12.01 hrs, Volume= 6.733 af, Atten= 1%, Lag= 0.4 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 17.1 fps, Min. Travel Time= 0.3 min
Avg. Velocity = 4.4 fps, Avg. Travel Time= 1.0 min

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Peak Depth= 0.45'
Capacity at bank full= 958.79 cfs
12.00' x 2.00' deep channel, n= 0.028 Length= 270.0' Slope= 0.3300 '/'

Reach D11-1: Downchute 11

Inflow = 44.64 cfs @ 12.01 hrs, Volume= 3.931 af
Outflow = 44.38 cfs @ 12.02 hrs, Volume= 3.928 af, Atten= 1%, Lag= 0.8 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 12.9 fps, Min. Travel Time= 0.5 min
Avg. Velocity = 3.6 fps, Avg. Travel Time= 1.8 min

Peak Depth= 0.29'
Capacity at bank full= 958.79 cfs
12.00' x 2.00' deep channel, n= 0.028 Length= 400.0' Slope= 0.3300 '/'

Reach D2-1: Downchute 2

Inflow = 17.07 cfs @ 12.05 hrs, Volume= 1.014 af
Outflow = 16.96 cfs @ 12.06 hrs, Volume= 1.013 af, Atten= 1%, Lag= 0.3 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 11.4 fps, Min. Travel Time= 0.2 min
Avg. Velocity = 2.9 fps, Avg. Travel Time= 0.8 min

Peak Depth= 0.25'
Capacity at bank full= 413.13 cfs
6.00' x 2.00' deep channel, n= 0.028 Length= 130.0' Slope= 0.3300 '/'

Reach D2-2: Downchute 2

Inflow = 67.63 cfs @ 12.15 hrs, Volume= 5.642 af
Outflow = 67.54 cfs @ 12.16 hrs, Volume= 5.641 af, Atten= 0%, Lag= 0.1 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 15.2 fps, Min. Travel Time= 0.1 min
Avg. Velocity = 4.1 fps, Avg. Travel Time= 0.3 min

Peak Depth= 0.37'
Capacity at bank full= 958.79 cfs
12.00' x 2.00' deep channel, n= 0.028 Length= 80.0' Slope= 0.3300 '/'

Reach D2-3: Downchute 2

Inflow = 100.64 cfs @ 12.16 hrs, Volume= 8.487 af
Outflow = 100.28 cfs @ 12.17 hrs, Volume= 8.484 af, Atten= 0%, Lag= 0.4 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 13.6 fps, Min. Travel Time= 0.2 min
Avg. Velocity = 3.7 fps, Avg. Travel Time= 0.8 min

Peak Depth= 0.31'
Capacity at bank full= 2,096.11 cfs
24.00' x 2.00' deep channel, n= 0.028 Length= 190.0' Slope= 0.3300 '/'

Reach D2-4: Downchute 2

Inflow = 106.69 cfs @ 12.16 hrs, Volume= 10.605 af
Outflow = 106.53 cfs @ 12.17 hrs, Volume= 10.604 af, Atten= 0%, Lag= 0.1 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 15.6 fps, Min. Travel Time= 0.1 min
Avg. Velocity = 4.5 fps, Avg. Travel Time= 0.3 min

Peak Depth= 0.38'
Capacity at bank full= 1,524.08 cfs
18.00' x 2.00' deep channel, n= 0.028 Length= 90.0' Slope= 0.3300 '/'

Reach D3-1: Downchute 3

Inflow = 9.02 cfs @ 12.08 hrs, Volume= 0.602 af
Outflow = 8.94 cfs @ 12.09 hrs, Volume= 0.601 af, Atten= 1%, Lag= 0.7 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 8.3 fps, Min. Travel Time= 0.4 min
Avg. Velocity = 2.3 fps, Avg. Travel Time= 1.6 min

Peak Depth= 0.18'
Capacity at bank full= 366.70 cfs
6.00' x 2.00' deep channel, n= 0.028 Length= 220.0' Slope= 0.2600 '/'

Reach D3-2: Downchute 3

Inflow = 51.55 cfs @ 12.18 hrs, Volume= 4.485 af
Outflow = 51.49 cfs @ 12.19 hrs, Volume= 4.484 af, Atten= 0%, Lag= 0.2 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 13.6 fps, Min. Travel Time= 0.1 min
Avg. Velocity = 3.8 fps, Avg. Travel Time= 0.3 min

Peak Depth= 0.31'
Capacity at bank full= 958.79 cfs
12.00' x 2.00' deep channel, n= 0.028 Length= 80.0' Slope= 0.3300 '/'

Reach D3-3: Downchute 3

Inflow = 87.82 cfs @ 12.18 hrs, Volume= 8.936 af
Outflow = 87.52 cfs @ 12.19 hrs, Volume= 8.931 af, Atten= 0%, Lag= 0.6 min

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Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.1	100	0.3300	0.5		**Sheet Flow, Side Slope** Grass: Short n= 0.150 P2= 3.30"
1.7	690	0.0300	7.0	70.43	**Trap/Vee/Rect Channel Flow, Terrace** Bot.W=0.00' D=1.50' Z= 3.0 & 6.0 '/' n= 0.030
4.8	790	Total			

Subcatchment S6-3: Subcatchment 6

Runoff = 51.57 cfs @ 11.97 hrs, Volume= 2.523 af

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=7.40"

Area (ac)	CN	Description
6.900	74	>75% Grass cover, Good, HSG C

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.1	100	0.3300	0.5		**Sheet Flow, Side Slope** Grass: Short n= 0.150 P2= 3.30"
1.8	740	0.0300	7.0	70.43	**Trap/Vee/Rect Channel Flow, Terrace** Bot.W=0.00' D=1.50' Z= 3.0 & 6.0 '/' n= 0.030
0.8	530	0.0300	11.0	397.58	**Trap/Vee/Rect Channel Flow, Swale Type II** Bot.W=12.00' D=2.00' Z= 3.0 '/' n= 0.030
0.3	200	0.0300	11.0	397.58	**Trap/Vee/Rect Channel Flow, Swale Type II** Bot.W=12.00' D=2.00' Z= 3.0 '/' n= 0.030
6.0	1,570	Total			

Subcatchment S6-4: Subcatchment 6

Runoff = 32.92 cfs @ 11.95 hrs, Volume= 1.518 af

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=7.40"

Area (ac)	CN	Description
4.150	74	>75% Grass cover, Good, HSG C

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.9	90	0.3300	0.5		**Sheet Flow, Top of Landfill** Grass: Short n= 0.150 P2= 3.30"
1.7	690	0.0300	7.0	70.43	**Trap/Vee/Rect Channel Flow, Terrace** Bot.W=0.00' D=1.50' Z= 3.0 & 6.0 '/' n= 0.030
4.6	780	Total			

Subcatchment S6-5: Subcatchment 6

Runoff = 23.24 cfs @ 12.13 hrs, Volume= 1.745 af

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=7.40"

Area (ac)	CN	Description
4.790	74	>75% Grass cover, Good, HSG C

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.1	300	0.0500	0.3		**Sheet Flow, Top of Landfill** Grass: Short n= 0.150 P2= 3.30"
2.7	250	0.0500	1.6		**Shallow Concentrated Flow, Top of Landfill** Short Grass Pasture Kv= 7.0 fps
0.3	70	0.3300	4.0		**Shallow Concentrated Flow, Sideslope** Short Grass Pasture Kv= 7.0 fps
0.9	380	0.0300	7.0	70.43	**Trap/Vee/Rect Channel Flow, Terrace** Bot.W=0.00' D=1.50' Z= 3.0 & 6.0 '/' n= 0.030
20.0	1,000	Total			

Subcatchment S6-6: Subcatchment 6

Runoff = 17.84 cfs @ 11.94 hrs, Volume= 0.801 af

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=7.40"

Area (ac)	CN	Description
2.190	74	>75% Grass cover, Good, HSG C

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.9	90	0.3300	0.5		**Sheet Flow, Sideslope** Grass: Short n= 0.150 P2= 3.30"
1.0	430	0.0300	7.0	70.43	**Trap/Vee/Rect Channel Flow, Terrace** Bot.W=0.00' D=1.50' Z= 3.0 & 6.0 '/' n= 0.030
3.9	520	Total			

Subcatchment S6-7: Subcatchment 6

Runoff = 18.43 cfs @ 12.20 hrs, Volume= 1.626 af

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=7.40"

Area (ac)	CN	Description
4.470	74	>75% Grass cover, Good, HSG C

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Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
23.2	300	0.0200	0.2		**Sheet Flow, Top of Landfill** Grass: Short n= 0.150 P2= 3.30"
1.7	220	0.0900	2.1		**Shallow Concentrated Flow, Top of Landfill** Short Grass Pasture Kv= 7.0 fps
1.5	630	0.0300	7.0	70.43	**Trap/Vee/Rect Channel Flow, Terrace** Bot.W=0.00' D=1.50' Z= 3.0 & 6.0 '/' n= 0.030
26.4	1,150	Total			

Subcatchment S6-8: Subcatchment 6

Runoff = 11.08 cfs @ 11.95 hrs, Volume= 0.505 af

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=7.40"

Area (ac)	CN	Description
1.380	74	>75% Grass cover, Good, HSG C

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.9	90	0.3300	0.5		**Sheet Flow, Top of Landfill** Grass: Short n= 0.150 P2= 3.30"
1.4	600	0.0300	7.0	70.43	**Trap/Vee/Rect Channel Flow, Perimeter Drainage Channel** Bot.W=0.00' D=1.50' Z= 3.0 & 6.0 '/' n= 0.030
4.3	690	Total			

Subcatchment S7-1: Subcatchment 7

Runoff = 53.08 cfs @ 12.18 hrs, Volume= 4.523 af

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=7.40"

Area (ac)	CN	Description
12.430	74	>75% Grass cover, Good, HSG C

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
23.2	300	0.0200	0.2		**Sheet Flow, Top of Landfill** Grass: Short n= 0.150 P2= 3.30"
0.1	30	0.3300	4.0		**Shallow Concentrated Flow, Sideslope** Short Grass Pasture Kv= 7.0 fps
1.6	670	0.0300	7.0	70.43	**Trap/Vee/Rect Channel Flow, Terrace** Bot.W=0.00' D=1.50' Z= 3.0 & 6.0 '/' n= 0.030
24.9	1,000	Total			

Subcatchment S7-2: Subcatchment 7

Runoff = 56.94 cfs @ 12.02 hrs, Volume= 3.218 af

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=7.40"

Area (ac)	CN	Description
8.810	74	>75% Grass cover, Good, HSG C

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.9	230	0.1300	0.4		**Sheet Flow, Top of Landfill** Grass: Short n= 0.150 P2= 3.30"
1.7	690	0.0300	7.0	70.43	**Trap/Vee/Rect Channel Flow, Terrace** Bot.W=0.00' D=1.50' Z= 3.0 & 6.0 '/' n= 0.030
10.6	920	Total			

Subcatchment S8-1: Subcatchment 8

Runoff = 22.13 cfs @ 12.19 hrs, Volume= 1.892 af

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=7.40"

Area (ac)	CN	Description
5.200	74	>75% Grass cover, Good, HSG C

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
23.2	300	0.0200	0.2		**Sheet Flow, Top of Landfill** Grass: Short n= 0.150 P2= 3.30"
0.1	30	0.3300	4.0		**Shallow Concentrated Flow, Sideslope** Short Grass Pasture Kv= 7.0 fps
1.8	740	0.0300	7.0	70.43	**Trap/Vee/Rect Channel Flow, Terrace** Bot.W=0.00' D=1.50' Z= 3.0 & 6.0 '/' n= 0.030
25.1	1,070	Total			

Subcatchment S8-2: Subcatchment 8

Runoff = 52.88 cfs @ 11.96 hrs, Volume= 2.491 af

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=7.40"

Area (ac)	CN	Description
6.810	74	>75% Grass cover, Good, HSG C

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Subcatchment S4-2: Subcatchment 4

Runoff = 21.67 cfs @ 11.95 hrs, Volume= 0.995 af

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=7.40"

Area (ac)	CN	Description
2.720	74	>75% Grass cover, Good, HSG C

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.9	90	0.3330	0.5		**Sheet Flow, Sideslope** Grass: Short n= 0.150 P2= 3.30"
1.6	650	0.0300	7.0	70.43	**Trap/Vee/Rect Channel Flow, Terrace** Bot.W=0.00' D=1.50' Z= 3.0 & 6.0 '/' n= 0.030
4.5	740	Total			

Subcatchment S4-3: Subcatchment 4

Runoff = 23.48 cfs @ 11.95 hrs, Volume= 1.083 af

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=7.40"

Area (ac)	CN	Description
2.960	74	>75% Grass cover, Good, HSG C

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.9	90	0.3300	0.5		**Sheet Flow, Sideslope** Grass: Short n= 0.150 P2= 3.30"
1.7	690	0.0300	7.0	70.43	**Trap/Vee/Rect Channel Flow, Terrace** Bot.W=0.00' D=1.50' Z= 3.0 & 6.0 '/' n= 0.030
4.6	780	Total			

Subcatchment S4-4: Subcatchment 4

Runoff = 29.37 cfs @ 11.99 hrs, Volume= 1.495 af

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=7.40"

Area (ac)	CN	Description
4.090	74	>75% Grass cover, Good, HSG C

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.1	60	0.3330	0.5		**Sheet Flow, Sideslope** Grass: Short n= 0.150 P2= 3.30"
0.2	50	0.0050	4.3	85.07	**Trap/Vee/Rect Channel Flow, Perimeter Drainage Channel** Bot.W=6.00' D=2.00' Z= 2.0 '/' n= 0.030
5.4	710	0.0050	2.2	0.43	**Circular Channel (pipe), Drain** Diam= 6.0" Area= 0.2 sf Perim= 1.6' r= 0.13' n= 0.012
7.7	820	Total			

Subcatchment S5-1: Subcatchment 5

Runoff = 28.93 cfs @ 12.08 hrs, Volume= 1.940 af

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=7.40"

Area (ac)	CN	Description
5.320	74	>75% Grass cover, Good, HSG C

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.1	300	0.0500	0.3		**Sheet Flow, Top of Landfill** Grass: Short n= 0.150 P2= 3.30"

Subcatchment S5-2: Subcatchment 5

Runoff = 47.39 cfs @ 12.14 hrs, Volume= 3.690 af

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=7.40"

Area (ac)	CN	Description
10.130	74	>75% Grass cover, Good, HSG C

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
14.4	260	0.0500	0.3		**Sheet Flow, Top of Landfill** Grass: Short n= 0.150 P2= 3.30"
7.0	900	0.0300	2.1	1.46	**Trap/Vee/Rect Channel Flow, Dike** Bot.W=0.00' D=0.25' Z= 2.0 & 20.0 '/' n= 0.030
21.4	1,160	Total			

Subcatchment S5-3: Subcatchment 5

Runoff = 26.96 cfs @ 12.14 hrs, Volume= 2.073 af

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=7.40"

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Area (ac)	CN	Description
5.690	74	>75% Grass cover, Good, HSG C

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.1	300	0.0500	0.3		**Sheet Flow, Top of Landfill** Grass: Short n= 0.150 P2= 3.30"
2.9	270	0.0500	1.6		**Shallow Concentrated Flow, Top of Landfill** Short Grass Pasture Kv= 7.0 fps
1.9	810	0.0300	7.0	70.43	**Trap/Vee/Rect Channel Flow, Terrace** Bot.W=0.00' D=1.50' Z= 3.0 & 6.0 '/' n= 0.030
20.9	1,380	Total			

Subcatchment S5-4: Subcatchment 5

Runoff = 48.21 cfs @ 11.96 hrs, Volume= 2.300 af

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=7.40"

Area (ac)	CN	Description
6.290	74	>75% Grass cover, Good, HSG C

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.4	110	0.3300	0.5		**Sheet Flow, Sideslope** Grass: Short n= 0.150 P2= 3.30"
2.0	820	0.0300	7.0	70.43	**Trap/Vee/Rect Channel Flow, Terrace** Bot.W=0.00' D=1.50' Z= 3.0 & 6.0 '/' n= 0.030
5.4	930	Total			

Subcatchment S5-5: Subcatchment 5

Runoff = 51.32 cfs @ 11.98 hrs, Volume= 2.526 af

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=7.40"

Area (ac)	CN	Description
6.910	74	>75% Grass cover, Good, HSG C

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.3	150	0.3300	0.6		**Sheet Flow, Sideslope** Grass: Short n= 0.150 P2= 3.30"
2.2	900	0.0300	7.0	70.43	**Trap/Vee/Rect Channel Flow, Terrace** Bot.W=0.00' D=1.50' Z= 3.0 & 6.0 '/' n= 0.030
6.5	1,050	Total			

Subcatchment S5-6: Subcatchment 5

Runoff = 42.76 cfs @ 11.99 hrs, Volume= 2.157 af

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=7.40"

Area (ac)	CN	Description
5.900	74	>75% Grass cover, Good, HSG C

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.8	50	0.3300	0.5		**Sheet Flow, Sideslope** Grass: Short n= 0.150 P2= 3.30"
0.2	50	0.0050	4.3	85.07	**Trap/Vee/Rect Channel Flow, Perimeter Drainage Channel** Bot.W=6.00' D=2.00' Z= 2.0 '/' n= 0.030
5.4	710	0.0050	2.2	0.43	**Circular Channel (pipe), Drain** Diam= 6.0" Area= 0.2 sf Perim= 1.6' r= 0.13' n= 0.012
7.4	810	Total			

Subcatchment S6-1: Subcatchment 6

Runoff = 38.30 cfs @ 12.13 hrs, Volume= 2.907 af

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=7.40"

Area (ac)	CN	Description
7.980	74	>75% Grass cover, Good, HSG C

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.1	300	0.0500	0.3		**Sheet Flow, Top of Landfill** Grass: Short n= 0.150 P2= 3.30"
2.9	270	0.0500	1.6		**Shallow Concentrated Flow, Top of Landfill** Short Grass Pasture Kv= 7.0 fps
1.4	580	0.0300	7.0	70.43	**Trap/Vee/Rect Channel Flow, Terrace** Bot.W=0.00' D=1.50' Z= 3.0 & 6.0 '/' n= 0.030
20.4	1,150	Total			

Subcatchment S6-2: Subcatchment 6

Runoff = 22.03 cfs @ 11.95 hrs, Volume= 1.024 af

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=7.40"

Area (ac)	CN	Description
2.800	74	>75% Grass cover, Good, HSG C

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Subcatchment S2-4: Subcatchment 2

Runoff = 33.34 cfs @ 12.18 hrs, Volume= 2.846 af

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=7.40"

Area (ac)	CN	Description
7.820	74	>75% Grass cover, Good, HSG C

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
23.2	300	0.0200	0.2		**Sheet Flow, Top of Landfill** Grass: Short n= 0.150 P2= 3.30"
1.8	760	0.0300	7.0	70.43	**Trap/Vee/Rect Channel Flow, Terrace** Bot.W=0.00' D=1.50' Z= 3.0 & 6.0 '/' n= 0.030
25.0	1,060	Total			

Subcatchment S2-5: Subcatchment 2

Runoff = 45.82 cfs @ 11.95 hrs, Volume= 2.122 af

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=7.40"

Area (ac)	CN	Description
5.800	74	>75% Grass cover, Good, HSG C

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.9	90	0.3300	0.5		**Sheet Flow, Sideslope** Grass: Short n= 0.150 P2= 3.30"
1.8	760	0.0300	7.0	70.43	**Trap/Vee/Rect Channel Flow, Terrace** Bot.W=0.00' D=1.50' Z= 3.0 & 6.0 '/' n= 0.030
4.7	850	Total			

Subcatchment S2-6: Subcatchment 2

Runoff = 39.00 cfs @ 12.00 hrs, Volume= 2.039 af

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=7.40"

Area (ac)	CN	Description
5.580	74	>75% Grass cover, Good, HSG C

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.9	90	0.3300	0.5		**Sheet Flow, Sideslope** Grass: Short n= 0.150 P2= 3.30"
0.2	50	0.0050	4.3	85.07	**Trap/Vee/Rect Channel Flow, Perimeter Drainage Channel** Bot.W=6.00' D=2.00' Z= 2.0 '/' n= 0.030
5.4	710	0.0050	2.2	0.43	**Circular Channel (pipe), Drain** Diam= 6.0" Area= 0.2 sf Perim= 1.6' r= 0.13' n= 0.012
8.5	850	Total			

Subcatchment S3-1: Subcatchment 3

Runoff = 9.02 cfs @ 12.08 hrs, Volume= 0.602 af

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=7.40"

Area (ac)	CN	Description
1.650	74	>75% Grass cover, Good, HSG C

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.4	60	0.0500	0.2		**Sheet Flow, Top of Landfill** Grass: Short n= 0.150 P2= 3.30"
11.5	710	0.0070	1.0	0.71	**Trap/Vee/Rect Channel Flow, Dike** Bot.W=0.00' D=0.25' Z= 2.0 & 20.0 '/' n= 0.030
15.9	770	Total			

Subcatchment S3-2: Subcatchment 3

Runoff = 24.75 cfs @ 12.10 hrs, Volume= 1.757 af

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=7.40"

Area (ac)	CN	Description
4.820	74	>75% Grass cover, Good, HSG C

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.1	300	0.0500	0.3		**Sheet Flow, Top of Landfill** Grass: Short n= 0.150 P2= 3.30"
0.2	40	0.3300	4.0		**Shallow Concentrated Flow, Side slope** Short Grass Pasture Kv= 7.0 fps
1.8	770	0.0300	7.0	70.43	**Trap/Vee/Rect Channel Flow, Terrace** Bot.W=0.00' D=1.50' Z= 3.0 & 6.0 '/' n= 0.030
18.1	1,110	Total			

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Subcatchment S3-3: Subcatchment 3

Runoff = 22.74 cfs @ 12.23 hrs, Volume= 2.137 af

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=7.40"

Area (ac)	CN	Description
5.880	74	>75% Grass cover, Good, HSG C

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.4	70	0.3300	0.5		**Sheet Flow, Top of Landfill** Grass: Short n= 0.150 P2= 3.30"
11.6	200	0.0500	0.3		**Sheet Flow, Top of Landfill** Grass: Short n= 0.150 P2= 3.30"
15.2	790	0.0050	0.9	0.60	**Trap/Vee/Rect Channel Flow, Dike** Bot.W=0.00' D=0.25' Z= 2.0 & 20.0 '/' n= 0.030
29.2	1,060	Total			

Subcatchment S3-4: Subcatchment 3

Runoff = 30.94 cfs @ 12.19 hrs, Volume= 2.645 af

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=7.40"

Area (ac)	CN	Description
7.220	74	>75% Grass cover, Good, HSG C

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
23.2	300	0.0200	0.2		**Sheet Flow, Top of Landfill** Grass: Short n= 0.150 P2= 3.30"
1.9	800	0.0300	7.0	70.43	**Trap/Vee/Rect Channel Flow, Terrace** Bot.W=0.00' D=1.50' Z= 3.0 & 6.0 '/' n= 0.030
25.1	1,100	Total			

Subcatchment S3-5: Subcatchment 3

Runoff = 38.86 cfs @ 11.95 hrs, Volume= 1.807 af

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=7.40"

Area (ac)	CN	Description
4.940	74	>75% Grass cover, Good, HSG C

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.9	90	0.3300	0.5		**Sheet Flow, Sideslope** Grass: Short n= 0.150 P2= 3.30"
1.9	800	0.0300	7.0	70.43	**Trap/Vee/Rect Channel Flow, Terrace** Bot.W=0.00' D=1.50' Z= 3.0 & 6.0 '/' n= 0.030
4.8	890	Total			

Subcatchment S3-6: Subcatchment 3

Runoff = 38.44 cfs @ 12.00 hrs, Volume= 2.024 af

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=7.40"

Area (ac)	CN	Description
5.540	74	>75% Grass cover, Good, HSG C

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.9	90	0.3300	0.5		**Sheet Flow, Sideslope** Grass: Short n= 0.150 P2= 3.30"
0.2	50	0.0050	4.3	85.07	**Trap/Vee/Rect Channel Flow, Perimeter Drainage Channel** Bot.W=6.00' D=2.00' Z= 2.0 '/' n= 0.030
5.6	740	0.0050	2.2	0.43	**Circular Channel (pipe), Drain** Diam= 6.0" Area= 0.2 sf Perim= 1.6' r= 0.13' n= 0.012
8.7	880	Total			

Subcatchment S4-1: Subcatchment 4

Runoff = 29.23 cfs @ 12.11 hrs, Volume= 2.118 af

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=7.40"

Area (ac)	CN	Description
5.810	74	>75% Grass cover, Good, HSG C

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.1	300	0.0500	0.3		**Sheet Flow, Top of Landfill** Grass: Short n= 0.150 P2= 3.30"
1.4	130	0.0500	1.6		**Shallow Concentrated Flow, Top of Landfill** Short Grass Pasture Kv= 7.0 fps
0.1	30	0.3300	4.0		**Shallow Concentrated Flow, Side Slope** Short Grass Pasture Kv= 7.0 fps
1.2	500	0.0300	7.0	70.43	**Trap/Vee/Rect Channel Flow, Terrace** Bot.W=0.00' D=1.50' Z= 3.0 & 6.0 '/' n= 0.030
18.8	960	Total			

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Subcatchment S1-1: Subcatchment 1

Runoff = 44.36 cfs @ 12.15 hrs, Volume= 3.482 af

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=7.40"

Area (ac)	CN	Description
9.560	74	>75% Grass cover, Good, HSG C

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.1	300	0.0500	0.3		**Sheet Flow, Top of Landfill** Grass: Short n= 0.150 P2= 3.30"
1.6	150	0.0500	1.6		**Shallow Concentrated Flow, Top of Landfill** Short Grass Pasture Kv= 7.0 fps
0.4	90	0.3300	4.0		**Shallow Concentrated Flow, Side Slope** Short Grass Pasture Kv= 7.0 fps
3.6	380	0.0200	1.7	2.89	**Trap/Vee/Rect Channel Flow, Swale Type I** Bot.W=0.00' D=0.25' Z= 3.0 & 50.0 '/' n= 0.030
21.7	920	Total			

Subcatchment S1-2: Subcatchment 1

Runoff = 15.29 cfs @ 11.96 hrs, Volume= 0.717 af

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=7.40"

Area (ac)	CN	Description
1.960	74	>75% Grass cover, Good, HSG C

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.9	90	0.3300	0.5		**Sheet Flow, Sideslope** Grass: Short n= 0.150 P2= 3.30"
2.1	880	0.0300	7.0	70.43	**Trap/Vee/Rect Channel Flow, Terrace** Bot.W=0.00' D=1.50' Z= 3.0 & 6.0 '/' n= 0.030
5.0	970	Total			

Subcatchment S1-3: Subcatchment 1

Runoff = 24.25 cfs @ 11.96 hrs, Volume= 1.137 af

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=7.40"

Area (ac)	CN	Description
3.110	74	>75% Grass cover, Good, HSG C

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.9	90	0.3300	0.5		**Sheet Flow, Sideslope** Grass: Short n= 0.150 P2= 3.30"
2.1	880	0.0300	7.0	70.43	**Trap/Vee/Rect Channel Flow, Terrace** Bot.W=0.00' D=1.50' Z= 3.0 & 6.0 '/' n= 0.030
5.0	970	Total			

Subcatchment S1-4: Subcatchment 1

Runoff = 26.08 cfs @ 11.95 hrs, Volume= 1.218 af

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=7.40"

Area (ac)	CN	Description
3.330	74	>75% Grass cover, Good, HSG C

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.9	90	0.3300	0.5		**Sheet Flow, Sideslope** Grass: Short n= 0.150 P2= 3.30"
2.0	830	0.0300	7.0	70.43	**Trap/Vee/Rect Channel Flow, Terrace** Bot.W=0.00' D=1.50' Z= 3.0 & 6.0 '/' n= 0.030
4.9	920	Total			

Subcatchment S1-5: Subcatchment 1

Runoff = 44.01 cfs @ 12.01 hrs, Volume= 2.433 af

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=7.40"

Area (ac)	CN	Description
6.660	74	>75% Grass cover, Good, HSG C

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.1	140	0.3300	0.6		**Sheet Flow, Sideslope** Grass: Short n= 0.150 P2= 3.30"
0.2	50	0.0050	4.3	85.07	**Trap/Vee/Rect Channel Flow, Perimeter Drianage Channel** Bot.W=6.00' D=2.00' Z= 2.0 '/' n= 0.030
5.7	750	0.0050	2.2	0.43	**Circular Channel (pipe), Drain** Diam= 6.0" Area= 0.2 sf Perim= 1.6' r= 0.13' n= 0.012
10.0	940	Total			

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FSS 3/26/03
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Subcatchment S10-1: Subcatchment 10

Runoff = 52.44 cfs @ 12.12 hrs, Volume= 3.877 af

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=7.40"

Area (ac)	CN	Description
10.640	74	>75% Grass cover, Good, HSG C

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.1	300	0.0500	0.3		**Sheet Flow, Top of Landfill** Grass: Short n= 0.150 P2= 3.30"
1.8	270	0.1300	2.5		**Shallow Concentrated Flow, Sideisope** Short Grass Pasture Kv= 7.0 fps
1.6	660	0.0300	7.0	70.43	**Trap/Vee/Rect Channel Flow, Terrace** Bot.W=0.00' D=1.50' Z= 3.0 & 6.0 '/' n= 0.030
19.5	1,230	Total			

Subcatchment S10-2: Subcatchment 10

Runoff = 57.64 cfs @ 11.98 hrs, Volume= 2.859 af

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=7.40"

Area (ac)	CN	Description
7.820	74	>75% Grass cover, Good, HSG C

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.9	130	0.3300	0.6		**Sheet Flow, Landfill Sideslope** Grass: Short n= 0.150 P2= 3.30"
2.9	750	0.0050	4.3	85.07	**Trap/Vee/Rect Channel Flow, Perimeter Channel** Bot.W=6.00' D=2.00' Z= 2.0 '/' n= 0.030
6.8	880	Total			

Subcatchment S2-1: Subcatchment 2

Runoff = 17.45 cfs @ 12.03 hrs, Volume= 1.015 af

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=7.40"

Area (ac)	CN	Description
2.780	74	>75% Grass cover, Good, HSG C

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.6	200	0.0500	0.3		**Sheet Flow, Top of Landfill** Grass: Short n= 0.150 P2= 3.30"

Subcatchment S2-2: Subcatchment 2

Runoff = 35.12 cfs @ 12.10 hrs, Volume= 2.493 af

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=7.40"

Area (ac)	CN	Description
6.840	74	>75% Grass cover, Good, HSG C

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.1	300	0.0500	0.3		**Sheet Flow, Top of Landfill** Grass: Short n= 0.150 P2= 3.30"
0.2	40	0.3300	4.0		**Shallow Concentrated Flow, Sideslope** Short Grass Pasture Kv= 7.0 fps
1.8	770	0.0300	7.0	70.43	**Trap/Vee/Rect Channel Flow, Terrace** Bot.W=0.00' D=1.50' Z= 3.0 & 6.0 '/' n= 0.030
18.1	1,110	Total			

Subcatchment S2-3: Subcatchment 2

Runoff = 22.97 cfs @ 12.23 hrs, Volume= 2.148 af

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=7.40"

Area (ac)	CN	Description
5.910	74	>75% Grass cover, Good, HSG C

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.4	70	0.3300	0.5		**Sheet Flow, Sideslope** Grass: Short n= 0.150 P2= 3.30"
11.6	200	0.0500	0.3		**Sheet Flow, Top of Landfill** Grass: Short n= 0.150 P2= 3.30"
15.0	780	0.0050	0.9	0.60	**Trap/Vee/Rect Channel Flow, Dike** Bot.W=0.00' D=0.25' Z= 2.0 & 20.0 '/' n= 0.030
29.0	1,050	Total			

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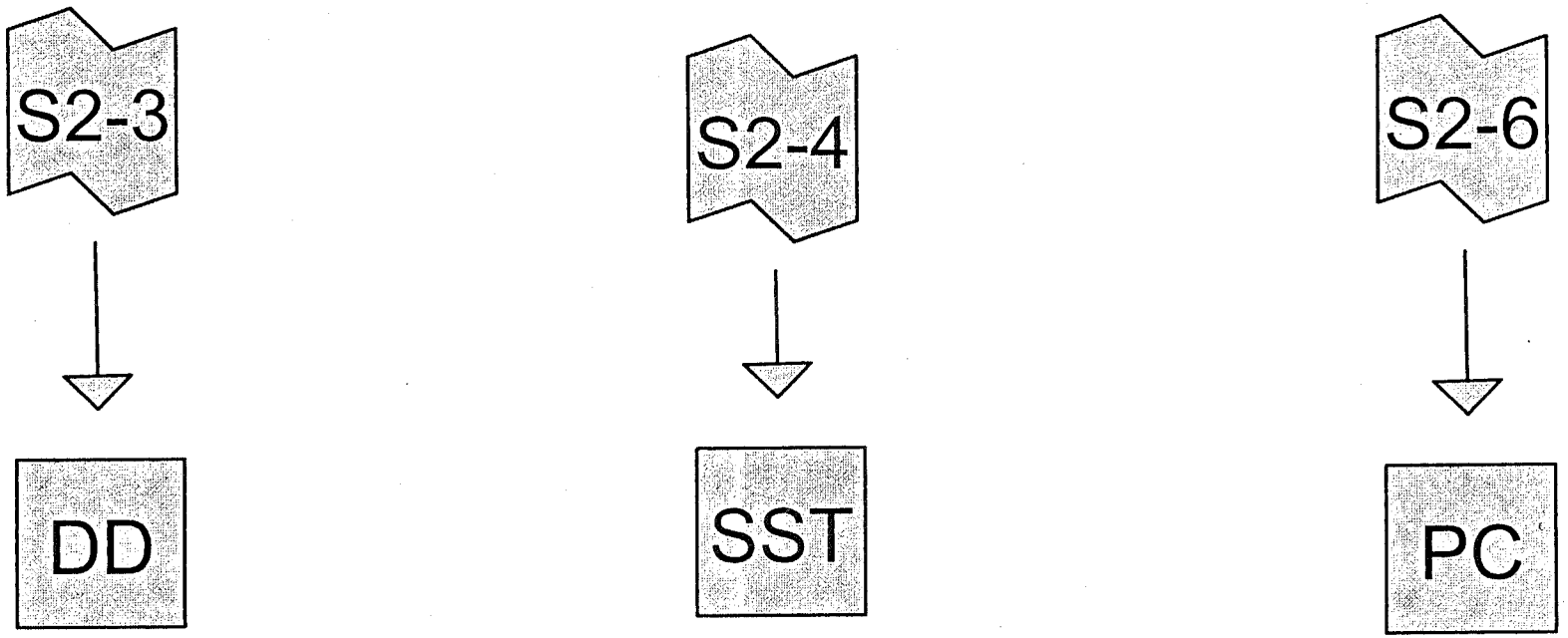
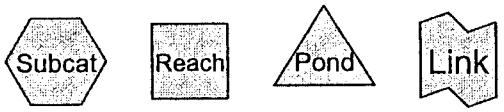


ATTACHMENT 2-2



Drainage Diagram for Terrace Channel Dike Design
Prepared by GeoSyntec Consultants 3/19/2003
HydroCAD® 6.00 s/n 000663 © 1986-2001 Applied Microcomputer Systems

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CWM3 3/26/03 4/21

Appendix VIb-I.4

Sideslope Terraces, Swales, and Perimeter Drainage Channels Design

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GEOSYNTEC CONSULTANTS

COMPUTATION COVER SHEET

lient: DSWA **Project:** Cherry Island Landfill **Project/Proposal #:** ME0250 **Task #:** 2.9.2

TITLE OF COMPUTATIONS **APPENDIX VIb-I.4: SIDESLOPE TERRACES, SWALES, AND PERIMETER DRAINAGE CHANNEL DESIGN**

COMPUTATIONS BY:
Signature
26 March 2003
DATE
Printed Name and Title: William M. Steier, P.E. Project Engineer

ASSUMPTIONS AND PROCEDURES CHECKED BY:
(Peer Reviewer)
Signature
26 March 2003
DATE
Printed Name and Title: Eric. S. Steinhauser, P.E. Associate

COMPUTATIONS CHECKED BY:
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26 March 2003
DATE
Printed Name and Title: Eric. S. Steinhauser, P.E. Associate

COMPUTATIONS BACKCHECKED BY:
(Originator)
Signature
26 March 2003
DATE
Printed Name and Title: William M. Steier, P.E. Project Engineer

APPROVED BY:
(PM or Designate)
Signature
29 March 2003
DATE
Printed Name and Title: David Espinoza, P.E. Senior Engineer

APPROVAL NOTES: The calculations presented herein are suitable for a landfill elevation of 195 ft-msl. As shown in this calculation package, the design was performed for a more conservative grading configuration than that shown in Drawing 78 entitled "Landfill Final Development and Grading Plan" (Appendix VIb-A).

RDE 6/10/04

REVISIONS (Number and initial all revisions)

NO.	SHEET	DATE	BY	CHECKED BY	APPROVAL

APPENDIX VIb-I.4
SIDESLOPE TERRACES, SWALES, AND PERIMETER DRAINAGE CHANNEL DESIGN

PURPOSE

The purpose of this calculation package is to: (i) verify that the proposed geometry of the various stormwater management features of the Cherry Island Landfill (CIL) final cover system are sufficiently sized to convey the design discharge; and (ii) select the appropriate lining material of these features. The stormwater management features to be designed include: (i) sideslope terraces (SST); (ii) swales (SW); and (iii) perimeter drainage channels (PC). Each of these features will be designed to convey the peak discharge from the 100-year, 24-hour design storm, and withstand the erosive forces from the peak discharge of the 25-year, 24-hour design storm.

METHOD

The peak discharge values for the 25 and 100-year, 24-hour design storms for the various stormwater management features are provided in Appendices VIb-I.2 and VIb-I.3, respectively. The peak discharge values were calculated using *HydroCAD® Stormwater Modeling System*", version 6 [Applied Microcomputer Systems, 2001] (HydroCAD®).

Each of the final cover system stormwater management features is designed as either a triangular or trapezoidal channel. The allowable discharge in each feature was calculated using Manning's equation [Chow, 1959] expressed as:

$$Q = \frac{1.49}{n} A R^{2/3} S^{1/2} \qquad (1)$$

where: Q = discharge (ft^3/sec);
n = Manning's roughness coefficient (dimensionless);
A = area of cross-section of flow (ft^2);
R = hydraulic radius = $\frac{A}{P}$;
P = wetted perimeter (ft.); and
S = longitudinal slope of the channel (ft/ft).

The velocity (V) of the flow in a channel may be calculated as follows:

$$V = \frac{Q}{A} \qquad (2)$$

The erosive force in the channels is related to the tractive stresses imposed by the force of the flowing water. The tractive force in the channel at normal flow depth was calculated using the following equation [Chow, 1959].

$$\tau = \gamma R S \qquad (3)$$

where: τ = tractive stress (lb/ft^2);
γ = unit weight of water = 62.4 (lb/ft^3);
R = hydraulic radius of flow cross-section (ft.); and
S = longitudinal slope of the channel (ft/ft).

CALCULATION PARAMETERS

The individual calculation parameters used for analysis of each stormwater feature are summarized in Attachment 1. Design discharges are obtained from Appendixes VIb-I.2 and VIb-I.3, and minimum channel slopes and depths are obtained from Appendix VIb-I.2 and drawings. For post-development conditions, the Manning roughness coefficient is based on vegetated erosion control mat, n = 0.03 (see Attachment 2).

CALCULATION

The required geometry of the various stormwater management features was based on the peak discharge resulting from the 100-year, 24-hour design storm, calculated using Equation 1. The selection of channel lining material is based on: (i) the peak discharge flow velocity resulting from the 25-year, 24-hour design storm, calculated using Equation 2; and (ii) the tractive stresses calculated for the 25-year, 24-hour design storm using Equation 3.

RESULTS

Attachment 3 summarizes the peak discharge and the resulting geometry for the various stormwater management features, including the minimum freeboard, based on the 100-year, 24-hour design storm. Based on the information presented in Attachment 3, the minimum available freeboard is 0.36 ft.

Attachment 4 summarizes the peak discharge flow velocities, tractive stresses, and the selected channel lining materials. Based on the results presented in Attachment 4, the range of velocities is from 3.1 to 5.3 ft/sec. In addition, the range of tractive stresses is from 0.3 to 0.9 lb/ft^2. The selected erosion control mat lining for all the stormwater management features must have an ultimate velocity of two times the maximum calculated velocity, and an ultimate tractive stress of two times the maximum calculated tractive stress. Erosion control mats may be constructed of ultraviolet degradable material or ultraviolet non-degradable material.

REFERENCES

Applied Microcomputer Systems, "*HydroCAD® Stormwater Modeling System*", Version 6, Chocorua, New Hampshire 2002.

Chow, V.T., *Open Channel-Hydraulics*. New York: McGraw-Hill, 1959.

Delaware Department of Natural Resources, *Delaware Erosion and Sediment Control Handbook*, Dover, Delaware, 1989.

ATTACHMENT - 1

CALCULATION PARAMETERS FOR DESIGN OF DIVERSION DIKES SIDESLOPE TERRACES, SWALES

Channel ID[1]	Peak Discharge[2] Q_{100} (ft^3/sec)	Peak Discharge[3] Q_{25} (ft3/sec)	Minimum Slope of Channel[4] S (ft/ft)	Manning's Roughness[5] n	Channel Cross-Section				Channel Lining[6]
					Bottom Width b (ft.)	Side Slope (Left) z (H: 1V)	Side Slope (Right) z (H: 1V)	Available Depth D (ft.)	
SW1-1	44.4	30.4	0.02	0.03	0	3	50	2	ECM
SW2-1	17.5	12.1	0.05	0.03	12	3	3	2	ECM
SW2-2	69.0	47.4	0.02	0.03	12	3	3	2	ECM
SW3-1	52.5	36.0	0.02	0.03	12	3	3	2	ECM
SW5-1	28.9	19.9	0.05	0.03	12	3	3	2	ECM
SW6-1	94.2	64.6	0.012	0.03	12	3	3	2	ECM
DD (Typ)	23.0	15.7	0.05	0.03	0	50	2	1.5	ECM
SST (Typ)	33.3	22.9	0.03	0.03	0	3	6	1.5	ECM
PC (Typ)	39.0	27.0	0.005	0.03	6	2	2	2	ECM

NOTES

1. Designation of the channel is from Schematic Plan presented in the Appendix VIb-I.2.
2. Peak discharge for the 100-year, 24-hour design storm is presented in Appendix VIb-I.3.
3. Peak discharge for the 25-year, 24-hour design storm is presented in Appendix VIb-I.2.
4. Minimum slope information is taken from drawings and Appendix VIb-I.2.
5. Manning's n used in the calculations is 0.03 for vegetated erosion control mat lining.
6. ECM - Erosion Control Mat

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WMS 3/26/03 ASS 3/26/03

ATTACHMENT - 2

Manning Roughness Coefficient Reference

VALUES OF THE ROUGHNESS COEFFICIENT n (*continued*)

Type of channel and description	Minimum	Normal	Maximum
C. EXCAVATED OR DREDGED			
a. Earth, straight and uniform			
1. Clean, recently completed	0.016	0.018	0.020
2. Clean, after weathering	0.018	0.022	0.025
3. Gravel, uniform section, clean	0.022	0.025	0.030
4. With short grass, few weeds	0.022	0.027	0.033
b. Earth, winding and sluggish			
1. No vegetation	0.023	0.025	0.030
2. Grass, some weeds	0.025	0.030	0.033
3. Dense weeds or aquatic plants in deep channels	0.030	0.035	0.040
4. Earth bottom and rubble sides	0.028	0.030	0.035
5. Stony bottom and weedy banks	0.025	0.035	0.040
6. Cobble bottom and clean sides	0.030	0.040	0.050
c. Dragline-excavated or dredged			
1. No vegetation	0.025	0.028	0.033
2. Light brush on banks	0.035	0.050	0.060
d. Rock cuts			
1. Smooth and uniform	0.025	0.035	0.040
2. Jagged and irregular	0.035	0.040	0.050
e. Channels not maintained, weeds and brush uncut			
1. Dense weeds, high as flow depth	0.050	0.080	0.120
2. Clean bottom, brush on sides	0.040	0.050	0.080
3. Same, highest stage of flow	0.045	0.070	0.110
4. Dense brush, high stage	0.080	0.100	0.140
D. NATURAL STREAMS			
D-1. Minor streams (top width at flood stage <100 ft)			
a. Streams on plain			
1. Clean, straight, full stage, no rifts or deep pools	0.025	0.030	0.033
2. Same as above, but more stones and weeds	0.030	0.035	0.040
3. Clean, winding, some pools and shoals	0.033	0.040	0.045
4. Same as above, but some weeds and stones	0.035	0.045	0.050
5. Same as above, lower stages, more ineffective slopes and sections	0.040	0.048	0.055
6. Same as 4, but more stones	0.045	0.050	0.060
7. Sluggish reaches, weedy, deep pools	0.050	0.070	0.080
8. Very weedy reaches, deep pools, or floodways with heavy stand of timber and underbrush	0.075	0.100	0.150

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ATTACHMENT - 3
ANALYSIS OF CHANNEL GEOMETRY
100-YEAR DESIGN STORM

Channel ID[1]	Peak Discharge[2] Q_{100} (ft3/sec)	Available Depth D (ft.)	Depth at Peak Discharge (ft.)	Freeboard Depth (ft.)	Channel Lining[3]
SW1-1	44.4	2	0.70	1.30	ECM
SW2-1	17.5	2	0.30	1.70	ECM
SW2-2	69.0	2	0.84	1.16	ECM
SW3-1	52.5	2	0.72	1.28	ECM
SW5-1	28.9	2	0.40	1.60	ECM
SW6-1	94.2	2	1.16	0.84	ECM
DD (Typ)	23.0	1.5	0.47	1.03	ECM
SST (Typ)	33.3	1.5	1.14	0.36	ECM
PC (Typ)	39.0	2	1.33	0.67	ECM

NOTES

1. Designation of the channel on Schematic Plan presented in the Appendix VIb-I.2.
2. Peak discharge for the 100-year, 24-hour design storm is presented in Appendix VIb-I.3.
3. ECM - Erosion Control Mat

WMB 3/26/03
SSS 3/26/03

ATTACHMENT - 4
ANALYSIS OF CHANNEL LINING TRACTIVE STRESS AND VELOCITY - SUMMARY

Channel ID[1]	Peak Discharge[2] Q_{25} (ft^3/sec)	Available Depth D (ft^3/sec)	Depth of Flow at Peak Q_{25}[3] Y (ft/ft)	Average Velocity[4] V	Max Tractive Stress[5] τ (ft.)	Channel Lining[6] (H: 1V)
SW1-1	30.4	2	0.61	3.17	0.38	ECM
SW2-1	12.1	2	0.23	4.01	0.68	ECM
SW2-2	47.4	2	0.69	4.96	0.74	ECM
SW3-1	36.0	2	0.59	4.52	0.64	ECM
SW5-1	19.9	2	0.31	4.83	0.90	ECM
SW6-1	64.6	2	0.95	4.62	0.59	ECM
DD (Typ)	15.7	1.5	0.39	3.72	0.61	ECM
SST (Typ)	22.9	1.5	0.99	5.29	0.90	ECM
PC (Typ)	27.0	2	1.09	3.08	0.26	ECM

NOTES

1. Designation of the channel on Schematic Plan presented in Appendix VIb.-I.2.
2. Peak discharge from Appendix VIb.-I.2.
3. Y is a function of the cross sectional flow area, A, defined by solution to Equation 1.
4. From Equation 2.
5. From Equation 3.
6. ECM - Erosion Control Mat

Appendix VIb-I.5

Downchute Geometric Design

GEOSYNTEC CONSULTANTS

COMPUTATION COVER SHEET

lient: DSWA **Project:** Cherry Island Landfill **Project/Proposal #:** ME0250 **Task #:** 2.9.2

TITLE OF COMPUTATIONS **APPENDIX VIb-I.5: DOWNCHUTE GEOMETRIC DESIGN**

COMPUTATIONS BY:
Signature
Printed Name and Title: William M. Steier, P.E. — Project Engineer
26 March 2003 DATE

ASSUMPTIONS AND PROCEDURES CHECKED BY:
(Peer Reviewer)
Signature
Printed Name and Title: Eric. S. Steinhauser, P.E. — Associate
26 March 2003 DATE

COMPUTATIONS CHECKED BY:
Signature
Printed Name and Title: Eric. S. Steinhauser, P.E. — Associate
26 March 2003 DATE

OMPUTATIONS BACKCHECKED BY:
(Originator)
Signature
Printed Name and Title: William M. Steier, P.E. — Project Engineer
26 March 2003 DATE

APPROVED BY:
(PM or Designate)
Signature
Printed Name and Title: David Espinoza, P.E. — Senior Engineer
3/31/03 DATE

APPROVAL NOTES: The calculations presented herein are suitable for a landfill elevation of 195 ft-msl. As shown in this calculation package, the design was performed for a more conservative grading configuration than that shown in Drawing 78 entitled "Landfill Final Development and Grading Plan" (Appendix VIb-A).

REVISIONS (Number and initial all revisions)

NO.	SHEET	DATE	BY	CHECKED BY	APPROVAL

APPENDIX VIb-I.5
DOWNCHUTE GEOMETRIC DESIGN

PURPOSE

The purpose of this calculation package is to verify the proposed geometry of the downchutes for the final cover system of the Cherry Island Landfill. Downchutes will convey stormwater runoff from a series of swales and side slope terraces to drop inlet structures located at the perimeter of the landfill. As the contributing drainage area to the downchute increases, the width of the downchute will increase accordingly. Because of the landfill slope will be inclined at 3 horizontal to 1 vertical (3H:1V), a series of steps along the downchute are planned to dissipate energy and reduce flow velocity. The proposed downchutes will be constructed using a combination of revert mattresses and gabions.

METHOD

The downchute channel geometry will be sized to accommodate the peak discharge from the 25-year, 24-hour design storm. In addition, the 100-year, 24-hour design storm is routed through proposed downchutes to verify that the structures can convey the flow without overtopping. The peak discharges for the 25 and 100-year, 24-hour design storms for the final cover system sub-drainage areas were calculated in Appendix VIb-I.2 and VIb-I.3, respectively.

The proposed downchutes consist of rectangular cross section open channels with a series of vertical drops. The design methodology presented in Chow [1959] for Straight Drop Spillway design was adopted. The equations used to evaluate the geometry of flow are provided below:

$$D = \frac{q^2}{gh^3} \qquad (1)$$

$$\frac{L_d}{h} = 4.30D^{0.27} \qquad (2)$$

$$\frac{y_p}{h} = 1.00D^{0.22} \qquad (3)$$

$$\frac{y_1}{h} = 0.54D^{0.425} \qquad (4)$$

$$\frac{y_2}{h} = 1.66D^{0.27} \qquad (5)$$

where: D = drop number (dimensionless);
q = unit discharge or discharge per unit width of the channel (Q/b) ($ft^3/sec/ft$);
Q = discharge (ft^3/sec);
b = width of channel (ft.);
g = acceleration due to gravity = 32.2 ft/s^2;
h = height of a single drop (ft.);
L_d = drop length (ft.);
y_p = pool depth under the nappe (ft.);
y_1 = depth at the beginning of the hydraulic jump (ft.); and
y_2 = tailwater depth sequent to y_1 (ft.).

Attachment 1 illustrates the various components of flow geometry in a single drop spillway unit. The length of the hydraulic jump after the drop (L) is evaluated using the relationship shown in Attachment 2. The following equations are used to calculate the input parameters required for Attachment 2 [Chow, 1959]:

$$v_1 = \frac{q}{y_1} \qquad (6)$$

$$F_1 = \frac{v_1}{\sqrt{gy_1}} \qquad (7)$$

where: v_1 = velocity of flow at the beginning of the hydraulic jump (ft/s); and
F_1 = Froude Number at the beginning of the hydraulic jump (dimensionless).

The required length of the apron (L_{apron}) is defined as the distance required to contain the drop length and the hydraulic jump that occurs after the drop (i.e., $L_{apron} = L_d + L$).

CALCULATION PARAMETERS

Calculation parameters that are directly related to the proposed downchute geometry are illustrate in Attachment 3 (proposed stepped downchute configuration) and Attachment 4 (proposed downchute cross section). Using the site geometry and the information expressed in the aforementioned equations and presented in Attachments 3 and 4, the following parameters are know:

Discharge to downchute (Q) will vary by location along the downchute corresponding to contributing drainage area. For the calculation, the allowable Q is calculated for a given downchute configuration.

Height of a single drop (h) was selected as 3 ft., which corresponds to the nominal height of a gabion basket.

Length of apron (L_{apron}) was selected as 12 ft. as this best conforms to the 3H:1V landfill side slope and 3-ft. tall gabions. Therefore, the with of the downchute channel (b) is varied to solve for an L_{apron} of 12 ft. for a given Q.

Width of downchute (b) was selected to be a minimum of 6 ft., successively increasing in increments of 6ft., which is consistent with the nominal width of standard revert mattresses.

Apron slope (S) was selected to be 0.0833 ft/ft to best conform to the 3H:1V landfill side slope.

CALCULATION

The iterative calculation to size the downchute geometry is presented in Attachment 5. As noted above, the allowable Q was calculated based on a L_{apron} of 12 ft. and b expressed in widths of 6 ft. increments.

Using the downchute geometry calculated in Attachment 5, the maximum flow depth (y_2) expected during the 100-year, 24-hour design storm discharge (Q) is recalculated using equation 1 and 5. A summary of the calculated maximum flow depth by downchute type is presented in Attachment 6.

RESULTS

From Attachment 5, five designations of downchute cross sections were proposed, as summarized below.

Downchute Type	Channel Width, b (ft.)	Channel Depth (ft.)
Type I	6	3
Type II	12	3
Type III	18	3
Type IV	24	3
Type V	30	3

Attachment 5 also provides the calculated allowable Q for each of these downchute types listed above. In Attachment 7, the specific downchute types are related to a specific drainage

subarea based on the calculated discharge values from the 25-year, 24-hour design storm presented in Appendix VIb-I.2. In addition, Attachment 7 provides a summary of the freeboard resulting from the 100-year, 24-hour design storm. The calculation for freeboard is presented in Attachment 7.

REFERENCE

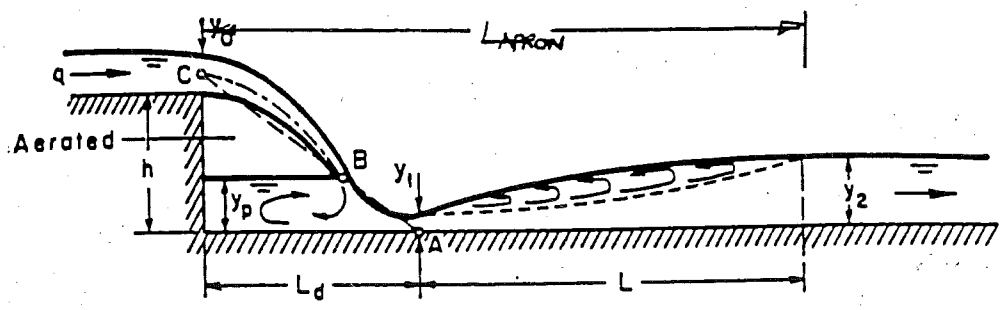
Agostini, R., Conte, A., Malaguti, G, and Papetti, A., *"Flexible Linings in Reno Mattress and Gabions for Canals and Canalized Water Courses"*, Officine Maccaferri S.P.A., Bolonga, Italy. 1985.

Chow, V.T., *Open Channel-Hydraulics*, McGraw-Hill, New York, 1959.

Written by: William M. Steier, P.E. Date: 3/26/03 Reviewed by: E. STEINHAUSER Date: 3/26/03

Client: DSWA Project: Cherry Island Landfill Project/Proposal No.: ME0250 Task No.: 2.9.2

ATTACHMENT 1

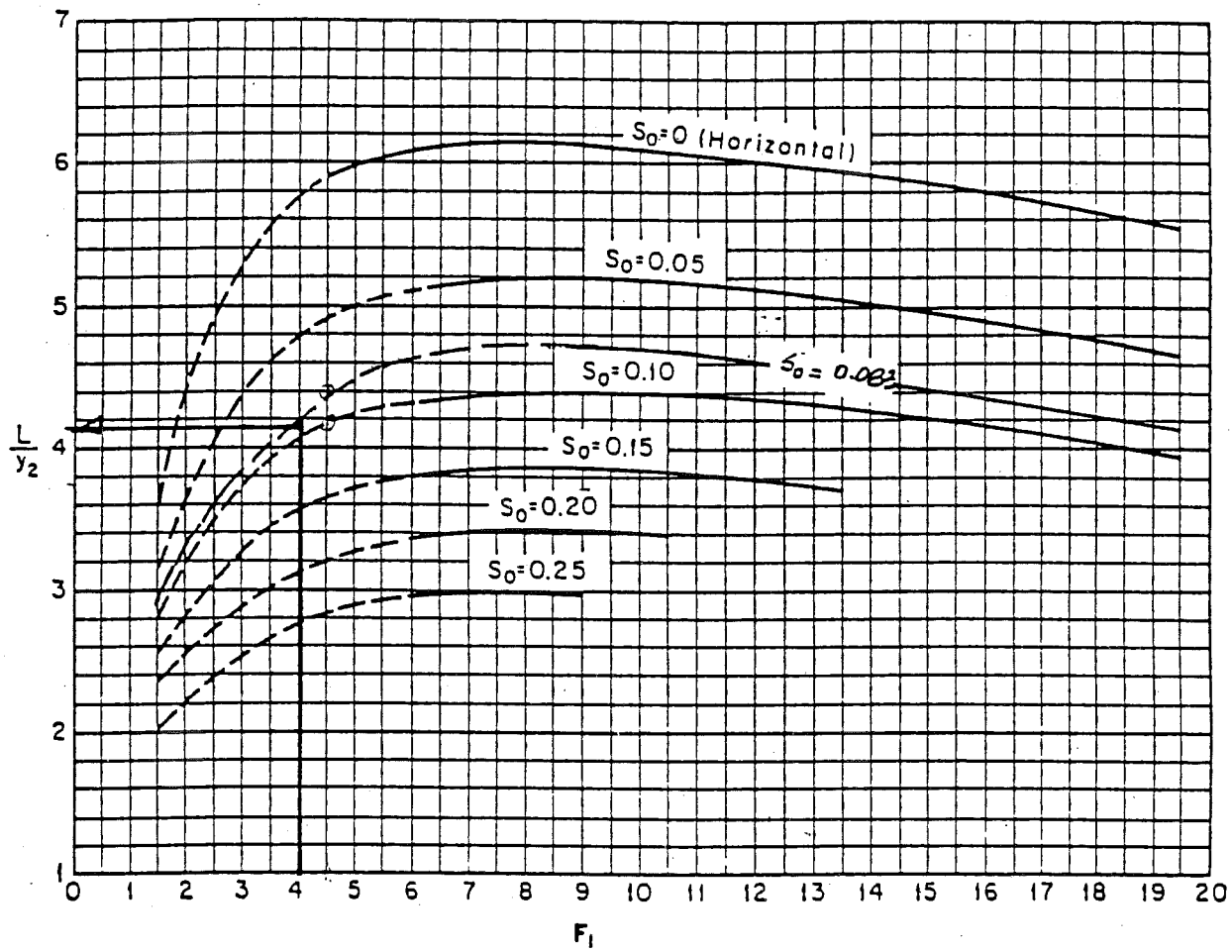


Flow Geometry of a Straight Drop Spillway [Chow, 1959]

Written by: William M. Steier, P.E. Date: 3/26/03 Reviewed by: E. STEINHAUSER Date: 3/26/03

Client: DSWA Project: Cherry Island Landfill Project/Proposal No.: ME0250 Task No.: 2.9.2

ATTACHMENT 2

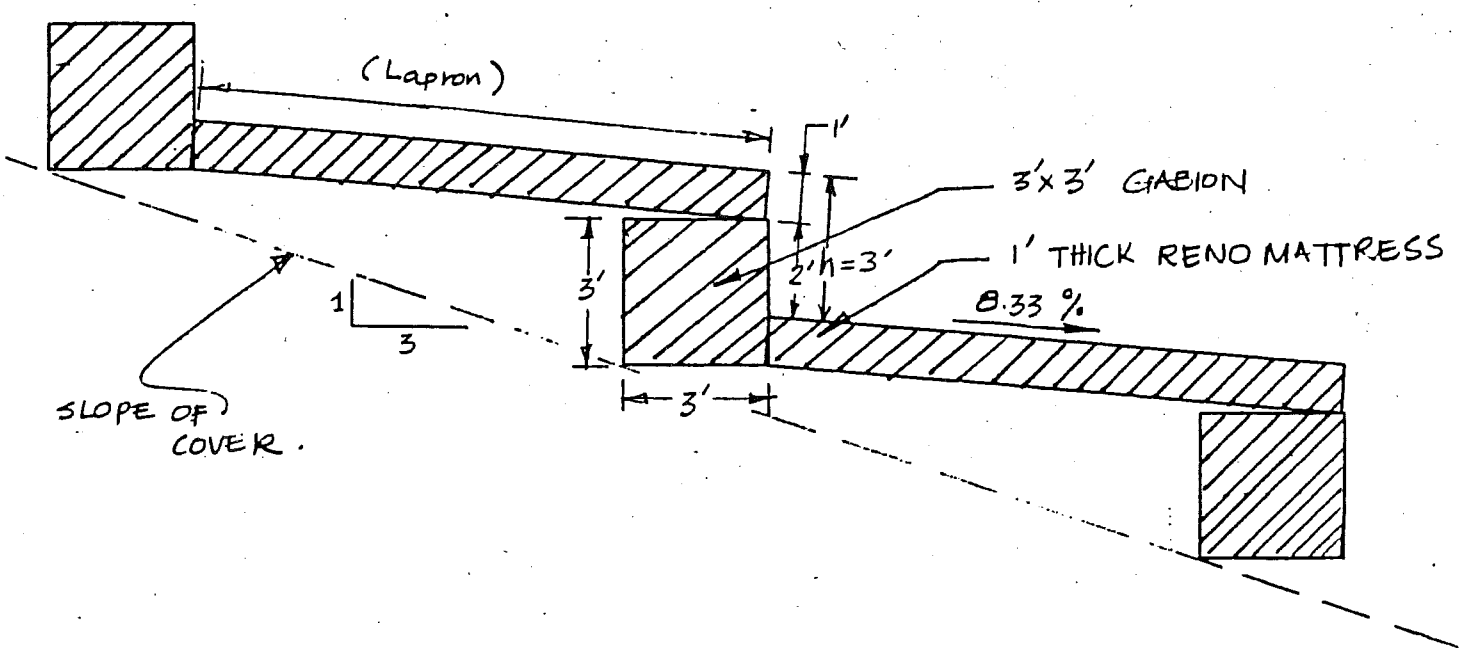


Length in terms of Sequent Depth of Hydraulic Jumps in Sloping Channels [Chow, 1959]

Written by: W STEIER Date: 03/03/26 (YY MM DD) Reviewed by: E STEINHAUSER Date: 03/03/26 (YY MM DD)

Client: DSWA Project: CIC Project/Proposal No.: MG0250 Task No.: 2.9.2

ATTACHMENT 3



LONGITUDINAL SECTION (TYPICAL)

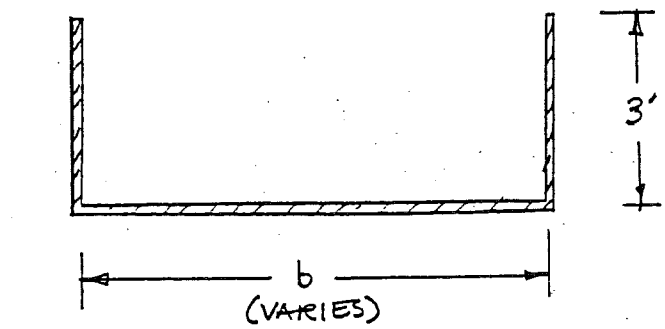
STEPPED DOWNCHUTE

(ONLY 2 STEPS SHOWN HERE)

Written by: W STEIER Date: 03/03/26 (YY MM DD) Reviewed by: E STEINHAUSER Date: 03/03/26 (YY MM DD)

Client: DSWA Project: CIC Project/Proposal No.: MEO250 Task No.: 2.9.2

ATTACHMENT 4



CROSS-SECTION
DOWNCHUTE

Attachment 5

Design/Check: Geometry/Sizing Stepped Downchute 25-Year Design Storm
Methodology: See Calculation Package
Project: Cherry Island Landfill
Feature Location: FINAL COVER DOWNCHUTE

Type	Maximum Allowable Discharge Q (ft^3/sec)	Drop Height h (ft.)	Channel Width b (ft.)	Channel Slope S (ft/ft)	Unit Discharge q (ft^3/sec/ft)	Drop Number D (Eq.1)	Drop Length L_d (Eq.2) (ft.)	Hydraulic Jump Characteristics y_p (Eq.3) (ft.)	y_1 (Eq.4) (ft.)	y_2 (Eq.5) (ft.)	v_1 (Eq.6) (ft/sec)	F_1 (Eq.7)	L/y_2 *(Note)*	L (ft.)	Minimum Length $L + L_d$ (ft.)	Design Length L_{apron} (ft.)
I	27.0	3.0	6.0	0.833	4.5	0.02	4.67	1.31	0.33	1.80	13.73	4.2	4.1	7.40	12.07	12
II	54.0	3.0	12.0	0.833	4.5	0.02	4.67	1.31	0.33	1.80	13.73	4.2	4.1	7.40	12.07	12
III	81.0	3.0	18.0	0.833	4.5	0.02	4.67	1.31	0.33	1.80	13.73	4.2	4.1	7.40	12.07	12
IV	108.0	3.0	24.0	0.833	4.5	0.02	4.67	1.31	0.33	1.80	13.73	4.2	4.1	7.40	12.07	12
V	135.0	3.0	30.0	0.833	4.5	0.02	4.67	1.31	0.33	1.80	13.73	4.2	4.1	7.40	12.07	12

Note: From Attachment 2, for $F_1 = 4.2$, $L/y_2 = 4.1$.

WMB .RSS 3/26/03 3/26/03 10/12

WMS 3/26/03
SCS 3/26/03

Attachment 6

Design/Check: Flow Depth Stepped Downchute, 100-Year Design Storm
Methodology: See Calculation Package
Project: Cherry Island Landfill
Feature Location: FINAL COVER DOWNCHUTE

Downchute Type	Reach[1]	Maximum Discharge Q_{100} By Type[1] (cfs)	y_2 (Eq.5) (ft.)
I	Reach D6-1	23.2	1.66
II	Reach D2-2	67.6	2.04
III	Reach D5-2	110.9	2.14
IV	Reach D5-3	157.6	2.21

Notes:
1. Reach and Q_{100} taken from Atachment 7.

WMS 3/26/03
SSS 3/26/03

Attachment 7
Results of Stepped Downchute Design and Freeboard Summary

Reach # (Corresponds to Schematic Plan)	Peak Q_{25}[1] (ft^3/sec)	Downchute Design Type	Peak Q_{100}[1] (ft^3/sec)	Peak Depth By Downchute Type (100 Year Discharge) From Attachment 6 ft	Freeboard[2] d_{FB} (ft.)
Reach D1-1	29.7	II	43.4	2.0	1.0
Reach D1-2	36.9	II	54.9	2.0	1.0
Reach D1-3	54.2	III	79.9	2.1	0.9
Reach D2-1	11.8	I	17.1	1.7	1.3
Reach D2-2	46.4	II	67.6	2.0	1.0
Reach D2-3	69.1	III	100.6	2.1	0.9
Reach D2-4	73.2	III	106.7	2.1	0.9
Reach D3-1	6.2	I	9.0	1.7	1.3
Reach D3-2	35.3	II	51.6	2.0	1.0
Reach D3-3	60.2	III	87.8	2.1	0.9
Reach D4-1	26.6	II	38.8	2.0	1.0
Reach D4-2	41.3	II	60.3	2.0	1.0
Reach D5-1	70.2	III	102.1	2.1	0.9
Reach D5-2	76.4	III	110.9	2.1	0.9
Reach D5-3	107.1	IV	157.6	2.2	0.8
Reach D6-1	16.0	I	23.2	1.7	1.3
Reach D6-2	30.9	II	45.1	2.0	1.0
Reach D6-3	94.3	IV	139.9	2.2	0.8
Reach D7-1	36.4	II	53.1	2.0	1.0
Reach D7-2	64.1	III	93.7	2.1	0.9
Reach D8-1	43.1	II	62.6	2.0	1.0
Reach D9-1	29.4	II	42.7	2.0	1.0
Reach D10-1	64.0	III	93.3	2.1	0.9
Reach D11-1	30.4	II	44.6	2.0	1.0

Notes:
1. Peak discharge obtained from Appendix VIb-I.2, and Vib-I.3.
2. Freeboard (d_{FB})= downchute depth (3 ft.) - peak flow depth.

Appendix VIb-I.6

Downchute Lining Design

GEOSYNTEC CONSULTANTS

COMPUTATION COVER SHEET

Client: DSWA **Project:** Cherry Island Landfill **Project/Proposal #:** ME0250 **Task #:** 2.9.2

TITLE OF COMPUTATIONS APPENDIX VIb-I.6: DOWNCHUTE LINING DESIGN

COMPUTATIONS BY:
Signature
Printed Name and Title: William M. Steier, P.E. Project Engineer
26 March 2003 DATE

ASSUMPTIONS AND PROCEDURES CHECKED BY:
(Peer Reviewer)
Signature
Printed Name and Title: Eric. S. Steinhauser, P.E. Associate
26 March 2003 DATE

COMPUTATIONS CHECKED BY:
Signature
Printed Name and Title: Eric. S. Steinhauser, P.E. Associate
26 March 2003 DATE

COMPUTATIONS BACKCHECKED BY:
(Originator)
Signature
Printed Name and Title: William M. Steier, P.E. Project Engineer
26 March 2003 DATE

APPROVED BY:
(PM or Designate)
Signature
Printed Name and Title: David Espinoza, P.E. Senior Engineer
3/31/03 DATE

APPROVAL NOTES: The calculations presented herein are suitable for a landfill elevation of 195 ft-msl. As shown in this calculation package, the design was performed for a more conservative grading configuration than that shown in Drawing 78 entitled "Landfill Final Development and Grading Plan" (Appendix VIb-A).

DOE 6/10/03

REVISIONS (Number and initial all revisions)

NO.	SHEET	DATE	BY	CHECKED BY	APPROVAL

APPENDIX VIb-I.6
DOWNCHUTE LINING DESIGN

PURPOSE

The purpose of this calculation package is to verify the proposed lining material for the downchutes of the Cherry Island Landfill final cover system. Downchutes will convey stormwater runoff from a series of swales and side slope terraces to drop inlet structures located at the perimeter of the landfill. As the contributing drainage area to the downchute increases, the width of the downchute will increase accordingly. Because of the landfill slope will be inclined at 3 horizontal to 1 vertical (3H:1V), a series of steps along the downchute are planned to dissipate energy and reduce flow velocity. The proposed downchutes will be constructed using revert mattresses.

METHOD

The design procedure and methodology presented in this calculation are specifically for gabion revert mattresses and are based on the procedure presented in the design reference, "*Flexible Linings in Reno Mattress and Gabions for Canals and Canalized Water Courses*", [Agostini, 1985].

The downchutes were sized to accommodate the peak discharge from the 25-year, 24-hour design storm. The peak discharges for the 25-year, 24-hour design storm for the final cover system sub-drainage areas are calculated in Appendix VIb-I.2. The proposed downchutes consist of rectangular cross section open channels with a series of vertical drops. The geometric design of downchutes is addressed in Appendix VIb-I.5.

For the lining design calculations presented herein, the average velocity and depth are calculated based on a unit width basis. The water flow depth and velocity are estimated by solving Manning's equation [Chow, 1959], which is expressed as:

$$Q = \frac{1.49}{n} A R^{2/3} S^{1/2} \qquad (1)$$

$$V = \frac{Q}{A} \qquad (2)$$

$$y = \frac{A}{b} \qquad (3)$$

where: Q = discharge (ft^3/sec);
n = Manning's roughness coefficient (dimensionless);
A = area of flow (ft^2);
R = hydraulic radius = $\frac{A}{P}$ (ft.);
P = wetted perimeter (ft.);
S = longitudinal slope of the channel (ft/ft);
V = velocity (ft/sec);
y = flow depth (ft.); and
b = channel width (ft.).

Manning's roughness coefficient (n) for aggregate is calculated using the following equation from Agostini, et. al. [1985].

$$n = \frac{d_{90}^{1/6}}{26} \qquad (4)$$

where: d_{90} = sieve size passing 90 percent by of the aggregate particles (m).

The tractive stress resulting from the anticipated flow and critical tractive stress within in the unit downchute channel are estimated using the following equations [Agostini, et. al., 1985]:

$$t_b = \gamma_w \, y \, i \qquad (5)$$

$$t_c = 0.10(\gamma_s - \gamma_w) \, d_{50} \qquad (6)$$

where: t_b = tractive stress at the bottom of the channel (kg/m^2);
t_c = critical tractive stress (kg/m^2);
γ_s = unit weight of solid stone, assumed specific gravity 2.6 = 2550 kg/m^3;
γ_w = unit weight of water = 1,000 kg/m^3;
y = flow depth (m);
i = channel slope = 0.0833 m/m; and
d_{50} = median diameter of aggregate (m).

The critical design channel velocity for stability of the revert mattress aggregate is a function of the Froude number and the median aggregate diameter (i.e., d_{50}). The relationship between these parameters and the critical velocity are presented in Attachment 1, [Agostini, et. al., 1985].

The design flow at the base of the revert mattress is evaluated using the following equation [Agostini, et. al., 1985].

$$v_b = \frac{1}{n_f}\left(\frac{d_{50}}{2}\right)^{2/3} i^{1/2} \qquad (7)$$

The critical flow velocity at the base of the revert mattress for non-cohesive soils is evaluated using the following equation [Agostini, et. al., 1985].

$$v_e = 16.1\left(i^{1/2}\right) \qquad \text{(non-cohesive soil)} \qquad (8)$$

where: v_b = velocity at the bottom of Revert Mattress (m/sec);
v_e = critical velocity at the bottom of Revert Mattress (m/sec); and
n_f = 0.02 if a geotextile present or 0.025 if there is an aggregate layer (dimensionless).

The critical flow velocity, v_b, at the base of the revert mattress for various cohesive soils is presented in Attachment 2.

If a geotextile is used between the revert mattress and the base soil, then the allowable base soil velocity is calculated as follows:

$$v_b \leq 0.5\, v_e \qquad (9)$$

CALCULATION PARAMETERS

The proposed revert mattresses will have a thickness of 12 in. and will be filled with 4 to 6-in. diameter stone. Underlying revert mattresses will be geotextile and a layer of aggregate that meets the requirements of Del No. 8 of Standard Specification 813 [DelDOT, 2001], which is summarized below.

Written by: William M. Steier Date: 26 March 2003 Reviewed by: Eric S. Steinhauser Date: 26 March 2003

Client: DSWA Project: Cherry Island Landfill Project/Proposal No.: ME0250 Task No.: 2.9.2

GRADING REQUIREMENTS MINIMUM AND MAXIMUM PERCENTAGES PASSING

Del. No.	Sieve Size (in., square openings), millimeters except where noted													
	4 (100)	3.5 (90)	3 (75)	2.5 (63)	2 (50)	12 (37.5)	1 (25)	3/4 (19)	0.5 (12.5)	3/8 (9.5)	No. 4 (4.75)	No. 8 (2.36)	No. 16 (1.18)	No. 100 (150 μm)
8									100	85 - 100	10 - 30	0 - 10	0 - 5	

CALCULATION

Evaluation and comparison of critical values to design are provided in Attachment 3. Design values are acceptable if they are less than the critical value. Comparison of design values to critical values are made for the following parameters: (i) tractive stress ($\tau_b<\tau_c$), (ii) flow velocity at revert mattress surface ($v<v_c$); and (iii) flow velocity at base soil level ($v_b<v_e$).

RESULTS

Tractive stresses and flow velocity at the surface and base of the revert mattress are less than the critical values for each parameter.

REFERENCES

Agostini, R., Conte, A., Malaguti, G, and Papetti, A., "*Flexible Linings in Reno Mattress and Gabions for Canals and Canalized Water Courses*", Officine Maccaferri, S.P.A., Bolonga, Italy, 1985.

Chow, V.T., "*Open Channel Hydraulics*", McGraw-Hill, New York, 1959.

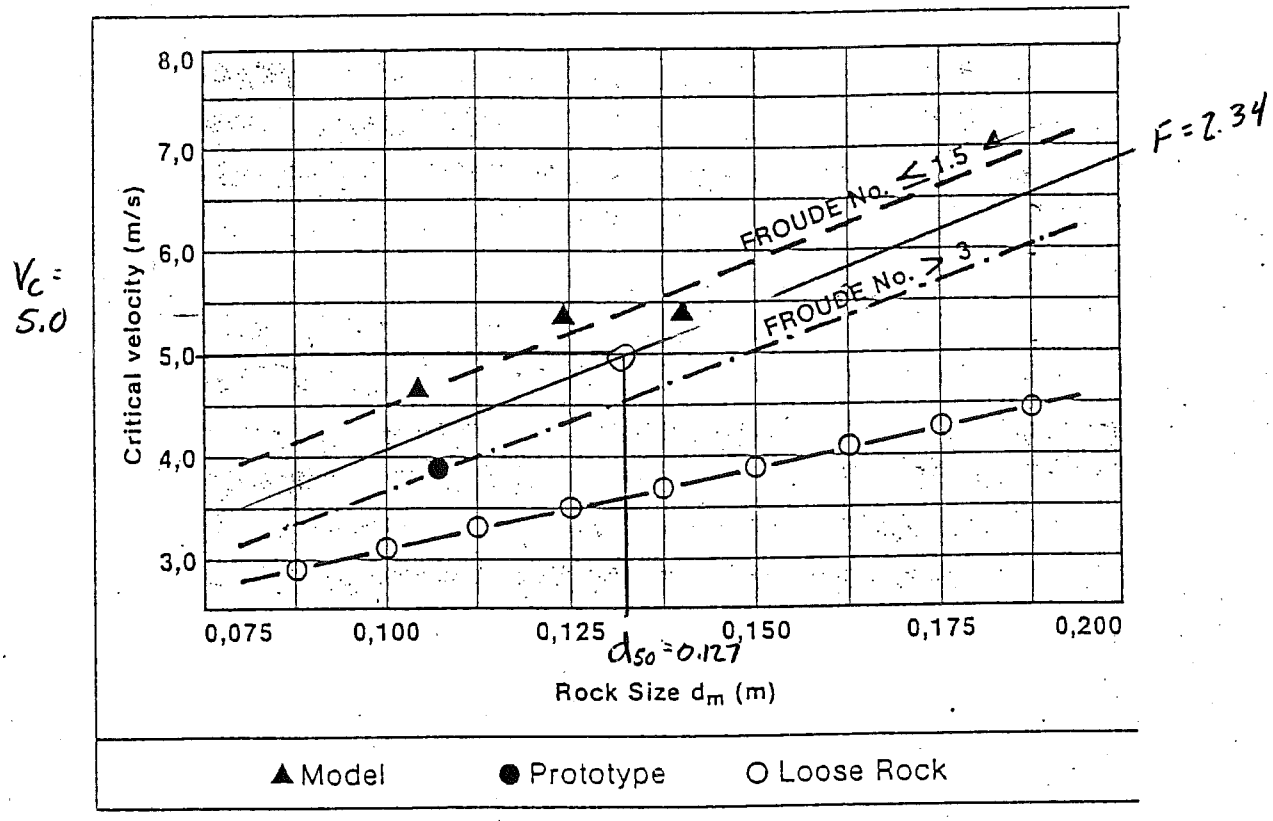
Delaware Department of Transportation (DelDOT). "*Specifications for Road and Bridge Construction*", Dover, Delaware, Aug, 2001.

Written by: William M. Steier Date: 3/26/03 Reviewed by: Eric S. Steinhauser Date: 3/26/03

Client: DSWA Project: Cherry Island Landfill Project/Proposal No.: ME0250 Task No.: 2.9.2

ATTACHMENT 1

Critical Velocity as a Function of Froude Number, and Median Riprap Size [Agostini, et. al., 1985]



Critical velocity v_c that initiates rock movement as a function of their size.

Written by: William M. Steier Date: 3/26/03 Reviewed by: Eric S. Steinhauser Date: 3/26/03

Client: DSWA Project: Cherry Island Landfill Project/Proposal No.: ME0250 Task No.: 2.9.2

ATTACHMENT 2

Limiting Velocity at Soil Bed Level for Various Soils [Agostini, et. al., 1985]

- Limiting velocities at bed level for various soils

Bed Material	TYPE	Velocity in metres per second	
		No material carried in suspension	Colloidal material carried in suspension
Fine sand. (Non-colloidal)		0.45	0.75
Sandy clay. (Non-colloidal)	2	0.55	0.75
Soft clays	3	0.60	0.90
Muds		0.75	1.05
Coarse sand		0.75	1.50
Medium clay	4	1.15	1.50
Gravel		1.20	1.85
Shingle		1.50	1.70
Hard clay	5	1.85	1.85

ATTACHMENT 3

Design/Check: Lining Design by Allowable Velocity, Tractive Stress
Methodology: See Calculation Package
Project: Cherry Island Landfill
Feature: FINAL COVER DOWNCHUTE

Constants and Design Parameters

Discharge, Q_{max} =	107.10	ft^3/sec	Specific Weight of Water, γ_w =	1000	kg/m^3
Width, B =	24.0	ft.	Specific Weight of Aggregate, G_s =	2550	kg/m^3
Left Side Slope, Z_1 =	0.00	horizontal :1 vertical			
Right Side Slope, Z_2 =	0.00	horizontal :1 vertical	Base Soil Type (See Attachment 2) =	1	(Enter: 1-5; 1 = non cohesive)
Manning's Roughness Coeff., n =	0.028	(calculated from Eq. 2)	Base Soil Protection =	Geotextile	(Enter: Geotextile or Gravel)
Longitudinal Channel Slope, S_o =	0.0833	ft/ft			

Note: Shaded Cells Indicate Input Data

Reno Mattress Lining Reference Table

Lining Thickness	D100	D90	D50	D0
(in.)	(m)	(m)	(m)	(m)
6	0.102	0.099	0.089	0.076
9	0.152	0.144	0.114	0.076
12	0.152	0.147	0.127	0.102
18	0.25	0.237	0.19	0.12

Base Soil Critical Velocity Reference Table, From Attachment 2

Soil Type	Description	Critical Velocity, (m/s)
1	Non-Cohesive	From Eq. 8
2	Sandy Clay (non-colloidal)	0.55
3	Soft Clay	0.6
4	Medium Clay	1.15
5	Hard Clay	1.85

WMS 3/26/03 RGS 3/26/03

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ATTACHMENT 3

Design/Check: Lining Design by Allowable Velocity, Tractive Stress
Methodology: See Calculation Package
Project: Cherry Island Landfill
Feature: FINAL COVER DOWNCHUTE

Calculation of average flow depth and velocity for critical downchute section Reach D5-3

Depth of Flow Y ft.	Area of Flow A ft^2	Wetted Perimeter P ft.	Hydraulic Radius R=A/P ft.	Channel Slope ft/ft	Average Velocity V ft/s	Discharge (Flow Rate) Q=AV ft^3/s	Avg. Tractive Stress τ lb/ft^2	Froude Number F --	Comments
0.49	11.76	24.98	0.47	0.08	9.29	109.28	2.45	2.34	Design Q Taken from Appendix VbI-I.5, Attachment 5

Reno Mattress Thickness (6 in.,9 in.,12 in.,18 in.) = 12
Maximum Riprap Size, d_{100} = 0.152 m
Riprap Size, d_{90} = 0.147 m
Median Riprap Size, d_{50} = 0.127 m
Minimum Riprap Size , d_0 = 0.102 m

Channel Flow Velocity (Top of Reno Mattress)
Flow Velocity, v = 2.83 m/sec
Froude Number, F = 2.34
Critical Flow Velocity, v_c = 5 See Attachment 1
$v < v_c$? OK Function of F and d_{50},

Manning Coefficient Estimate
Manning Coefficient, n = 0.028 Eq 4

Tractive Stress
Tractive Stress (Design Discharge), τ_b = 12.44 kg/m^2,Eq 5
Critical Tractive Stress, τ_c = 19.69 kg/m^2,Eq 6
$t_b < t_c$? OK

Channel Flow Velocity (Bottom of Reno Mattress)
Flow Velocity, v_b = 2.30 m/s; Eq. 7
Allowable Base Soil Velocity Cohesive Soil, v_e = NA Attachment 2
Allowable Base Soil Velocity Non-Cohesive Soil, v_e = 6.28 m/s; Eq. 8
Allowable Base Soil Velocity with Geotextile, v_e = 3.14 m/s; Eq. 9
$v_b < v_e$? OK

Note: Shaded Cells Indicate Input Data

WMM 3/26/03 JSS 3/26/03

9/9

Appendix VIb-I.7

Drop Inlet Design

1/20

GEOSYNTEC CONSULTANTS

COMPUTATION COVER SHEET

Client: DSWA Project: Cherry Island Landfill Project/Proposal #: ME0250 Task #: 2.9.2

TITLE OF COMPUTATIONS APPENDIX VIb-I.7: DROP INLET DESIGN

COMPUTATIONS BY:
Signature [signature] 26 March 2003 DATE
Printed Name and Title: William M. Steier, P.E., Project Engineer

ASSUMPTIONS AND PROCEDURES CHECKED BY:
(Peer Reviewer)
Signature [signature] 26 March 2003 DATE
Printed Name and Title: Eric. S. Steinhauser, P.E., Associate

COMPUTATIONS CHECKED BY:
Signature [signature] 26 March 2003 DATE
Printed Name and Title: Eric. S. Steinhauser, P.E., Associate

COMPUTATIONS BACKCHECKED BY:
(Originator)
Signature [signature] 26 March 2003 DATE
Printed Name and Title: William M. Steier, P.E., Project Engineer

APPROVED BY:
(PM or Designate)
Signature [signature] 3/21/03 DATE
Printed Name and Title: David Espinoza, P.E., Senior Engineer

APPROVAL NOTES: The calculations presented herein are suitable for a landfill elevation of 195 ft-msl. As shown in this calculation package, the design was performed for a more conservative grading configuration than that shown in Drawing 78 entitled "Landfill Final Development and Grading Plan" (Appendix VIb-A).

BJE 6/10/09

REVISIONS (Number and initial all revisions)

NO.	SHEET	DATE	BY	CHECKED BY	APPROVAL

1/20

GEOSYNTEC CONSULTANTS

COMPUTATION COVER SHEET

Client: DSWA Project: Cherry Island Landfill Project/Proposal #: ME0250 Task #: 2.9.2

TITLE OF COMPUTATIONS APPENDIX VIb-I.7: DROP INLET DESIGN

COMPUTATIONS BY:
Signature [signature] 26 March 2003 DATE
Printed Name and Title William M. Steier, P.E. Project Engineer

ASSUMPTIONS AND PROCEDURES CHECKED BY:
(Peer Reviewer)
Signature [signature] 26 March 2003 DATE
Printed Name and Title Eric. S. Steinhauser, P.E. Associate

COMPUTATIONS CHECKED BY:
Signature [signature] 26 March 2003 DATE
Printed Name and Title Eric. S. Steinhauser, P.E. Associate

COMPUTATIONS BACKCHECKED BY:
(Originator)
Signature [signature] 26 March 2003 DATE
Printed Name and Title William M. Steier, P.E. Project Engineer

APPROVED BY:
(PM or Designate)
Signature [signature] 3/21/03 DATE
Printed Name and Title David Espinoza, P.E. Senior Engineer

APPROVAL NOTES: The calculations presented herein are suitable for a landfill elevation of 195 ft-msl. As shown in this calculation package, the design was performed for a more conservative grading configuration than that shown in Drawing 78 entitled "Landfill Final Development and Grading Plan" (Appendix VIb-A).

BJE 6/10/09

REVISIONS (Number and initial all revisions)

NO.	SHEET	DATE	BY	CHECKED BY	APPROVAL

The diameter of the horizontal orifice is 72 in., which corresponds to an open area, a, of 28.3 ft^2. The orifice is located atop a 60 ft. deep (approximate) vertical shaft, which will provide for a tailwater of 0 ft. A summary of the stormwater discharge to each drop inlet, along with the length of the broad crested weir for each drop inlet, is presented in Attachment 3.

CALCULATION

The stage-discharge curve (i.e., Q vs. H) for the broad crested weir and horizontal orifice are prepared by HydroCAD [2001] using Equations 1 and 2. Stage-discharge curves for each drop inlet structure are presented in Attachment 4.

The downchute channels are not designed to store water; therefore, for modeling purposes, a nominal storage capacity of 1 ft^3 is assumed for all stages. A Limited storage of stormwater is possible within the upper portion of each drop inlet and is assumed to be equivalent to the interior volume of the drop inlet. The stage-storage curve for each structure is presented along with stage discharge curves in Attachments 4.

The time step, D_t, for Storage Indication Routing of discharge through the drop inlet structure is 0.05 hours, which is equivalent to the time step used for runoff calculations presented in Appendix VIb-I.3.

The maximum height of water above the broad crested weir and horizontal orifice are analyzed using the Storage-Indication Routing method. Detailed routing computations are performed by HydroCAD [2001]. Results for each drop inlet are presented in Attachment 5.

RESULTS

A summary of the maximum water elevations within each drop inlet and the corresponding available freeboard is presented in Attachment 6. The minimum freeboard available during the 100-year, design storm is 1.2 ft. at Drop Inlet DI5-1. Each culvert is adequately sized to pass the 100-year design storm.

REFERENCES

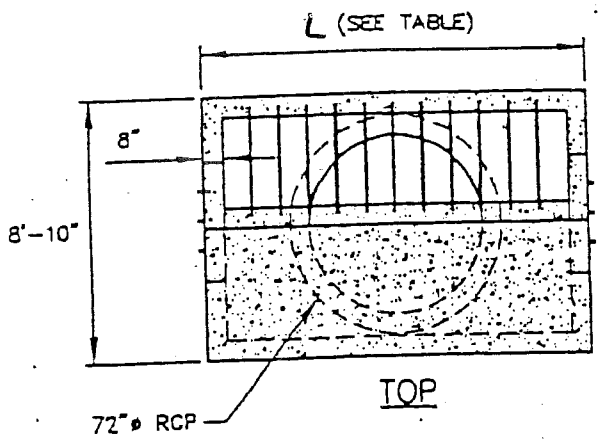
Applied Microcomputer Systems, "*HydroCAD® Stormwater Modeling System*", Version 6, Chocorua, New Hampshire 2002.

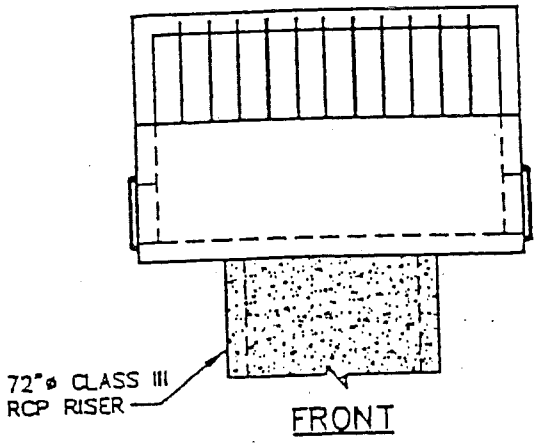
Ponce, V.M., "*Engineering Hydrology*", Prentice Hall, Englewood Cliffs, New Jersey, 1989.

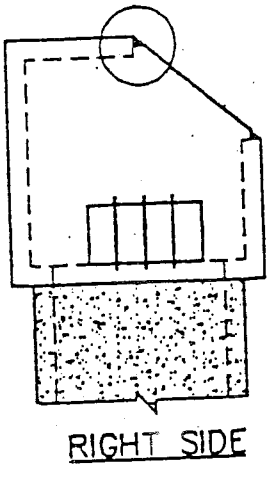
Written by: William M. Steier Date: 3/26/03 Reviewed by: Eric S. Steinhauser Date: 3/26/03

Client: DSWA Project: Cherry Island Landfill Project/Proposal No.: ME0250 Task No.: 2.9.2

ATTACHMENT 1
DROP INLET DESIGN







DROP INLET TABLE	
TYPE	L
III	19'-4"
IV	25'-4"
V	31'-4"

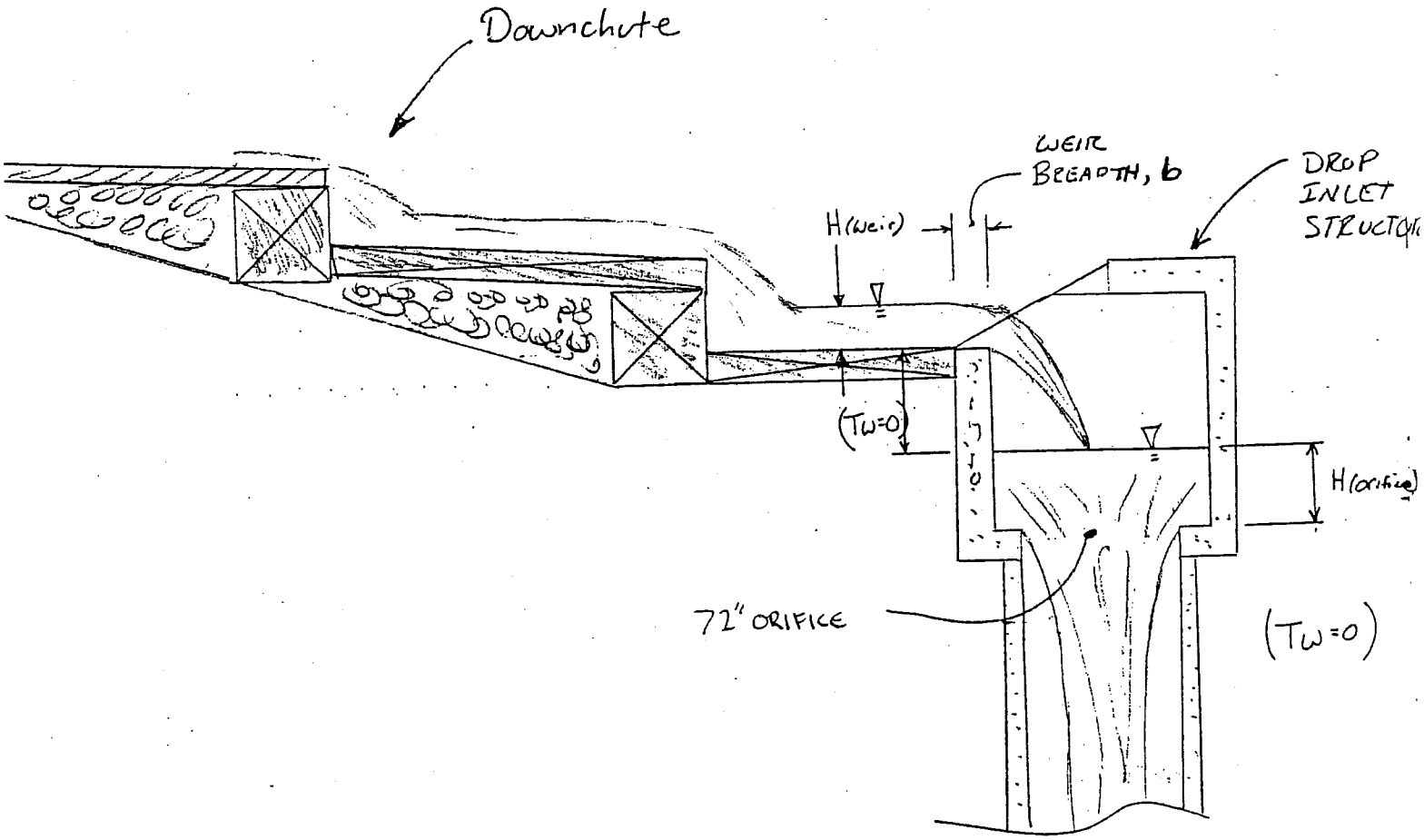
3 DETAIL
— DROP INLET

Written by: William M. Steier Date: 3/26/03 Reviewed by: Eric S. Steinhauser Date: 3/26/03

Client: DSWA Project: Cherry Island Landfill Project/Proposal No.: ME0250 Task No.: 2.9.2

ATTACHMENT 2

DOWNCHUTE / WEIR / ORIFICE CROSS SECTION



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ATTACHMENT - 3
DROP INLET DESIGN PARAMETER SUMMARY

Channel ID	Description	Weir Length (L) or Orifice Diameter (ft.)	Peak Discharge Q_{100}[1] (ft^3/sec)
DI1-1	Broad Crested Weir	18	121.3
DI1-2	Orifice	6	121.3
DI2-1	Broad Crested Weir	24	133.3
DI2-2	Orifice	6	133.3
DI3-1	Broad Crested Weir	24	114.8
DI3-2	Orifice	6	114.8
DI4-1	Broad Crested Weir	12	88.9
DI4-2	Orifice	6	88.9
DI5-1	Broad Crested Weir	30	199.5
DI5-2	Orifice	6	199.5
DI6-1	Broad Crested Weir	24	157.9
DI6-2	Orifice	6	157.9

Written by: William M. Steier Date: 3/26/03 Reviewed by: Eric S. Steinhauser Date: 3/26/03

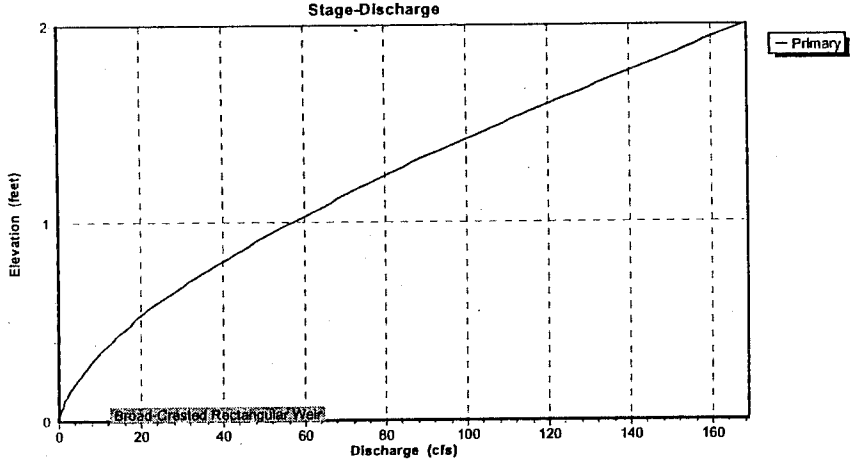
Client: DSWA Project: Cherry Island Landfill Project/Proposal No.: ME0250 Task No.: 2.9.2

ATTACHMENT 4

STAGE-STORAGE / STAGE-DISCHARGE PLOTS

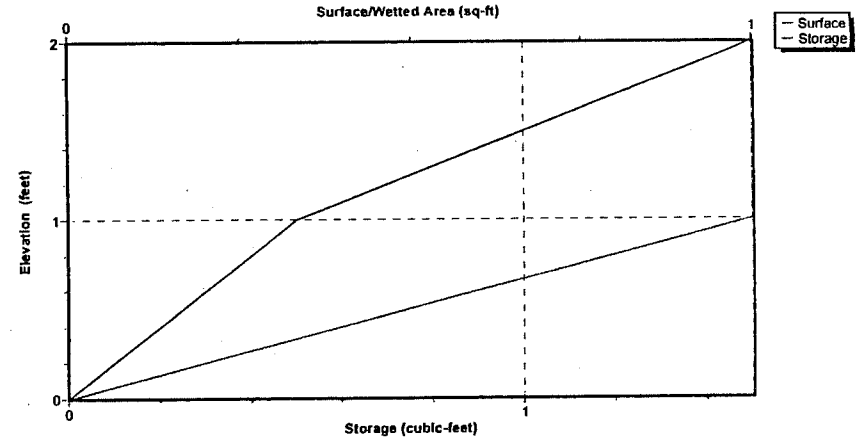
Pond DI1-1: Drop Inlet 1

Stage-Discharge



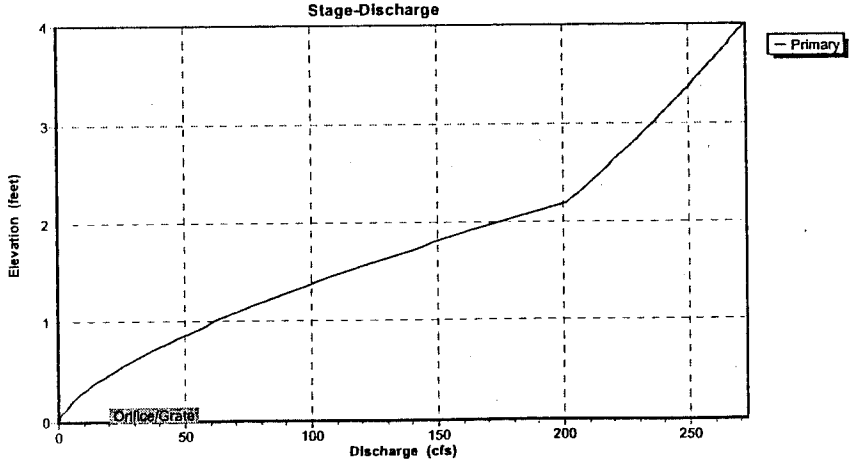
Pond DI1-1: Drop Inlet 1

Stage-Area-Storage



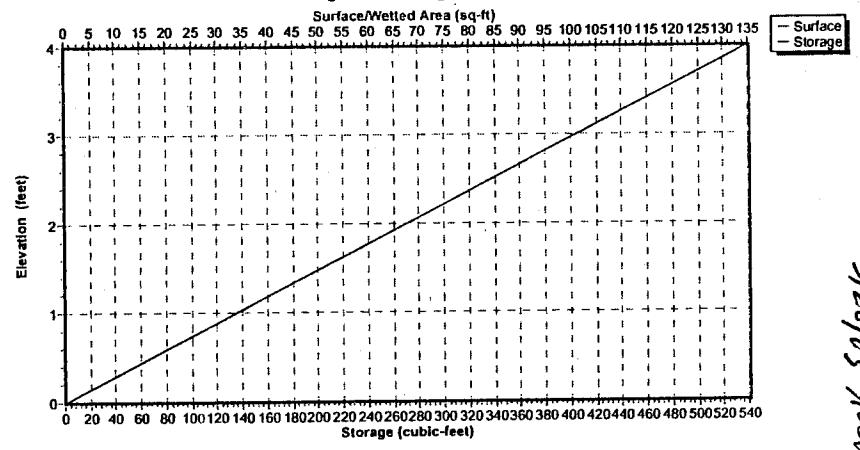
Pond DI1-2: Drop Inlet 1

Stage-Discharge



Pond DI1-2: Drop Inlet 1

Stage-Area-Storage



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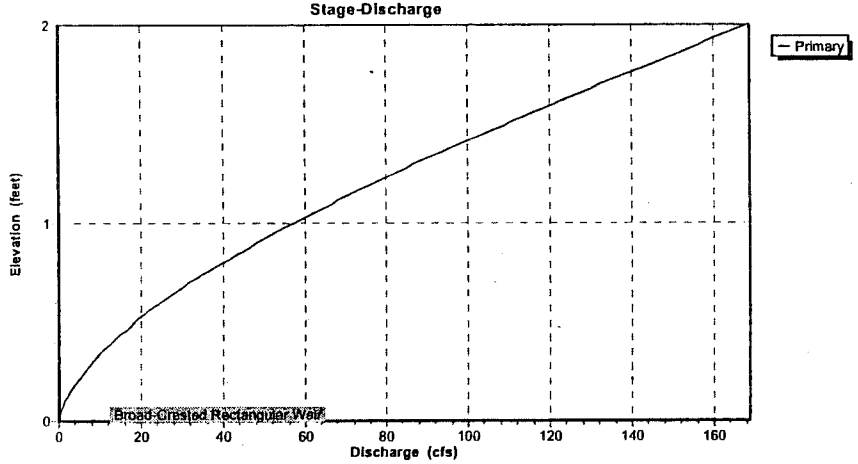
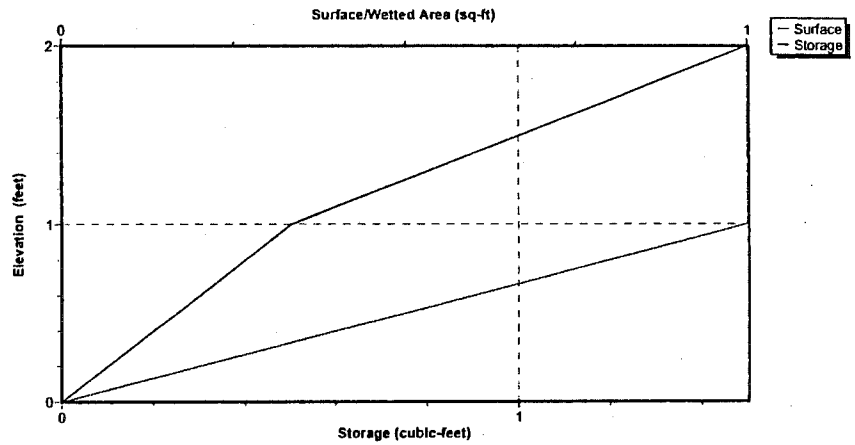
Pond DI3-1: Drop Inlet 3

Stage-Discharge



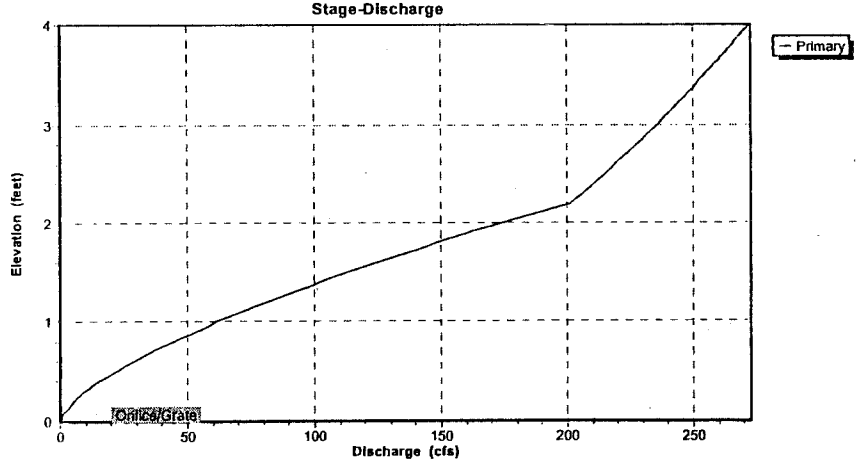
Pond DI3-1: Drop Inlet 3

Stage-Area-Storage



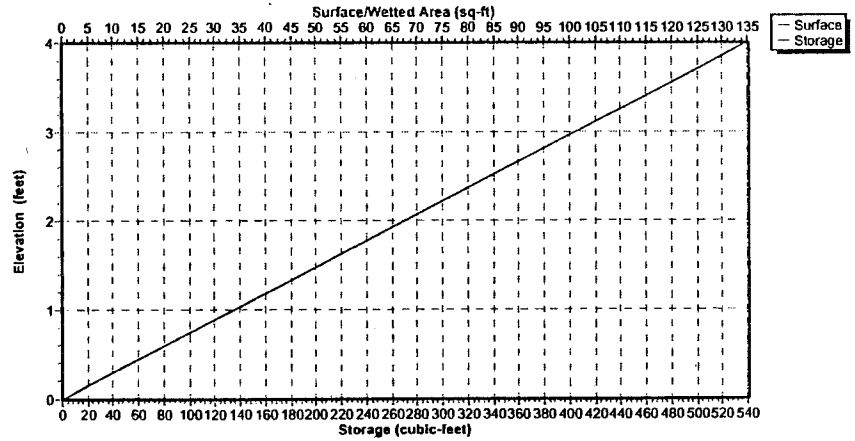
Pond DI3-2: Drop Inlet 3

Stage-Discharge



Pond DI3-2: Drop Inlet 3

Stage-Area-Storage



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APPENDIX VIb-I.7
DROP INLET DESIGN

PURPOSE

The purpose of this calculation package is to verify the size of the stormwater drop inlets that will be located around the perimeter of the Cherry Island Landfill. The drop inlets will receive stormwater from the downchutes and perimeter drainage channel and convey the stormwater through the mechanically stabilized earth (MSE) berm to outlet culverts located at the base of the MSE berm.

METHOD

The drop inlets incorporate two conveyance features: (i) a broad crested weir that intercepts discharges across the entire width of the downchute; and (ii) a horizontal orifice that permits the discharge to drop form the top of the inlet to the base of the drop inlet structure. The typical drop inlet is presented in Attachment 1 and a cross section of the downchute/weir/orifice flow path being modeled is presented in Attachment 2.

Each drop inlet is evaluated using stage-storage and stage-discharge curves based on the hydraulic characteristics of the drop inlet. Using theses curves the discharge from the 100-year, 24-hour design storm is routed through the drop inlets.

The discharge capacity of the broad crested weir and horizontal orifice are evaluated using the following equations [HydroCAD, 2001]:

$$Q = C_w \, L \, H^{2/3} \qquad (1)$$

$$Q = C_o \, a \sqrt{2gh} \qquad (2)$$

$$h = H - TW \qquad (3)$$

where:
- Q = total discharge (ft^3/sec);
- C_w = weir coefficient, function of crest breadth and head h (dimensionless);
- L = crest length (ft.)
- H = head at inlet (ft.) (see Attachment 2);
- C_o = orifice discharge coefficient (0.6);
- a = orifice area (ft^2);
- g = gravitational constant (32.2 ft/sec^2);

h = effective head (ft.); and
TW = tailwater (0 ft. for all structures).

The maximum height of water above each structure is analyzed using the Storage-Indication Routing method [Ponce, 1989].

$$I - O = \frac{\Delta S}{\Delta t} \qquad (4)$$

where: I = inflow rate into the structure (ft^3/sec);
O = outflow rate from the structure (ft^3/sec);
ΔS = change in storage (ft^3); and
Δt = time change increment (hr).

CALCULATION PARAMETERS

The discharge to each drop inlet is obtained from Appendix VIb-I.3. The length of broad crested weir, L, is based on the downchute width at the intersection with the drop inlet. Downchute widths are taken from Appendix VIb-I.5.

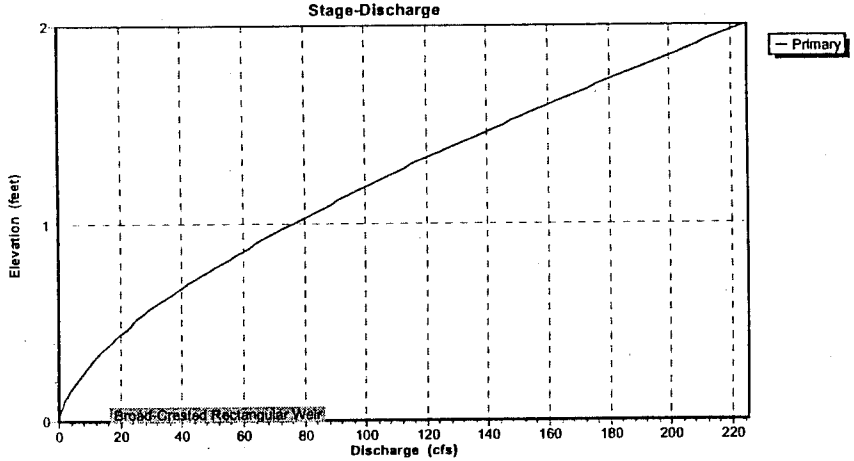
The broad crested weir is designed to have a breadth, b, of 8 in. (0.67 ft.). The weir coefficient, C_w, is interpolated from the coefficients presented by HydroCAD [2001], which are summarized below.

WEIR COEFFICIENT C_w

Head	Weir Breadth, b		
Ft.	0.5 ft.	0.75 ft.	Interpolated @ 0.67 ft.
0.2	2.80	2.75	2.76
0.4	2.92	2.80	2.82
0.6	3.08	2.89	2.93
0.8	3.30	3.04	3.09
1.0	3.32	3.14	3.18
1.2	3.32	3.20	3.22
1.4	3.32	3.26	3.27
1.6	3.32	3.29	3.30
1.8	3.32	3.32	3.32
2.0	3.32	3.31	3.31
2.2	3.32	3.32	3.32
2.4	3.32	3.32	3.32

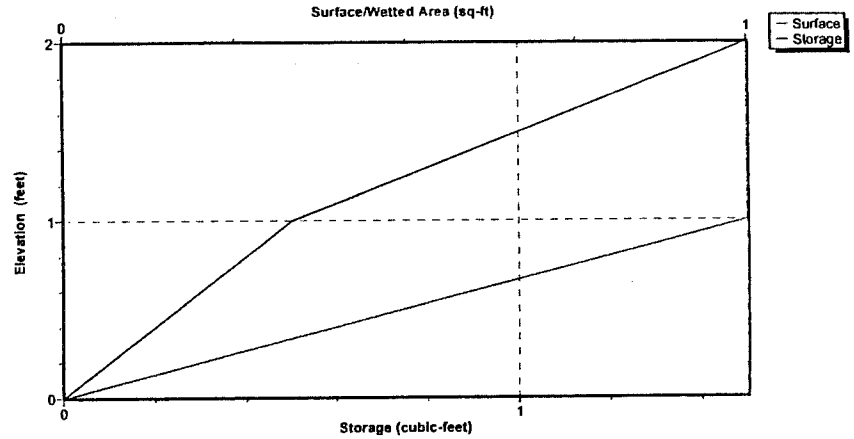
Pond DI5-1: Drop Inlet 5

Stage-Discharge



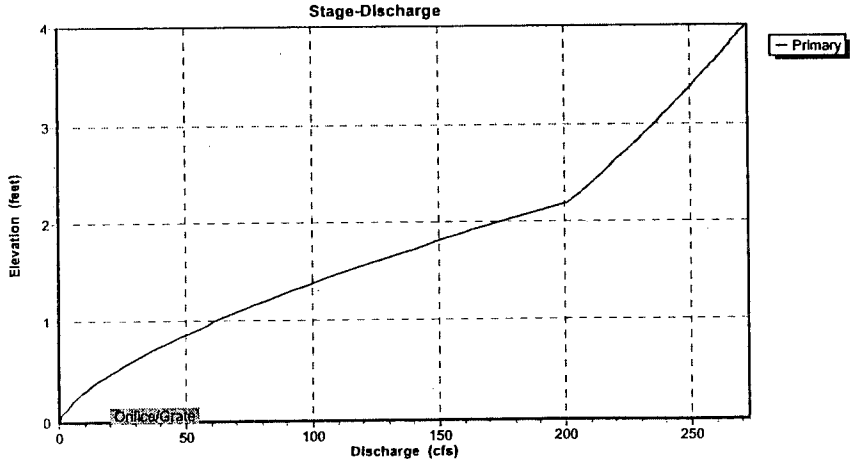
Pond DI5-1: Drop Inlet 5

Stage-Area-Storage



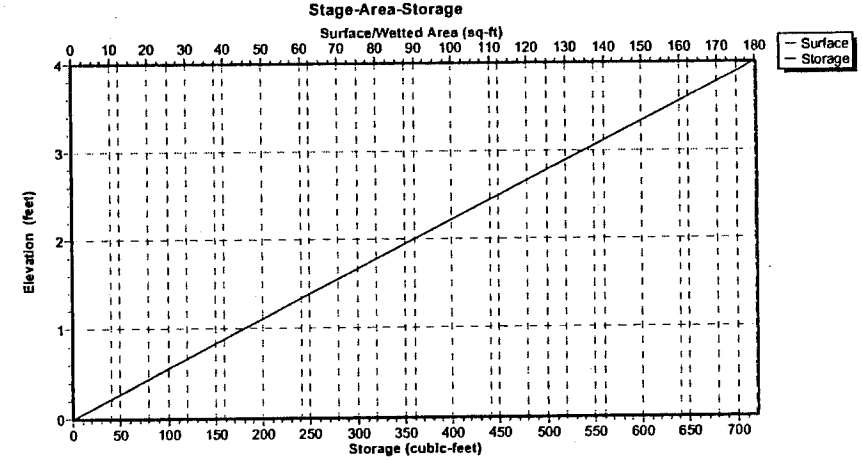
Pond DI5-2: Drop Inlet 5

Stage-Discharge



Pond DI5-2: Drop Inlet 5

Stage-Area-Storage



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ATTACHMENT 5

100-YEAR, 24-HOUR DESIGN STORM DISCHARGE HYDROCAD MODEL OUTPUT

Pond DI1-1: Drop Inlet 1

Inflow	=	121.29 cfs @	11.99 hrs,	Volume=	8.976 af
Outflow	=	121.29 cfs @	11.99 hrs,	Volume=	8.976 af, Atten= 0%, Lag= 0.0 min
Primary	=	121.29 cfs @	11.99 hrs,	Volume=	8.976 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Peak Elev= 1.61' Storage= 1 cf
Flood Elev= 3.00' Storage= 3 cf
Plug-Flow detention time=0.0 min calculated for 8.958 af (100% of inflow)
Storage and wetted areas determined by Prismatic sections

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
0.00	0	0	0
1.00	1	1	1
2.00	1	1	2

Primary OutFlow (Free Discharge)
└1=Broad-Crested Rectangular Weir

#	Routing	Invert	Outlet Devices
1	Primary	0.00'	**18.0' long x 0.7' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 Coef. (English) 2.76 2.82 2.93 3.09 3.18 3.22 3.27 3.30 3.32 3.31 3.32

Pond DI1-2: Drop Inlet 1

Inflow	=	121.29 cfs @	11.99 hrs,	Volume=	8.976 af
Outflow	=	121.17 cfs @	11.99 hrs,	Volume=	8.977 af, Atten= 0%, Lag= 0.0 min
Primary	=	121.17 cfs @	11.99 hrs,	Volume=	8.977 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs / 4

Peak Elev= 1.57' Storage= 212 cf
Plug-Flow detention time=(not calculated: outflow precedes inflow)
Storage and wetted areas determined by Prismatic sections

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
0.00	135	0	0
4.00	135	540	540

Primary OutFlow (Free Discharge)
└1=Orifice/Grate

#	Routing	Invert	Outlet Devices
1	Primary	0.00'	**72.0" Horiz. Orifice/Grate** Limited to weir flow C= 0.600

Pond DI2-1: Drop Inlet 2

Inflow	=	133.56 cfs @	12.01 hrs,	Volume=	12.643 af
Outflow	=	133.56 cfs @	12.01 hrs,	Volume=	12.643 af, Atten= 0%, Lag= 0.0 min
Primary	=	133.56 cfs @	12.01 hrs,	Volume=	12.643 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Peak Elev= 1.71' Storage= 1 cf
Flood Elev= 3.00' Storage= 3 cf
Plug-Flow detention time=0.0 min calculated for 12.643 af (100% of inflow)
Storage and wetted areas determined by Prismatic sections

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
0.00	0	0	0
1.00	1	1	1
2.00	1	1	2

Primary OutFlow (Free Discharge)
└1=Broad-Crested Rectangular Weir

#	Routing	Invert	Outlet Devices
1	Primary	0.00'	**18.0' long x 0.7' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 Coef. (English) 2.76 2.82 2.93 3.09 3.18 3.22 3.27 3.30 3.32 3.31 3.32

Pond DI2-2: Drop Inlet 2

Inflow	=	133.56 cfs @	12.01 hrs,	Volume=	12.643 af
Outflow	=	133.45 cfs @	12.01 hrs,	Volume=	12.643 af, Atten= 0%, Lag= 0.0 min
Primary	=	133.45 cfs @	12.01 hrs,	Volume=	12.643 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs / 4

Peak Elev= 1.67' Storage= 226 cf
Plug-Flow detention time=(not calculated: outflow precedes inflow)
Storage and wetted areas determined by Prismatic sections

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
0.00	135	0	0
4.00	135	540	540

Primary OutFlow (Free Discharge)
└1=Orifice/Grate

#	Routing	Invert	Outlet Devices
1	Primary	0.00'	**72.0" Horiz. Orifice/Grate** Limited to weir flow C= 0.600

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Pond DI5-1: Drop Inlet 5

Inflow = 199.50 cfs @ 12.00 hrs, Volume= 14.674 af
Outflow = 199.50 cfs @ 12.00 hrs, Volume= 14.674 af, Atten= 0%, Lag= 0.0 min
Primary = 199.50 cfs @ 12.00 hrs, Volume= 14.674 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs / 3

Peak Elev= 1.84' Storage= 1 cf
Flood Elev= 3.00' Storage= 3 cf
Plug-Flow detention time=0.0 min calculated for 14.674 af (100% of inflow)
Storage and wetted areas determined by Prismatic sections

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
0.00	0	0	0
1.00	1	1	1
2.00	1	1	2

Primary OutFlow (Free Discharge)
└1=Broad-Crested Rectangular Weir

#	Routing	Invert	Outlet Devices
1	Primary	0.00'	**24.0' long x 0.7' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 Coef. (English) 2.76 2.82 2.93 3.09 3.18 3.22 3.27 3.30 3.32 3.31 3.32

Pond DI5-2: Drop Inlet 5

Inflow = 199.50 cfs @ 12.00 hrs, Volume= 14.674 af
Outflow = 199.29 cfs @ 12.00 hrs, Volume= 14.674 af, Atten= 0%, Lag= 0.0 min
Primary = 199.29 cfs @ 12.00 hrs, Volume= 14.674 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs / 4

Peak Elev= 2.19' Storage= 394 cf
Plug-Flow detention time=(not calculated: outflow precedes inflow)
Storage and wetted areas determined by Prismatic sections

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
0.00	180	0	0
4.00	180	720	720

Primary OutFlow (Free Discharge)
└1=Orifice/Grate

#	Routing	Invert	Outlet Devices
1	Primary	0.00'	**72.0" Horiz. Orifice/Grate** Limited to weir flow C= 0.600

Pond DI6-1: Drop Inlet 6

Inflow = 157.91 cfs @ 12.00 hrs, Volume= 12.623 af
Outflow = 157.91 cfs @ 12.00 hrs, Volume= 12.623 af, Atten= 0%, Lag= 0.0 min
Primary = 157.91 cfs @ 12.00 hrs, Volume= 12.623 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Peak Elev= 1.58' Storage= 1 cf
Flood Elev= 3.00' Storage= 3 cf
Plug-Flow detention time=0.0 min calculated for 12.597 af (100% of inflow)
Storage and wetted areas determined by Prismatic sections

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
0.00	0	0	0
1.00	1	1	1
2.00	1	1	2

Primary OutFlow (Free Discharge)
└1=Broad-Crested Rectangular Weir

#	Routing	Invert	Outlet Devices
1	Primary	0.00'	**24.0' long x 0.7' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 Coef. (English) 2.76 2.82 2.93 3.09 3.18 3.22 3.27 3.30 3.32 3.31 3.32

Pond DI6-2: Drop Inlet 6

Inflow = 157.91 cfs @ 12.00 hrs, Volume= 12.623 af
Outflow = 157.74 cfs @ 12.00 hrs, Volume= 12.623 af, Atten= 0%, Lag= 0.0 min
Primary = 157.74 cfs @ 12.00 hrs, Volume= 12.623 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs / 4

Peak Elev= 1.87' Storage= 337 cf
Plug-Flow detention time=(not calculated: outflow precedes inflow)
Storage and wetted areas determined by Prismatic sections

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
0.00	180	0	0
4.00	180	720	720

Primary OutFlow (Free Discharge)
└1=Orifice/Grate

#	Routing	Invert	Outlet Devices
1	Primary	0.00'	**72.0" Horiz. Orifice/Grate** Limited to weir flow C= 0.600

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WMS 3/26/03 BSS 3/26/03 19/20

ATTACHMENT - 6

DROP INLET FEATURES DESIGN RESULTS

Channel ID	Description	Available Depth D (ft.)	Depth of Flow at Peak Q Y[1] (ft.)	Available Freeboard D-Y (ft.)
DI1-1	Broad Crested Weir	3.00	1.61	1.39
DI1-2	Orifice	4.00	1.57	2.43
DI2-1	Broad Crested Weir	3.00	1.71	1.29
DI2-2	Orifice	4.00	1.67	2.33
DI3-1	Broad Crested Weir	3.00	1.55	1.45
DI3-2	Orifice	4.00	1.51	2.49
DI4-1	Broad Crested Weir	3.00	1.71	1.29
DI4-2	Orifice	4.00	1.28	2.72
DI5-1	Broad Crested Weir	3.00	1.84	1.16
DI5-2	Orifice	4.00	2.19	1.81
DI6-1	Broad Crested Weir	3.00	1.58	1.42
DI6-2	Orifice	4.00	1.87	2.13

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Appendix VIb-I.8

Stormwater Outlet Culvert Design

GEOSYNTEC CONSULTANTS

COMPUTATION COVER SHEET

Client: DSWA Project: Cherry Island Landfill Project/Proposal #: ME0250 Task #: 2.9.2

TITLE OF COMPUTATIONS APPENDIX VIb-I.8: STORMWATER OUTLET CULVERT DESIGN

COMPUTATIONS BY:
Signature
Printed Name and Title: William M. Steier, P.E., Project Engineer
25 March 2003
DATE

ASSUMPTIONS AND PROCEDURES CHECKED BY:
(Peer Reviewer)
Signature
Printed Name and Title: Eric. S. Steinhauser, P.E., Associate
25 March 2003
DATE

COMPUTATIONS CHECKED BY:
Signature
Printed Name and Title: Eric. S. Steinhauser, P.E., Associate
25 March 2003
DATE

COMPUTATIONS BACKCHECKED BY:
(Originator)
Signature
Printed Name and Title: William M. Steier, P.E., Project Engineer
25 March 2003
DATE

APPROVED BY:
(PM or Designate)
Signature
Printed Name and Title: David Espinoza, P.E., Senior Engineer
31 March 03
DATE

APPROVAL NOTES:

The calculations presented herein are suitable for a landfill elevation of 195 ft-msl. As shown in this calculation package, the design was performed for a more conservative grading configuration than that shown in Drawing 78 entitled "Landfill Final Development and Grading Plan" (Appendix VIb-A).

RDS 6/10/04

REVISIONS (Number and initial all revisions)

NO.	SHEET	DATE	BY	CHECKED BY	APPROVAL

APPENDIX VIb-I-8
STORMWATER OUTLET CULVERT DESIGN

PURPOSE

The purpose of this calculation package is to design the stormwater outlet culverts for the final cover system of the Cherry Island Landfill. Outlet culverts will convey the stormwater runoff associated with a 100-year, 24-hour design storm that enters the various drop inlets around the landfill to outlets at either the Christina River or Delaware River. This calculation presents the stormwater outlet culvert sizes, minimum slope, and outlet velocity.

METHOD

The peak stormwater discharge from a 100-year, 24-hour design storm contributing to each stormwater outlet culvert was calculated in Appendix VIb-I.3.

Sizing the culverts is a step-wise process, as described below.

1. A preliminary design for each outlet culvert was performed using "*HydroCAD® Stormwater Modeling System*", version 6 [Applied Microcomputer Systems, 2001] (HydroCAD®) to route the 100-year, 24-hour design storm through the overall stormwater management system. The HydroCAD® model network diagram is presented in Attachment 1. This analysis was performed with the assumption that the outlet culverts were 72-in. diameter concrete pipes sloped at one percent. Attachment 2 presents as summary of the HydroCAD® input parameters. Attachment 3 presents the results of the analysis.

2. Using Manning's equation, the results of the preliminary design were refined to establish subcritical flow in the outlet culverts. For the analysis, pipe diameter and slope were varied. The refined culvert diameters and slopes for each segment are presented in Attachment 4. Design criteria for outlet culverts included:

    - a maximum pipe diameter of 72 in. – selected as a practical upper bound to limit construction costs;
    - subcritical flow – selected to restrict flow velocities and force the drop inlet structure to provide the primary kinetic energy dissipation for the culvert system, which will prevent the formation of hydraulic jumps and turbulent flow within the culverts; and
    - a maximum outlet velocity of 14 ft/sec – selected to provide an upper bound for outlet protection requirements and limit construction costs.

Subcritical flow conditions are evaluated by comparing the normal flow depth (y_n) in each culvert segment to the critical flow depth (y_{cr}). The normal flow depth at the design discharge is estimated by trial and error solution for each stormwater outlet culvert using Manning's Equation [Chow, 1959]:

$$Q = \frac{1.49}{n} A R^{2/3} S^{1/2} \tag{1}$$

where: Q = discharge (ft^3/sec);
n = Manning's roughness coefficient (dimensionless);
A = area of cross-section of flow (ft^2);
R = hydraulic radius = $\frac{A}{P}$ (ft.);
P = wetted perimeter (ft.); and
S = longitudinal slope of the channel (ft/ft).

From geometry, the area and wetted perimeter of a circular cross section are each a function of the central angle of the circle, see Attachment 5. Formulas for area and perimeter are as follows:

$$A = \frac{\left(\frac{D}{2}\right)^2 \times (\theta - \sin\theta)}{2} \tag{2}$$

$$P = \frac{D}{2} \times \theta \tag{3}$$

where: A = flow area (ft^2);
D = culvert diameter (ft.)
θ = central angle (radians)

The flow depth, y, is related to the central angle by the following equation:

$$y = \frac{D}{2}\left[1 - \cos\left(\frac{\theta}{2}\right)\right] \tag{4}$$

Multiple combinations of culvert sizes (i.e., diameter) and bed slopes were analyzed for each culvert. Analysis of the minimum bed slope/culvert size combination to convey the design discharge, and the corresponding normal flow depth, y_n, for each culvert is presented in Attachment 6.

Using the culvert diameter and anticipated flow rate (Q_{100}) from Attachment 4, the critical flow depth, y_{cr}, within each culvert is estimated by trial and error solution to the following equation [Daugherty et. al., 1985]:

$$\frac{Q^2}{g} = \left(\frac{A^3}{b}\right) \tag{5}$$

or

$$Q = \sqrt{g\left(\frac{A^3}{b}\right)} \tag{6}$$

where: Q = discharge (ft^3/sec);
g = gravitational constant (ft/sec^2)
A = area of cross-section of flow (ft^2); and
b = width of flow at the water surface (ft.).

From geometry, flow area, A, and width of flow at the water surface, b, for a circular cross section are each a function of the central angle, see Attachment 5. The flow area is estimated using Equation 2 and the flow width at the water surface is estimated using the following equation:

$$b = \frac{D}{2} \times 2\left(\sin\frac{\theta}{2}\right) \tag{7}$$

where: b = width of flow at the water surface (ft.);
D = Culvert diameter (ft.); and
θ = central angle (radians).

The critical depth, y_{cr}, is estimated from Equation 4. The critical depth and a comparison to the normal flow depth are presented in Attachment 6.

In consideration of culvert outlet protection requirements, the design outlet velocity is limited to 14 ft/sec or less. Outlet protection design for each culvert is presented in Appendix VIb-I.9.

Outlet velocity is calculated using the following equation and the calculated outlet velocities are presented in Attachment 4:

$$V = \frac{Q}{A} \tag{8}$$

where: V = outlet velocity (ft/sec);
Q = design discharge (ft^3/sec); and
A = flow area at the design discharge (ft^2).

3. Using head loss equations for flow through a manhole, flow at a manhole-junction, and friction loss along a pipe, estimate the hydraulic head losses at each manhole along the culvert length. Head losses through manholes MH1-1, 2, 3, 5, 6, MH3-1, and MH5-1, and 2 are estimated using the following equation [AISI, 1995]:

$$H_b = k_b \frac{V^2}{2g} \tag{9}$$

where: H_b = head loss due to a bend at a manhole (ft.);
k_b = head loss coefficient from Attachment 7 (dimensionless);
V = flow velocity (ft/sec); and
g = gravitational constant (ft/sec^2).

The head loss coefficient k_b is a function of the deflection angle of the manhole and manhole construction. For this design the manhole bases are shaped to reduce head losses. coefficients obtained from attachment 7 are based on the "Bend at Manhole, Curved or Deflector" curve. The deflection angle at each manhole is obtained from the drawings, and summarized in Attachment 9. For straight flow-through manholes the coefficient k_b is equal to 0.05 [ASAI, 1995], this value is used at the minimum value for design.

Head loss at junction manhole, MH-4, is estimated using the following equation:

$$\left(H_j + D_1 - D_2\right)\left[\left(A_1 + A_2\right)(0.5)\right] = \frac{Q_2^{\,2}}{A_2 g} - \frac{Q_1^{\,2}}{A_1 g} - \frac{Q_3^{\,2}}{A_3 g}\cos\beta \tag{10}$$

where: H_j = head loss due to a junction (ft.);
$Q_{1,2,3}$= discharge through Culverts 1, 2, and 3 (ft^3/sec), see Attachment 8 for depiction of culvert orientation;
$D_{1,2}$ = inlet and outlet culvert diameters (ft.);
$A_{1,2,3}$= flow area within section 1 and 2 respectively (ft^2) and;
β = angle between culverts 1 and 3 (radians).

For this calculation the flow through the pipe is assumed to be uniform. Therefore friction head loss, H_f, within the pipe is equal to the culvert bed slope times the length of the culvert section, L. A summary of the hydraulic head losses from manholes and junctions is presented in Attachment 9.

4. Estimate the water surface elevation (WSE) along the culvert lengths using the hydraulic head losses obtained in Step 3. Calculations start at normal depth, y_n, at the culvert outfall and proceed upstream. Water surface elevation at the inlet of each segment is calculated as follows:

$$WSE = (Invert) + (y_n) + (H_b + H_j + H_f) \tag{11}$$

A summary of the estimated water surface elevations and top of culvert elevations is presented in Attachment 10.

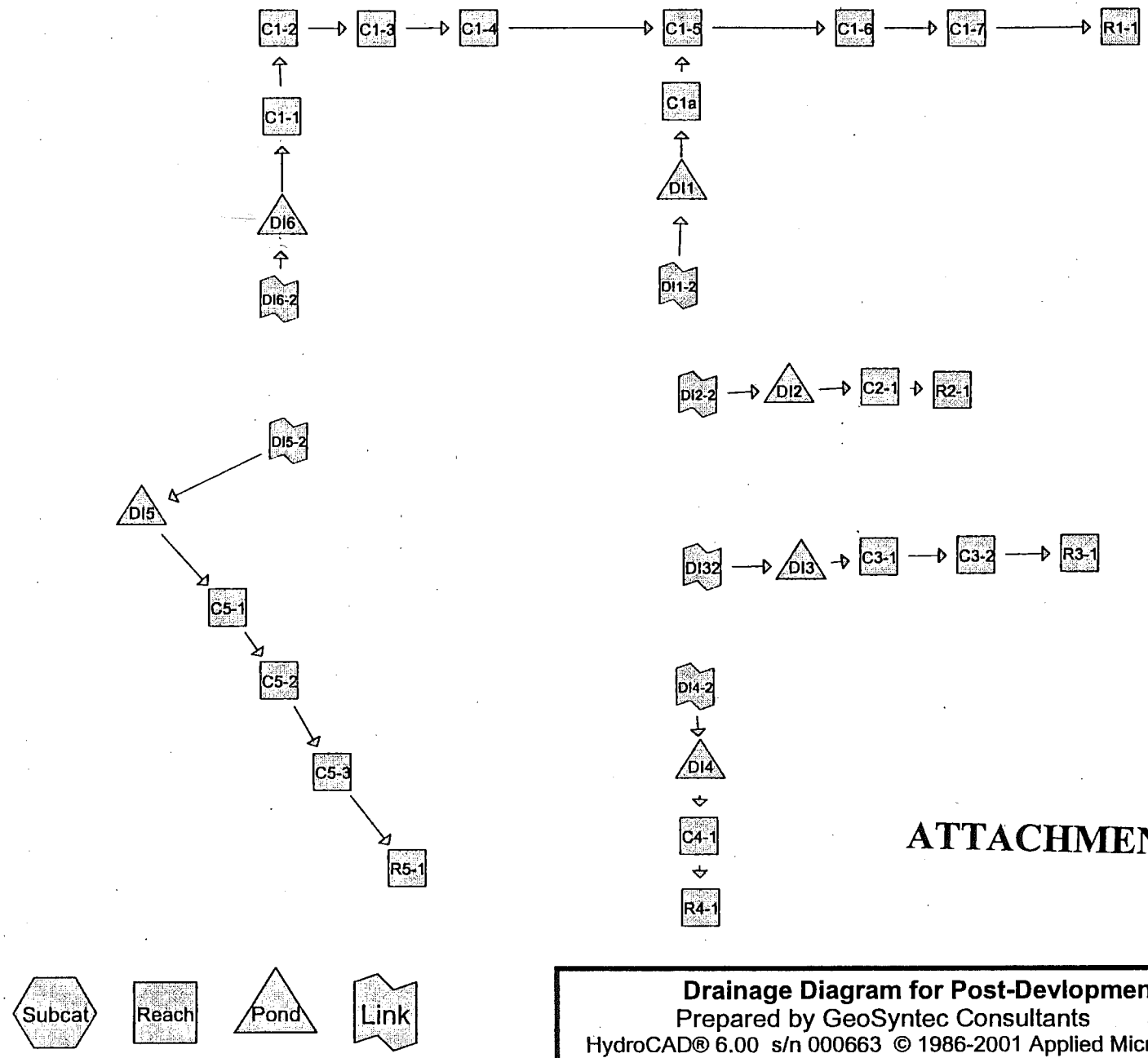
5. If the water surface estimated in Step 4 is greater than the top of the culvert, as presented in Attachment 11, then provide an invert adjustment at the affected manhole locations. The adjustment will allow culverts to maintain partially full flow depth. A summary of the refined invert elevations is presented in Attachment 10.

CALCULATION PARAMETERS

The calculation parameters of culvert diameter and bed slope are variable and are chosen based on trial and error solutions to Equation 1. Culverts will be constructed of reinforced concrete pipe (RCP). Manning roughness coefficient for RCP pipe is n = 0.012.

RESULTS

A summary of the final design culvert size, discharge, length, slope, invert elevation and outlet velocity are presented in Attachment 10. Because differential settlement is expected to occur along the flow axis of culvert segments crossing the perimeter berm, the construction elevation invert elevations of the culvert segments beneath the perimeter berm are increased to compensate for the predicted settlement. Information regarding the predicted settlement along the culverts is presented in Appendix VIb-I.10.



ATTACHMENT 1

Drainage Diagram for Post-Devlopment Culvert
Prepared by GeoSyntec Consultants 3/25/2003
HydroCAD® 6.00 s/n 000663 © 1986-2001 Applied Microcomputer Systems

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WMS 3/25/03 ASS 3/25/03

ATTACHMENT 2
PRELIMINARY DESIGN INPUT AND DESIGN DISCHARGE SUMMARY

Segment Identification	Culvert Diameter (ft.)	Slope (ft/ft)	Length (ft.)	Design Discharge Q_{100}[1] (ft^3/sec)
C1-1	6	0.01	40	157.8
C1-2	6	0.01	336	157.8
C1-3	6	0.01	336	157.8
C1-4	6	0.01	576	157.8
C1-5	6	0.01	512	275.8
C1-6	6	0.01	280	275.8
C1-7	6	0.01	72	275.8
C1a	6	0.01	80	121.5
C3-1	6	0.01	144	114.7
C2-1	6	0.01	112	133.5
C4-1	6	0.01	96	88.8
C5-1	6	0.01	16	199.3
C5-2	6	0.01	408	199.3
C5-3	6	0.01	160	199.3

Notes:
1. From Hydrocad Model "Post Development Culvert", model output presented in Attachment 3.
2. Manning n for RCP pipe = 0.012

Written by: William M. Steier Date: 25 March 2003 Reviewed by: Eric S. Steinhauser Date: 25 March 2003

Client: DSWA Project: Cherry Island Landfill Project/Proposal No.: ME0250 Task No.: 2.9.2

ATTACHMENT 3

HYDROCAD MODEL OUTPUT "POST DEVELOPMENT CULVERT" MODEL

Reach C1-1: Culvert 1

Inflow = 157.76 cfs @ 12.00 hrs, Volume= 12.622 af
Outflow = 157.85 cfs @ 12.01 hrs, Volume= 12.621 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 14.7 fps, Min. Travel Time= 0.0 min
Avg. Velocity = 5.4 fps, Avg. Travel Time= 0.1 min

Peak Depth= 2.43'
Capacity at bank full= 458.80 cfs
Inlet Invert= 22.00', Outlet Invert= 21.60'
72.0" Diameter Pipe n= 0.012 Length= 40.0' Slope= 0.0100 '/'

Reach C1-2: Culvert 1

Inflow = 157.85 cfs @ 12.01 hrs, Volume= 12.621 af
Outflow = 158.00 cfs @ 12.01 hrs, Volume= 12.617 af, Atten= 0%, Lag= 0.3 min

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 14.7 fps, Min. Travel Time= 0.4 min
Avg. Velocity = 5.3 fps, Avg. Travel Time= 1.0 min

Peak Depth= 2.43'
Capacity at bank full= 458.80 cfs
Inlet Invert= 21.85', Outlet Invert= 18.49'
72.0" Diameter Pipe n= 0.012 Length= 336.0' Slope= 0.0100 '/'

Reach C1-3: Culvert 1

Inflow = 158.00 cfs @ 12.01 hrs, Volume= 12.617 af
Outflow = 157.93 cfs @ 12.01 hrs, Volume= 12.612 af, Atten= 0%, Lag= 0.3 min

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 14.7 fps, Min. Travel Time= 0.4 min
Avg. Velocity = 5.3 fps, Avg. Travel Time= 1.0 min

Peak Depth= 2.43'
Capacity at bank full= 458.80 cfs
Inlet Invert= 19.79', Outlet Invert= 16.43'
72.0" Diameter Pipe n= 0.012 Length= 336.0' Slope= 0.0100 '/'

Reach C1-4: Culvert 1

Inflow = 157.93 cfs @ 12.01 hrs, Volume= 12.612 af
Outflow = 157.33 cfs @ 12.02 hrs, Volume= 12.604 af, Atten= 0%, Lag= 0.5 min

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 14.6 fps, Min. Travel Time= 0.7 min
Avg. Velocity = 5.3 fps, Avg. Travel Time= 1.8 min

Peak Depth= 2.42'
Capacity at bank full= 458.80 cfs
Inlet Invert= 18.52', Outlet Invert= 12.76'
72.0" Diameter Pipe n= 0.012 Length= 576.0' Slope= 0.0100 '/'

Reach C1-5: Culvert 1

Inflow = 275.79 cfs @ 12.01 hrs, Volume= 21.578 af
Outflow = 275.06 cfs @ 12.01 hrs, Volume= 21.568 af, Atten= 0%, Lag= 0.4 min

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 16.9 fps, Min. Travel Time= 0.5 min
Avg. Velocity = 6.3 fps, Avg. Travel Time= 1.4 min

Peak Depth= 3.35'
Capacity at bank full= 458.80 cfs
Inlet Invert= 17.88', Outlet Invert= 12.76'
72.0" Diameter Pipe n= 0.012 Length= 512.0' Slope= 0.0100 '/'

Reach C1-6: Culvert 1

Inflow = 275.06 cfs @ 12.01 hrs, Volume= 21.568 af
Outflow = 274.68 cfs @ 12.02 hrs, Volume= 21.563 af, Atten= 0%, Lag= 0.2 min

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 16.9 fps, Min. Travel Time= 0.3 min
Avg. Velocity = 6.3 fps, Avg. Travel Time= 0.7 min

Peak Depth= 3.35'
Capacity at bank full= 458.80 cfs
Inlet Invert= 16.08', Outlet Invert= 13.28'
72.0" Diameter Pipe n= 0.012 Length= 280.0' Slope= 0.0100 '/'

Reach C1-7: Culvert 1

Inflow = 274.68 cfs @ 12.02 hrs, Volume= 21.563 af
Outflow = 274.60 cfs @ 12.02 hrs, Volume= 21.561 af, Atten= 0%, Lag= 0.1 min

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 16.9 fps, Min. Travel Time= 0.1 min
Avg. Velocity = 6.3 fps, Avg. Travel Time= 0.2 min

Peak Depth= 3.34'
Capacity at bank full= 458.80 cfs
Inlet Invert= 16.08', Outlet Invert= 15.36'
72.0" Diameter Pipe n= 0.012 Length= 72.0' Slope= 0.0100 '/'

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3/27/03

Peak Depth= 2.76'
Capacity at bank full= 458.80 cfs
72.0" Diameter Pipe n= 0.012 Length= 168.0' Slope= 0.0100 '/'

Pond DI1: Outlet culvert 1-1

Inflow	=	121.17 cfs @	11.99 hrs,	Volume=	8.977 af
Outflow	=	121.21 cfs @	11.99 hrs,	Volume=	8.975 af, Atten= 0%, Lag= 0.0 min
Primary	=	121.21 cfs @	11.99 hrs,	Volume=	8.975 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Starting Elev= 4.00' Storage= 112 cf
Peak Elev= 10.01' Storage= 280 cf (168 cf above starting storage)
Flood Elev= 60.00' Storage= 1,680 cf (1,568 cf above starting storage)
Plug-Flow detention time= 1.0 min calculated for 8.953 af (100% of inflow)
Storage and wetted areas determined by Prismatic sections

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
0.00	28	0	0
60.00	28	1,680	1,680

Primary OutFlow (Fixed Tailwater Elevation= 7.50')
└─1=Culvert

#	Routing	Invert	Outlet Devices
1	Primary	4.00'	**54.0" x 1.0' long Culvert** CMP, square edge headwall, Ke= 0.500 Outlet Invert= 3.99' S= 0.0100 '/' n= 0.012 Cc= 0.900

Pond DI2: Outlet culvert 2

Inflow	=	133.45 cfs @	12.01 hrs,	Volume=	12.643 af
Outflow	=	133.47 cfs @	12.01 hrs,	Volume=	12.643 af, Atten= 0%, Lag= 0.0 min
Primary	=	133.47 cfs @	12.01 hrs,	Volume=	12.643 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Starting Elev= 4.00' Storage= 112 cf
Peak Elev= 8.50' Storage= 238 cf (126 cf above starting storage)
Flood Elev= 60.00' Storage= 1,680 cf (1,568 cf above starting storage)
Plug-Flow detention time= 0.7 min calculated for 12.614 af (100% of inflow)
Storage and wetted areas determined by Prismatic sections

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
0.00	28	0	0
60.00	28	1,680	1,680

Primary OutFlow (Free Discharge)
└─1=Culvert

#	Routing	Invert	Outlet Devices
1	Primary	4.00'	**72.0" x 1.0' long Culvert** RCP, rounded edge headwall, Ke= 0.100 Outlet Invert= 3.99' S= 0.0100 '/' n= 0.012 Cc= 0.900

Pond DI3: Outlet culvert 3

Inflow	=	114.70 cfs @	12.01 hrs,	Volume=	10.956 af
Outflow	=	114.73 cfs @	12.01 hrs,	Volume=	10.955 af, Atten= 0%, Lag= 0.0 min
Primary	=	114.73 cfs @	12.01 hrs,	Volume=	10.955 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Starting Elev= 4.00' Storage= 112 cf
Peak Elev= 8.12' Storage= 227 cf (115 cf above starting storage)
Flood Elev= 60.00' Storage= 1,680 cf (1,568 cf above starting storage)
Plug-Flow detention time= 0.7 min calculated for 10.953 af (100% of inflow)
Storage and wetted areas determined by Prismatic sections

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
0.00	28	0	0
60.00	28	1,680	1,680

Primary OutFlow (Free Discharge)
└─1=Culvert

#	Routing	Invert	Outlet Devices
1	Primary	4.00'	**72.0" x 1.0' long Culvert** RCP, rounded edge headwall, Ke= 0.100 Outlet Invert= 3.99' S= 0.0100 '/' n= 0.012 Cc= 0.900

Pond DI4: Outlet culvert 4

Inflow	=	88.80 cfs @	11.98 hrs,	Volume=	5.687 af
Outflow	=	88.82 cfs @	11.98 hrs,	Volume=	5.687 af, Atten= 0%, Lag= 0.0 min
Primary	=	88.82 cfs @	11.98 hrs,	Volume=	5.687 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Starting Elev= 4.00' Storage= 112 cf
Peak Elev= 7.09' Storage= 198 cf (86 cf above starting storage)
Flood Elev= 60.00' Storage= 1,680 cf (1,568 cf above starting storage)
Plug-Flow detention time= 1.0 min calculated for 5.685 af (100% of inflow)
Storage and wetted areas determined by Prismatic sections

WW 3/25/03 12/22
BSS 3/25/03

Link DI5-2: (new node)

Inflow	=	199.29 cfs @	12.00 hrs, Volume=	14.674 af	
Primary	=	199.29 cfs @	12.00 hrs, Volume=	14.674 af,	Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Primary Outflow Imported from Post-Devlopment~Pond DI5-2

Link DI6-2: (new node)

Inflow	=	157.74 cfs @	12.00 hrs, Volume=	12.623 af	
Primary	=	157.74 cfs @	12.00 hrs, Volume=	12.623 af,	Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Primary Outflow Imported from Post-Devlopment~Pond DI6-2

14/22
WW
3/25/03
SS
3/25/03

15/22 wm 3/25/03
SSS 3/25/03

ATTACHMENT 4

REFINED CULVERT DIAMETER / SLOPE SUMMARY

Segment Identification	Culvert Diameter (ft.)	Discharge Q_{100} (ft^3/sec)	Input			Section Outlet Velocity (ft/sec)
			Length (ft.)	Slope (ft/ft)	Manning n --	
C1-1	4.5	157.76	40	0.005	0.012	10.8
MH1-1	4.5	157.76	6	0.017	0.012	
C1-2	4.5	157.76	336	0.005	0.012	10.8
MH1-2	4.5	157.76	6	0.017	0.012	
C1-3	4.5	157.76	336	0.005	0.012	10.8
MH1-3	4.5	157.76	6	0.017	0.012	
C1-4	4.5	157.76	576	0.005	0.012	10.8
MH1-4	5.5	157.76	6	0.017	0.012	
C1-5	5.5	275.76	512	0.005	0.012	12.2
MH1-5	5.5	275.76	6	0.017	0.012	
C1-6	5.5	275.76	280	0.005	0.012	12.2
MH1-6	5.5	275.76	6	0.017	0.012	
C1-7	5.5	275.76	72	0.005	0.012	12.2
Outlet	5.5	275.76		0.005	0.012	
C3-1	4	114.73	112	0.005	0.012	10.0
MH3-1	4	114.73	6	0.017	0.012	
C3-2	4	114.73	16	0.005	0.012	10.0
Outlet	4	114.73		0.005	0.012	
C2-1	4.5	133.47	104	0.004	0.012	9.7
Outlet	4.5	133.47		0.004	0.012	
C4-1	3.5	88.82	104	0.006	0.012	10.0
Outlet	3.5	88.82		0.006	0.012	
C5-1	5	199.31	16	0.005	0.012	11.6
MH5-1	5	199.31	6	0.017	0.012	
C5-2	5	199.31	398	0.005	0.012	11.6
MH5-2	5	199.31	6	0.017	0.012	
C5-3	5	199.31	168	0.005	0.012	11.6
Outlet	5	199.31		0.005	0.012	
C-1a	4.5	121.21	80	0.004	0.012	9.6
MH1-4	4.5	121.21		0.004	0.012	

Written by: William M. Steier Date: 25 March 2003 Reviewed by: Eric S. Steinhauser Date: 25 March 2003

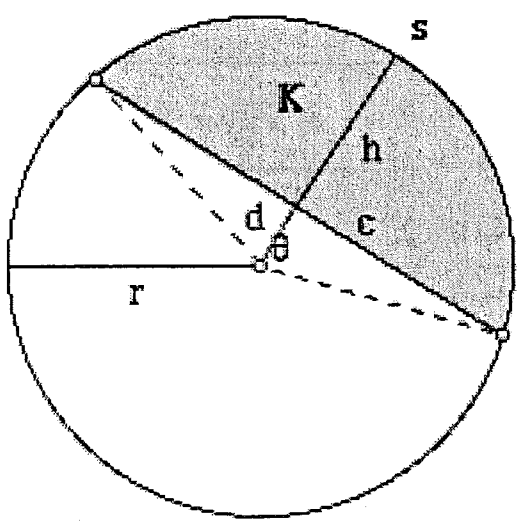
Client: DSWA Project: Cherry Island Landfill Project/Proposal No.: ME0250 Task No.: 2.9.2

ATTACHMENT 5

GEOMETRIC DEFINITIONS FOR CIRCLE PARAMETERS

Segment of a Circle [The Math Forum, 2003]

Either of the two regions into which a secant or a chord cuts a circle.
Chord length: c
Height: h
Distance from center of circle to chord's midpoint: d
Central angle: theta (in radians).
Area: K
Arc length: s
h = r – d [Flow Depth, y_n, y_{cr}, equation 4]
d = r cos (theta/2)
c = 2r sin(theta/2) [Flow Width, b, equation 6]
K = r^2[theta-sin(theta)]/2 [Flow Area, A, equation 2]
(r) (theta) = s [Wetted Flow Perimeter P, equation 3]



ATTACHMENT 6

CRITICAL AND NORMAL DEPTH CALCULATION

Segment Identification	Culvert Diameter D (ft.)	Discharge Q_{100} (ft^3/sec)	STEP 2 - REFINE CULVERT SLOPE AND DIAMETER TO MAINTAIN SUBCRITICAL FLOW										
			CRITICAL DEPTH CALCULATION				Critical Flow Depth	NORMAL DEPTH CALCULATION				Normal Flow Depth	Design Flow Condition Sub/Super Critical
			Central Angle θ (rad) Variable	Flow Area A (ft^2) Eq. 2	Flow Width b (ft.) Eq. 7	Calculated Q_{100} (ft^3/sec) Eq. 6	y_{cr} (ft.) Eq. 4	Central Angle θ (rad) Variable	Flow Area A (ft^2) Eq. 2	Flow Perimeter P (ft) Eq. 3	Manning Q_{100} (cfs) Eq. 1	y_n (ft.) Eq. 4	
C1-1	4.5	157.8	4.5	13.9	3.5	158.2	3.7	4.8	14.6	10.8	157.6	3.9	SubCritical
MH1-1	4.5	157.8											
C1-2	4.5	157.8	4.5	13.9	3.5	157.4	3.7	4.8	14.6	10.8	157.6	3.9	SubCritical
MH1-2	4.5	157.8											
C1-3	4.5	157.8	4.5	13.9	3.5	157.4	3.7	4.8	14.6	10.8	157.6	3.9	SubCritical
MH1-3	4.5	157.8											
C1-4	4.5	157.8	4.5	13.9	3.5	157.4	3.7	4.8	14.6	10.8	157.6	3.9	SubCritical
MH1-4	5.5	157.8											
C1-5	5.5	275.8	4.6	21.3	4.0	276.9	4.6	5.0	22.6	13.9	275.7	5.0	SubCritical
MH1-5	5.5	275.8											
C1-6	5.5	275.8	4.6	21.3	4.0	276.9	4.6	5.0	22.6	13.9	275.7	5.0	SubCritical
MH1-6	5.5	275.8											
C1-7	5.5	275.8	4.6	21.3	4.0	276.9	4.6	5.0	22.6	13.9	275.7	5.0	SubCritical
Outlet	5.5	275.8	4.6	21.3	4.0	276.9	4.6	5.0	22.6	13.9	275.7	5.0	
C3-1	4.0	114.7	4.5	10.9	3.2	114.8	3.2	4.8	11.5	9.5	114.8	3.4	SubCritical
MH3-1	4.0	114.7											
C3-2	4.0	114.7	4.5	10.9	3.2	114.8	3.2	4.8	11.5	9.5	114.8	3.4	SubCritical
Outlet	4.0	114.7	4.5	10.9	3.2	114.8	3.2	4.8	11.5	9.5	114.8	3.4	
C2-1	4.5	133.5	4.2	12.9	3.9	133.2	3.4	4.5	13.8	10.1	133.7	3.6	SubCritical
Outlet	4.5	133.5	4.2	12.9	3.9	133.2	3.4	4.5	13.8	10.1	133.7	3.6	
C4-1	3.5	88.8	4.6	8.6	2.6	88.5	2.9	4.8	8.9	8.4	88.8	3.1	SubCritical
Outlet	3.5	88.8	4.6	8.6	2.6	88.5	2.9	4.8	8.9	8.4	88.8	3.1	
C5-1	5.0	199.3	4.5	16.9	4.0	198.3	4.0	4.5	17.2	11.3	199.7	4.1	SubCritical
MH5-1	5.0	199.3											
C5-2	5.0	199.3	4.5	16.9	4.0	198.3	4.0	4.5	17.2	11.3	199.7	4.1	SubCritical
MH5-2	5.0	199.3											
C5-3	5.0	199.3	4.5	16.9	4.0	198.3	4.0	4.5	17.2	11.3	199.7	4.1	SubCritical
Outlet	5.0	199.3	4.5	16.9	4.0	198.3	4.0	4.5	17.2	11.3	199.7	4.1	
C-1a	4.5	121.2	4.1	12.2	4.0	121.0	3.2	4.1	12.6	9.3	121.1	3.3	SubCritical
MH1-4	4.5	121.2	4.1	12.2	4.0	121.0	3.2	4.1	12.6	9.3	121.1	3.3	

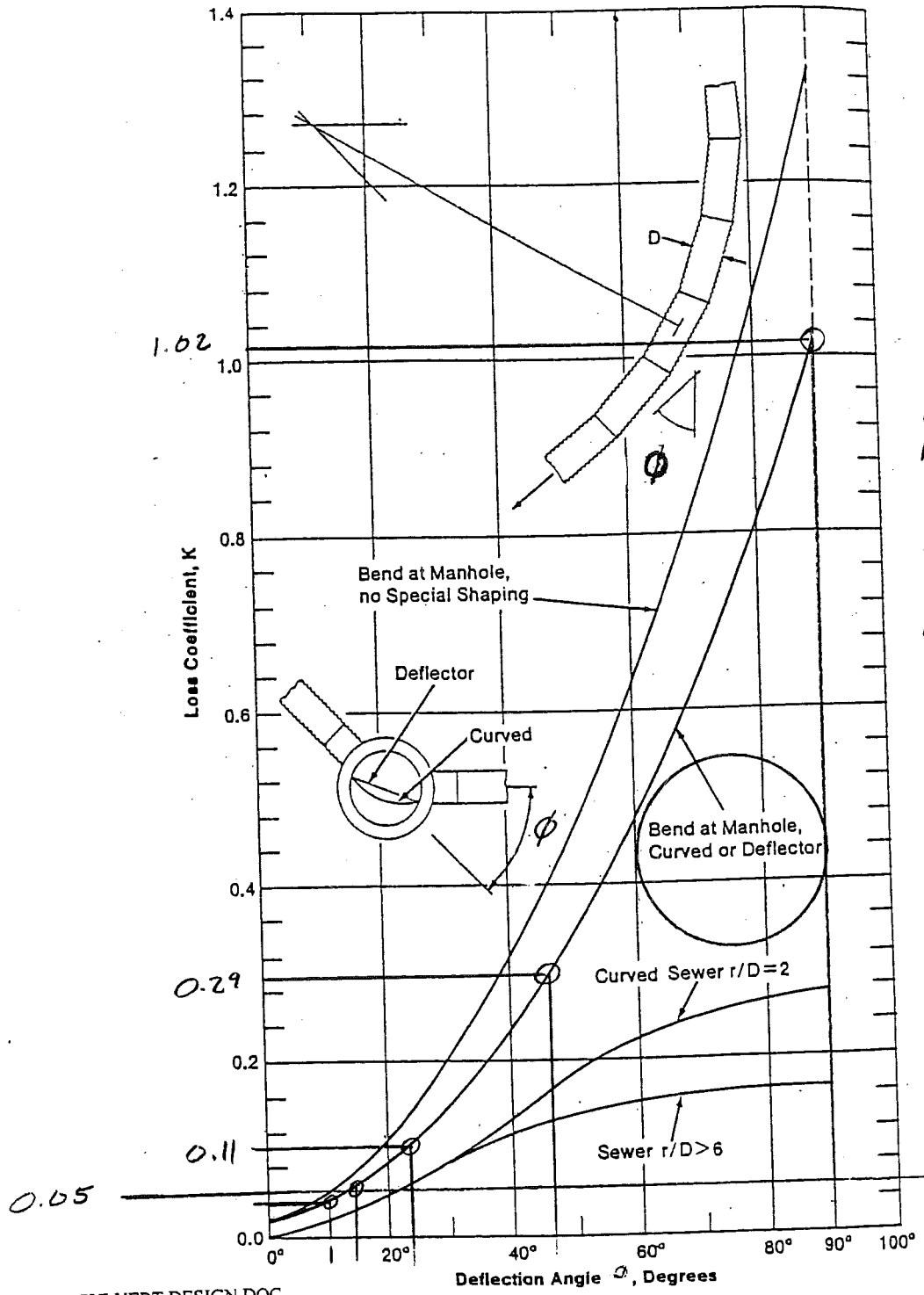
17/22
LWM 3/25/03

Written by: William M. Steier Date: 25 March 2003 Reviewed by: Eric S. Steinhauser Date: 25 March 2003

Client: DSWA Project: Cherry Island Landfill Project/Proposal No.: ME0250 Task No.: 2.9.2

ATTACHMENT 7

MANHOLE BEND LOSS COEFFICIENT, K_b



MH 1-1: 90° = 1.02
MH 1-2: 0° = $K_{b\,min}$=0
MH 1-3: 10° = $K_{b\,min}$
MH 1-5: 2° = $K_{b\,min}$
MH 1-6: 14° = 0.06
MH 3-1: 22° = 0.11
MH 5-1: 45° = 0.29
MH 5-2: 13° = 0.05

FOR STRAIGHT MANHOLE
K_b = 0.05 = K_{b1}

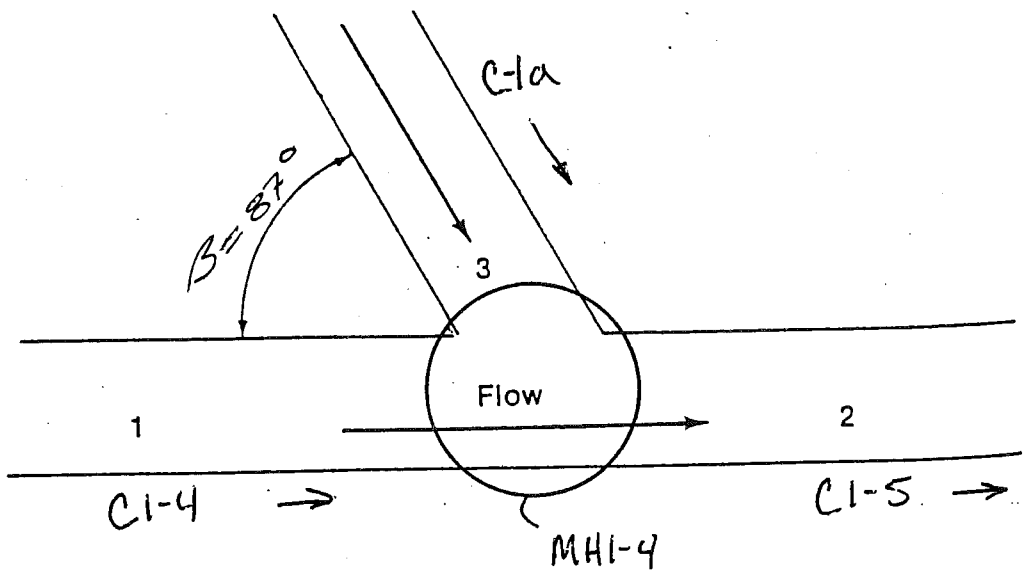
Written by: William M. Steier Date: 25 March 2003 Reviewed by: Eric S. Steinhauser Date: 25 March 2003

Client: DSWA Project: Cherry Island Landfill Project/Proposal No.: ME0250 Task No.: 2.9.2

ATTACHMENT 8

MANHOLE JUNCTION LOSS DEFINITION

$$(H_j + D_1 - D_2)\frac{(A_1 + A_2)}{2} = \frac{Q_2^2}{A_2 g} - \frac{Q_1^2}{A_1 g} - \frac{Q_3^2}{A_3 g}\cos\beta$$



[After AISI, 1995]

ATTACHMENT 9

HYDRAULIC HEAD LOSSES AND DESIGN SUMMARY

Segment Identification	Culvert Diameter (ft.)	Discharge Q_{100} (ft^3/sec)	STEP 3 - ESTIMATE HYDRAULIC LOSSES																
			FRICTION LOSS[1]	ANHOLE / BEND LOSS			JUNCTION LOSSES[3]												
			(ft.)	Bend Angle ϕ (deg)	K_b[2] --	H_b (ft.) Eq. 9	Inlet Diameter D_1 (ft)	Outlet Diameter D_2 (ft)	Inlet Area A_1 (ft^2)	Outlet Area A_2 (ft^2)	Lateral Inlet Area A_3 (ft^2)	Inlet Discharge Q_1 (ft^3/sec)	Outlet Discharge Q_2 (ft^3/sec)	Lateral Inlet Discharge Q_3[4] (ft^3/sec)	Angle β (deg)	Eq. 10 Left Side (ft.)	Eq. 10 Right Side (ft.)	H_j (ft.) Eq. 10	SUM OF LOSSES
C1-1	4.5	157.8	0.20																0.2
MH1-1	4.5	157.8	0.10	90	1.02	1.84													1.9
C1-2	4.5	157.8	1.7																1.7
MH1-2	4.5	157.8	0.1	0	0.05	0.1													0.2
C1-3	4.5	157.8	1.7																1.7
MH1-3	4.5	157.8	0.1	10	0.05	0.1													0.2
C1-4	4.5	157.8	2.9																2.9
MH1-4	5.5	157.8	0.1				4.5	5.5	14.6	22.6	12.3	157.8	275.8	118	87	49.6	49.7	3.7	3.8
C1-5	5.5	275.8	2.6																2.6
MH1-5	5.5	275.8	0.1	2	0.05	0.1													0.2
C1-6	5.5	275.8	1.4																1.4
MH1-6	5.5	275.8	0.1	14	0.06	0.1													0.2
C1-7	5.5	275.8	0.4																0.4
Outlet	5.5	275.8																	
C3-1	4	114.7	0.6																0.6
MH3-1	4	114.7	0.1	22	0.11	0.2													0.3
C3-2	4	114.7	0.1																0.1
Outlet	4.0	114.7																	
C2-1	4.5	133.5	0.4																0.4
Outlet	4.5	133.5																	
C4-1	3.5	88.8	0.6																0.6
Outlet	3.5	88.8																	
C5-1	5	199.3	0.1																0.1
MH5-1	5	199.3	0.1	45	0.29	0.6													0.7
C5-2	5	199.3	2.0																2.0
MH5-2	5	199.3	0.1	13	0.05	0.1													0.2
C5-3	5	199.3	0.8																0.8
Outlet	5.0	199.3																	
C-1a	4.5	121.2	0.3																0.3
MH1-4	4.5	121.2																	

Notes

1. Assume uniform flow through culvert, friction loss is equal to bed slope times length of culvert section
2. From Attachment 7, for bends at a manhole, or $k_b = 0.05$ for straight flow through manhole.
3. See Atachment 8 for definition of culvert diameter, flow area, and discharge subscripts.

20/22
WMS 3/25/03
3/25/03

ATTACHMENT 10

ESTIMATED WATER SURFACE ELEVATION AND DESIGN SUMMARY

Segment dentificatior	Culvert Diameter (ft.)	Discharge Q_{100} (ft^3/sec)	STEP 4- COMPARE ESTIMATED WATER SURFACE TO TOP OF PIPE			STEP 5 - REFINE INVERTS				
							DESIGN SUMMARY			
			Invert In[1] (ft-msl)	Top of Pipe (ft-msl)	Water Surface at Inlet (ft-msl) Eq. 11	Invert Adjustment (ft.)	Invert In Refined (ft-msl)	Top of Pipe Refined (ft-msl)	Water Surface at Inlet (ft-msl)	Section Velocity (ft/sec)
C1-1	4.5	157.8	21.4	25.9	32.3	7.0	28.4	32.9	32.3	10.8
MH1-1	4.5	157.8	21.2	25.7	32.1	7.0	28.2	32.7	32.5	
C1-2	4.5	157.8	21.1	25.6	30.1	5.5	26.6	31.1	30.6	10.8
MH1-2	4.5	157.8	19.4	23.9	28.5	5.5	24.9	29.4	28.9	
C1-3	4.5	157.8	19.3	23.8	28.3	5.5	24.8	29.3	28.7	10.8
MH1-3	4.5	157.8	17.6	22.1	26.6	5.5	23.1	27.6	25.1	
C1-4	4.5	157.8	17.5	22.0	26.4	3.5	21.0	25.5	24.9	10.8
MH1-4	5.5	157.8	14.6	20.1	23.5	3.5	18.1	23.6	23.5	
C1-5	5.5	275.8	14.5	20.0	19.8	0.0	14.5	20.0	19.8	12.2
MH1-5	5.5	275.8	12.0	17.5	17.2	0.0	12.0	17.5	17.2	
C1-6	5.5	275.8	11.9	17.4	17.0	0.0	11.9	17.4	17.0	12.2
MH1-6	5.5	275.8	10.5	16.0	15.6	0.0	10.5	16.0	15.6	
C1-7	5.5	275.8	10.4	15.9	15.3	0.0	10.4	15.9	15.3	12.2
Outlet	5.5	275.8	10.0	15.5	15.0	0.0	10.0	15.5	15.0	
C3-1	4.0	114.7	20.7	24.7	24.4	0.0	20.7	24.7	24.4	10.0
MH3-1	4.0	114.7	20.2	24.2	23.8	0.0	20.2	24.2	23.8	
C3-2	4.0	114.7	20.1	24.1	23.5	0.0	20.1	24.1	23.5	10.0
Outlet	4.0	114.7	20.0	24.0	23.4	0.0	20.0	24.0	23.4	
C2-1	4.5	133.5	10.4	14.9	14.1	0.0	10.4	14.9	14.1	9.7
Outlet	4.5	133.5	10.0	14.5	13.6	0.0	10.0	14.5	13.6	
C4-1	3.5	88.8	22.6	26.1	25.7	0.0	22.6	26.1	25.7	10.0
Outlet	3.5	88.8	22.0	25.5	25.1	0.0	22.0	25.5	25.1	
C5-1	5.0	199.3	33.1	38.1	37.9	20.0	53.1	58.1	57.8	11.6
MH5-1	5.0	199.3	33.0	38.0	37.8	20.0	53.0	58.0	57.7	
C5-2	5.0	199.3	32.9	37.9	37.1	20.0	52.9	57.9	57.0	11.6
MH5-2	5.0	199.3	30.9	35.9	35.1	20.0	50.9	55.9	35.1	
C5-3	5.0	199.3	30.8	35.8	34.9	0.0	30.8	35.8	34.9	11.6
Outlet	5.0	199.3	30.0	35.0	34.1	0.0	30.0	35.0	34.1	
C-1a	4.5	121.2	14.9	19.4	18.3	0.0	18.4	22.9	21.8	9.6
MH1-4	4.5	121.2	14.6	19.1	18.0	0.0	18.1	22.6	21.5	

Notes
1. Compute inverts working upstream (input outlet elevation based on topography at outlet).

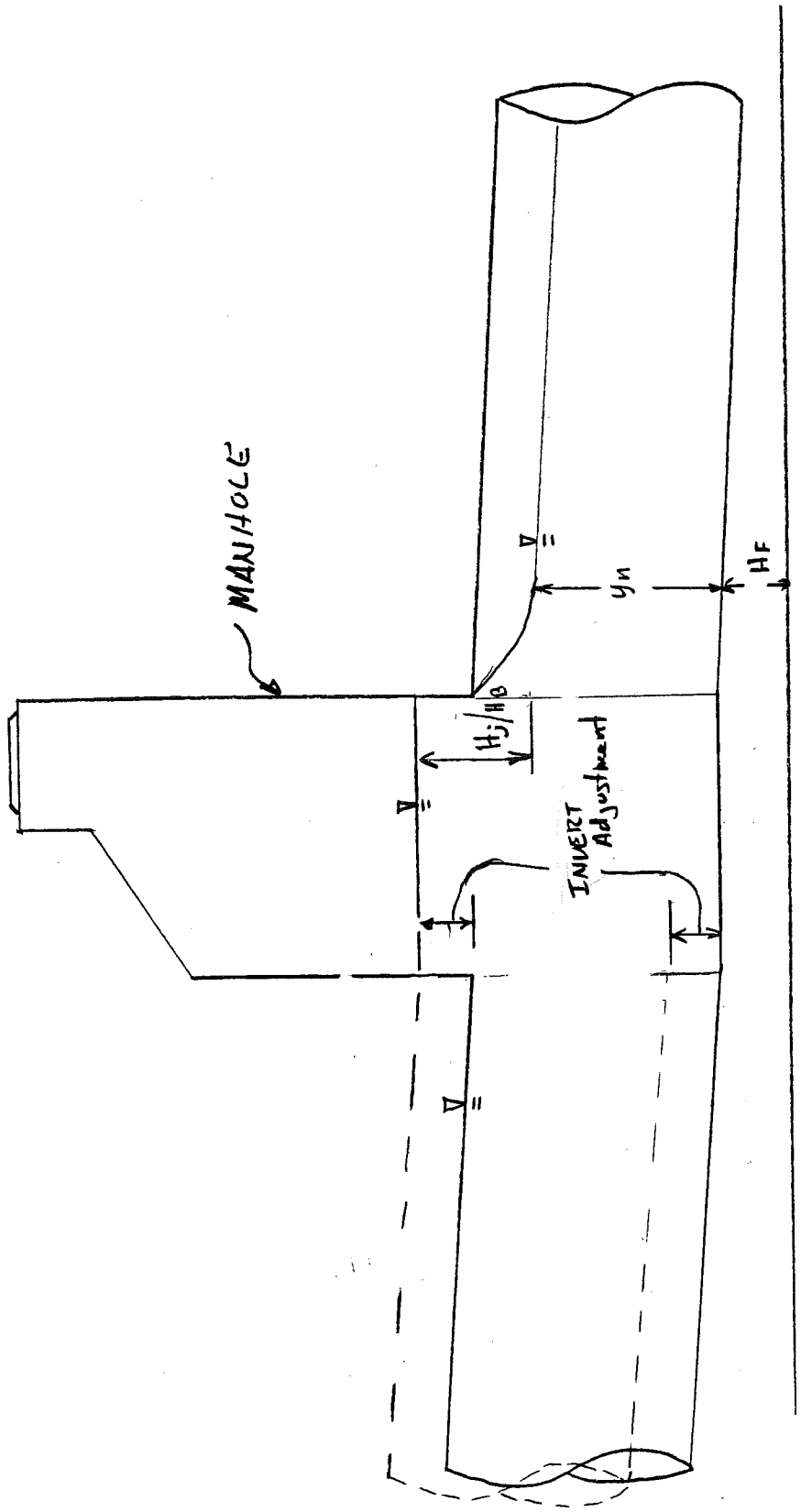
WMS 3/25/03
JSS 3/25/03

21/22

Written by: W STEIER Date 03/03/25 (YY MM DD) Reviewed by: E STEINHAUSER Date: 03/03/25 (YY MM DD)

Client: DSWA Project: CIL Project/Proposal No.: ME0250 Task No.: 2.9.2

ATTACHMENT 11



Appendix VIb-I.9

Culvert Outlet Protection and Outlet Channel Protection Design

1/10

GEOSYNTEC CONSULTANTS

COMPUTATION COVER SHEET

Client: DSWA **Project:** Cherry Island Landfill **Project/Proposal #:** ME0250 **Task #:** 2.9.2

TITLE OF COMPUTATIONS **APPENDIX VIb-I.9: CULVERT OUTLET AND OUTLET CHANNEL PROTECTION DESIGN**

COMPUTATIONS BY:
Signature
Printed Name and Title: William M. Steier, P.E. Project Engineer
26 March 2003 DATE

ASSUMPTIONS AND PROCEDURES CHECKED BY:
(Peer Reviewer)
Signature
Printed Name and Title: Eric. S. Steinhauser, P.E. Associate
26 March 2003 DATE

COMPUTATIONS CHECKED BY:
Signature
Printed Name and Title: Eric. S. Steinhauser, P.E. Associate
26 March 2003 DATE

COMPUTATIONS BACKCHECKED BY:
(Originator)
Signature
Printed Name and Title: William M. Steier, P.E. Project Engineer
26 March 2003 DATE

APPROVED BY:
(PM or Designate)
Signature
Printed Name and Title: David Espinoza, P.E. Senior Engineer
29 March 2003 DATE

APPROVAL NOTES:

The calculations presented herein are suitable for a landfill elevation of 195 ft-msl. As shown in this calculation package, the design was performed for a more conservative grading configuration than that shown in Drawing 78 entitled "Landfill Final Development and Grading Plan" (Appendix VIb-A).

REVISIONS (Number and initial all revisions)

NO.	SHEET	DATE	BY	CHECKED BY	APPROVAL

Written by: William M. Steier Date: 26 March 2003 Reviewed by: Eric S. Steinhauser Date: 26 March 2003

Client: DSWA Project: Cherry Island Landfill Project/Proposal No.:ME0250 Task No.: 2.9.2

APPENDIX VIb-I.9
CULVERT OUTLET PROTECTION AND OUTLET CHANNEL DESIGN

PURPOSE

The purpose of this calculation package is to design the culvert outlet protection and outlet channels for the Cherry Island Landfill. The culvert outlet protection, located at the discharge point from the culvert outlets, and the outlet channel will provide a non-erosive stormwater conveyance from the landfill to the Christiania and Delaware Rivers.

METHOD

Stormwater discharges for the various stormwater outlet culverts are estimated in Appendix VIB-I.8. Each stormwater outlet is designed to convey runoff from the 100-year, 24-hour design storm. The outlet protection will consist of riprap-lined features design in accordance with Standard Specification for Rock Outlet Protection, Type I [DDNR, 1989]. The outlet channel will be a continuation of the design rock outlet protection.

The typical configuration of the outlet protection is presented in Attachment 1. The dimensions of the outlet protection include:

- L_a = apron length (ft.);
- W = width of apron at connection to downstream channel (ft.); and
- d = diameter of stormwater outlet culvert (ft.).

The outlet protection dimensions may be selected using the design charts presented in Attachments 2-1 through 2-5. These design charts assume that the tailwater (t_w) in the outlet protection is less than one half of the culvert diameter. Therefore, for the anticipated stormwater discharge for each outlet culvert, an appropriately sized L_a, W, and median riprap dimension (d_{50}) may be selected.

CALCULATION PARAMETERS

Each culvert outlet will discharge onto an unrestricted open channel; therefore the tailwater depth will be less than one half of the culvert diameter. The stormwater discharge from the 100-year, 24-hour design storm and the outlet culvert diameters are obtained from Appendix VIb-I.8. A summary of the design discharges, Q_{100}, and outlet culvert diameters, d, presented Attachment 3.

Written by: William M. Steier Date: 26 March 2003 Reviewed by: Eric S. Steinhauser Date: 26 March 2003

Client: DSWA Project: Cherry Island Landfill Project/Proposal No.: ME0250 Task No.: 2.9.2

RESULTS

Solutions from the outlet design chart are shown on Attachments 2-1 – 2.5. The results are summarized in Attachment 3.

REFERENCE

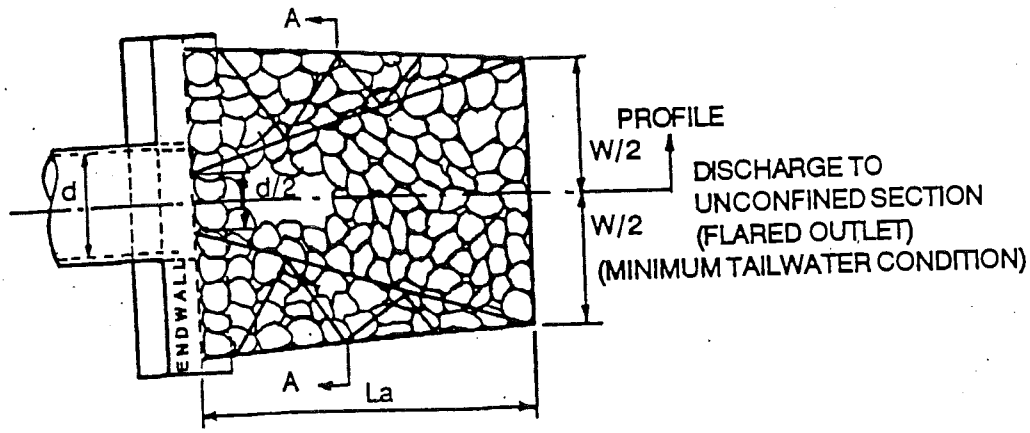
Delaware Department of Natural Resources (DDNR), "*Delaware Erosion and Sediment Control Handbook*", Dover, Delaware, 1989.

WMS 3/26/03
RSS 3/26/03

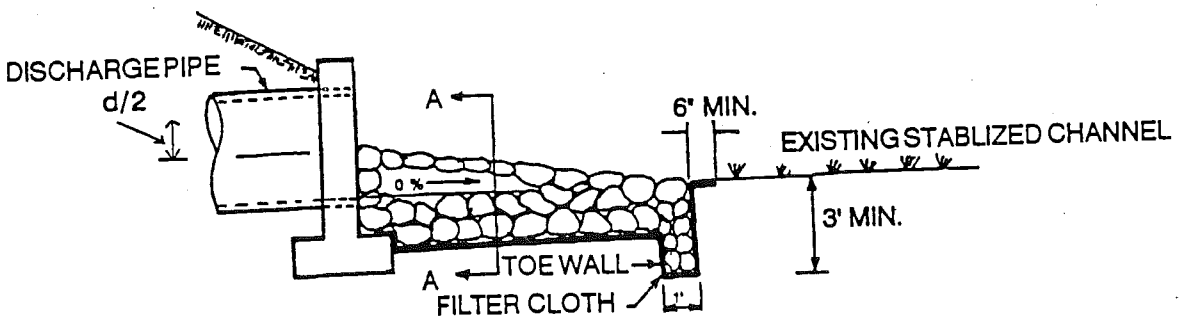
4/10

ATTACHMENT 1

ROCK OUTLET PROTECTION I

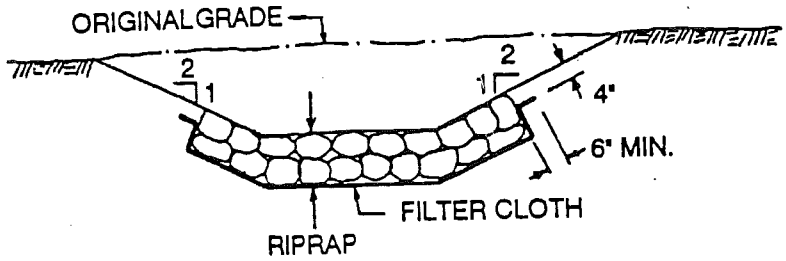


PLAN VIEW



PROFILE VIEW

RIPRAP TO BE EMBEDDED IN PROPOSED TRANSITION SECTION

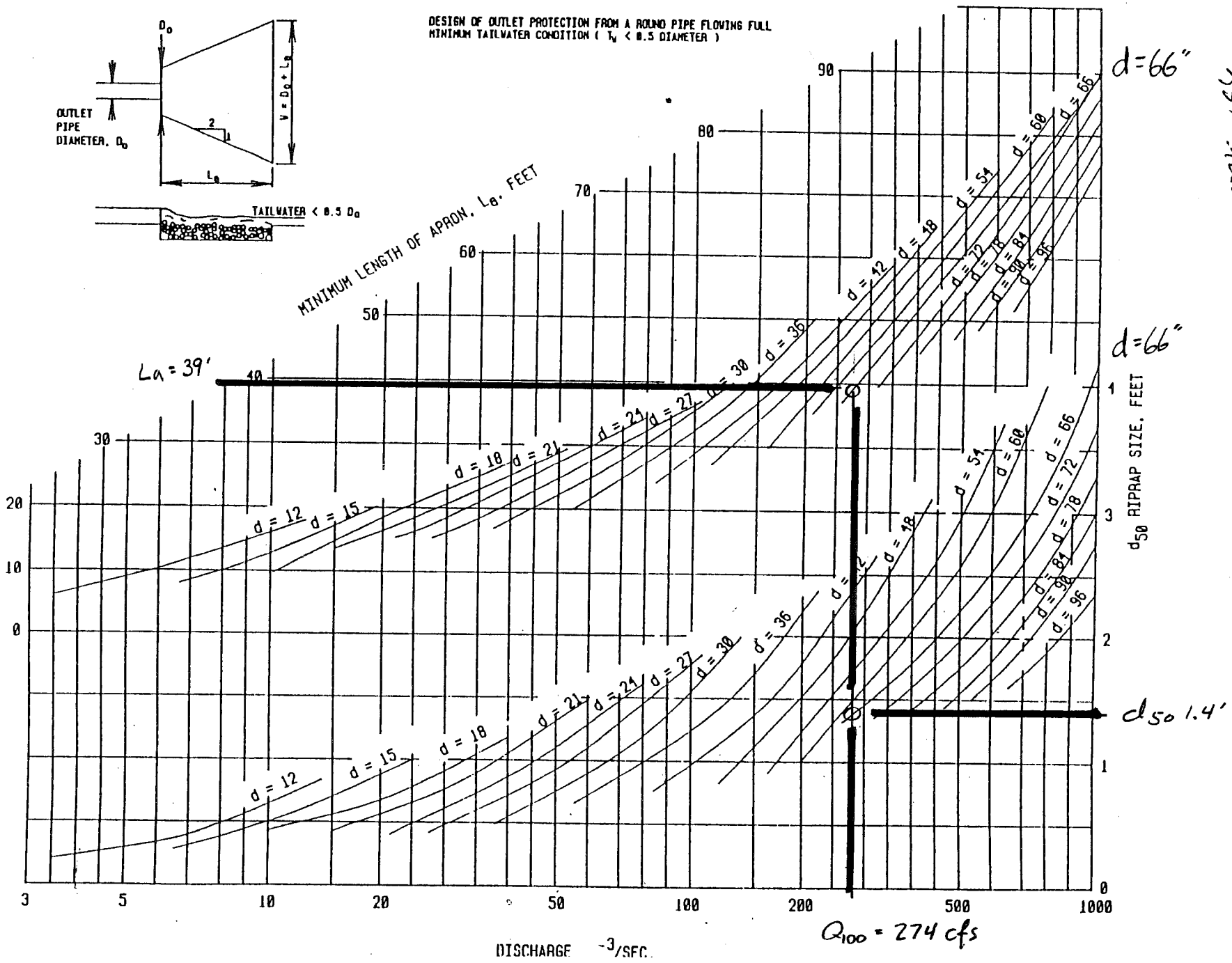


CROSS SECTION AT A - A

CONSTRUCTION SPECIFICATIONS

1. The subgrade for the filter, riprap or gabion shall be prepared to the required lines and grades as shown on the plan. Any fill required in the subgrade shall be compacted to a density of approximately that of the surrounding undisturbed material.
2. The riprap shall conform to the grading limits as shown on the plan.
3. Filter cloth shall be protected from punching, cutting or tearing. Any damage other than an occasional small hole shall be repaired by placing another piece of cloth over the damaged area. All connecting joints should overlap a minimum of 1 ft. If the damage is extensive, replace the entire filter cloth.
4. Stone for the riprap or gabion outlets may be placed by equipment. Riprap shall be placed in a manner to prevent damage to the filter cloth. Hand placement will be required to the extent necessary to prevent damage to the conduits, structures, etc.

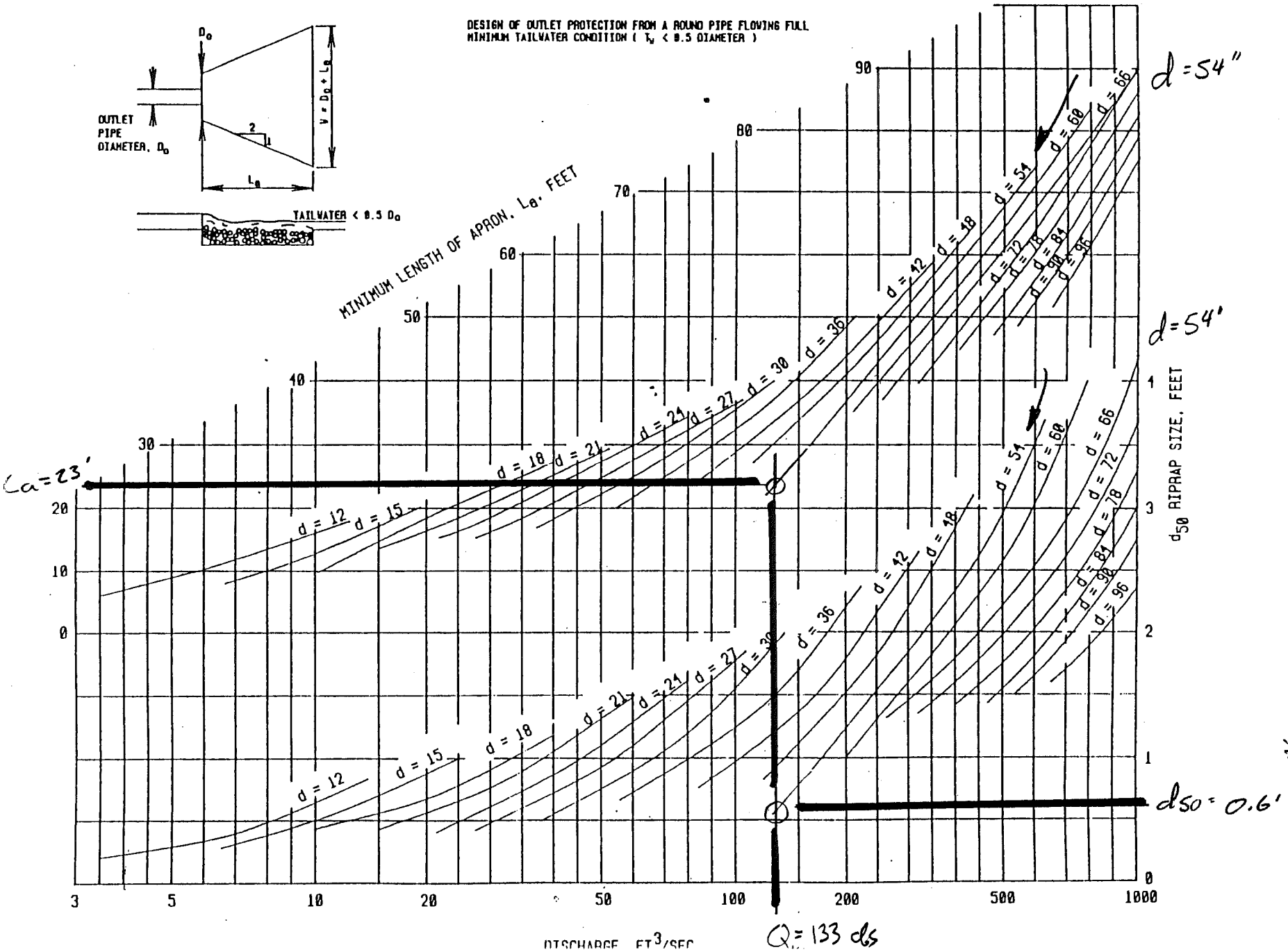
ATTACHMENT 2-1
OUTLET C1-7



5/10

WMS 3/26/03
JSS 3/26/03

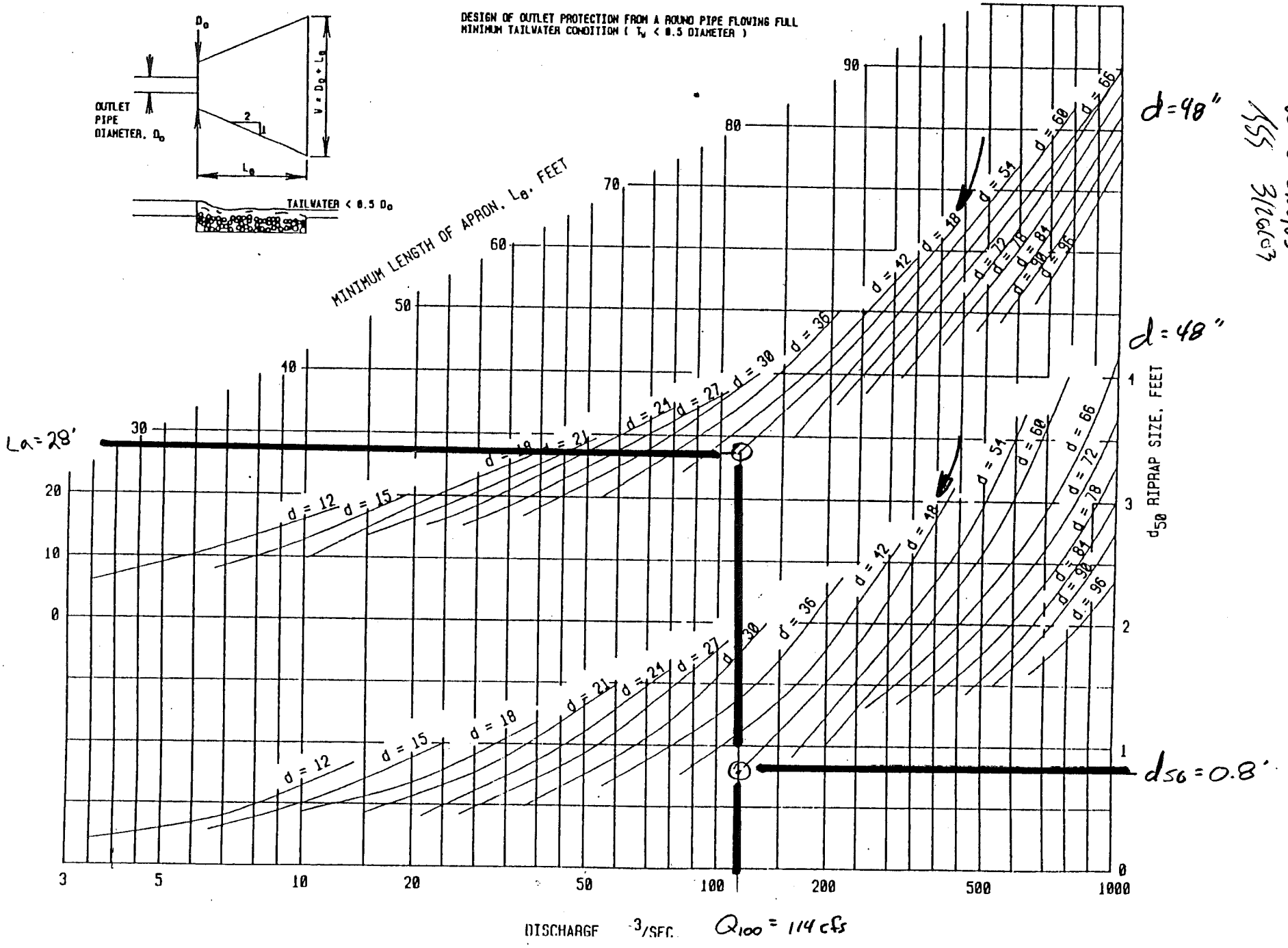
ATTACHMENT 2-2
OUTLET C2-1



LJM 3/26/03 SSS 3/26/03

6/10

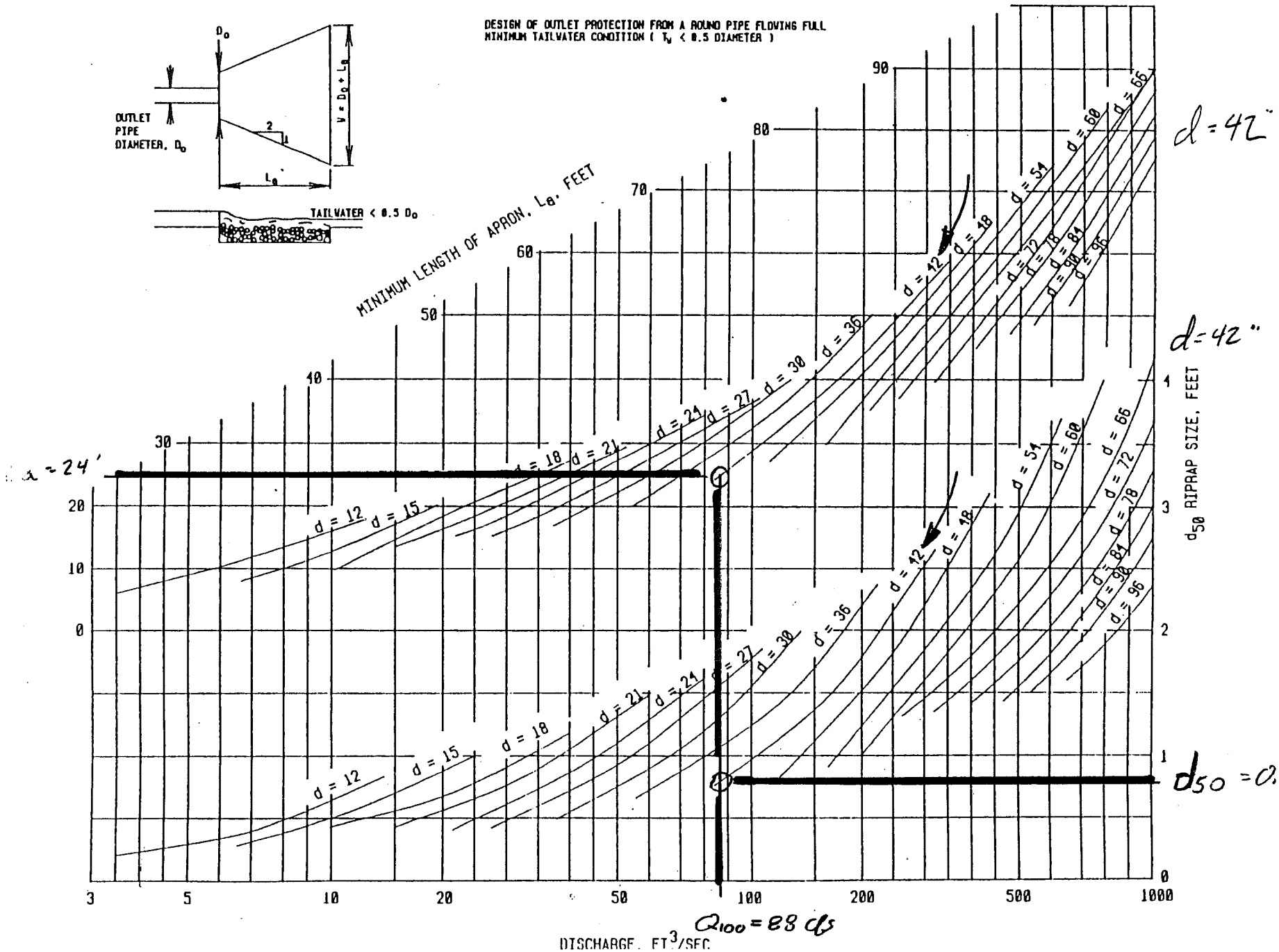
ATTACHMENT 2-3
OUTLET C3-2



7/10

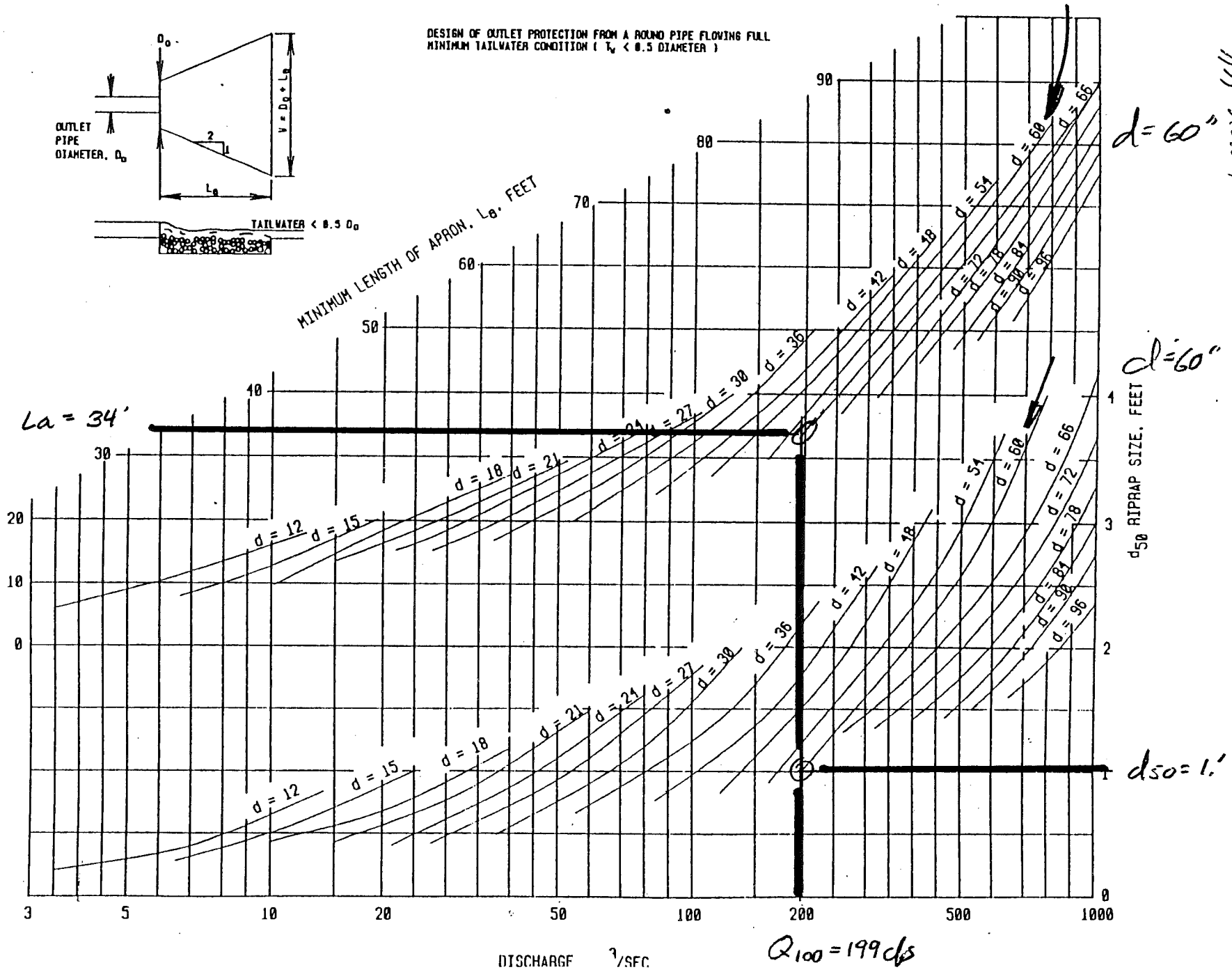
WMS 3/26/03
SSS 3/26/03

ATTACHMENT 2-4
OUTLET C4-1



WMS 3/26/03 155 3/26/03 8/10

ATTACHMENT 2-5
OUTLET C5-3



9/10 WMS 3/26/03 JSS 5/26/03

ATTACHMENT - 3

DESIGN OF OUTLET CULVERT APRON - SUMMARY

Channel ID	CALCULATION PARAMETERS		FINAL DESIGN[2]				
	Culvert Discharge Q_{100}[1] (ft^3/sec)	Culvert Design Diameter d (ft.)	Length of Apron Minimum L_a (ft.)	Width of Apron W (ft.)	Median Riprap Diameter (min) d_{50} (ft.)	Design Riprap Classification[3]	Riprap Lining Thickness (1.5 x Design Riprap d_{50}) (ft.)
C1-7	274.7	5.5	39	45	1.4	R-7	2.25
C2-1	133.5	4.5	23	28	0.6	R-6	1.5
C3-2	114.8	4.0	28	32	0.8	R-6	1.5
C4-1	88.8	3.5	24	28	0.8	R-6	1.5
C5-3	199.1	5.0	34	39	1.0	R-6	1.5

Notes:
1. From Appendix VIb-I.8.
2. From Attachments 2-1 through 2-5.
3. Classification per DELDOT Standard Specifications, 2001.

CWS 3/26/03 3/26/03 10/10

Appendix VIb-I.10

Stormwater Outlet Culvert Settlement Analysis

GEOSYNTEC CONSULTANTS

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COMPUTATION COVER SHEET

Client: DSWA Project: Cherry Island Landfill Project/Proposal #: ME0250 Task #: 2.9.2

TITLE OF COMPUTATIONS APPENDIX VIb-I.10: STORMWATER OUTLET CULVERT SETTLEMENT ANALYSIS

COMPUTATIONS BY:
Signature
26 March 2003
DATE
Printed Name and Title: William M. Steier, P.E. Project Engineer

ASSUMPTIONS AND PROCEDURES CHECKED BY:
(Peer Reviewer)
Signature
26 March 2003
DATE
Printed Name and Title: David Espinoza, P.E. Senior Engineer

COMPUTATIONS CHECKED BY:
Signature
26 March 2003
DATE
Printed Name and Title: Douglas Mandeville Senior Staff Engineer

COMPUTATIONS BACKCHECKED BY:
(Originator)
Signature
26 March 2003
DATE
Printed Name and Title: William M. Steier, P.E. Project Engineer

APPROVED BY:
(PM or Designate)
Signature
4/2/03
DATE
Printed Name and Title: David Espinoza, P.E. Senior Engineer

APPROVAL NOTES:

The calculations presented herein are suitable for a landfill elevation of 195 ft-msl. As shown in this calculation package, the design was performed for a more conservative grading configuration than that shown in Drawing 78 entitled "Landfill Final Development and Grading Plan" (Appendix VIb-A).

6/10/04

REVISIONS (Number and initial all revisions)

NO.	SHEET	DATE	BY	CHECKED BY	APPROVAL

APPENDIX VIb-I.10
STORMWATER OUTLET CULVERT SETTLEMENT ANALYSIS

PURPOSE

The purpose of this calculation is to analyze settlement of the stormwater outlet culverts at the Cherry Island Landfill (CIL). In turn, the estimated settlements are used for design of the pre-settlement construction elevations for drop inlet structures, and stormwater outlet culverts installed beneath the mechanically stabilized earth (MSE) berm.

METHOD

Settlement of the dredge/alluvium deposit and Potomac formation due to the loads imposed by the MSE berm construction can be estimated using consolidation theory (Holtz and Kovacs, 1981). Total settlement (δ) can be calculated as the sum of the primary settlement (δ_p) and secondary settlement (δ_s) as:

$$\delta = \delta_p + \delta_s \tag{1}$$

$$\delta_p = C_{c\varepsilon} H \cdot Log\left(\frac{\sigma'_{vo} + \Delta\sigma'}{\sigma'_{vo}}\right) \tag{2}$$

$$\delta_S = C_{\alpha\varepsilon} H \cdot Log\left(\frac{t_s}{t_p}\right) \tag{3}$$

where:

$C_{c\varepsilon}$ = modified coefficient of consolidation (ft^2/year) = $C_c/(1+e_o)$;
$C_{r\varepsilon}$ = modified coefficient of reconsolidation consolidation (ft^2/year) = $C_r/(1+e_o)$;
$C_{\alpha\varepsilon}$ = modified secondary coefficient of consolidation (ft^2/year) = $C_\alpha/(1+e_o)$;
H = thickness of the soil layer (ft);
σ'_{vo} = initial vertical effective stress (psf);
$\Delta\sigma$ = additional vertical stress (psf);
t_s = time for secondary consolidation (years); and
t_p = time for primary consolidation (years).

Prefabricated vertical drains (PVDs) will be installed within the dredge/alluvium deposits beneath the perimeter wall prior to construction. Settlements measured after construction on soft soils with PVDs show that secondary settlement is negligible. Therefore, secondary compression of the dredge/alluvium deposits is not included in this calculation.

The initial total vertical stress, σ'_{vo}, within the dredge/alluvium and Potomac Formations is estimated as follows:

$$\sigma'_{V0} = (\gamma z) - (h_w \gamma_w) \tag{4}$$

where:

σ'_{vo} = initial vertical effective stress (psf);

γ = unit weight of soil layer (psf);

z = depth below ground surface to point in question (ft);

h_w = height of water above the point analyzed (ft); ($h_w = 0$ above the water table); and

γ_w = unit weight of water.

The increase in vertical stress, $\Delta\sigma$, at various points within the dredge/alluvium and Potomac Formations is estimated using an elastic theory solution for a load over one-half of an infinite surface. The solution has the following form (Poulos and Davis, 1974):

$$\Delta\sigma = \sigma_z = \frac{p}{\pi}\left(\beta + \frac{xz}{R^2}\right) \tag{5}$$

where:

σ_z = change in vertical stress at location defined by the distances x, z, and R (ft) and angle β (rad); and

p = total applied load.

Graphical representation of parameters x, z, R, and angle β is presented in Attachment 1.

Design construction elevations for stormwater outlet culverts at the MSE berm face, *Elv. C*, and drop inlet structures, *Elv. D*, are calculated based on the geometric relationships presented in Attachment 2. The relationships are defined by the following equations:

$$Elv.\,C = Elv.A + (x_1\,\beta_1) + \Delta H \tag{6}$$

$$Elv.\,D = Elv.C + [x_2\,(\alpha + \beta_2)] \tag{7}$$

where:

$x_{1,2}$ = stormwater outlet culvert design lengths (ft);

$\beta_{1,2}$ = stormwater outlet culvert design slopes (ft/ft);

H = estimated settlement of the stormwater outlet culvert at the MSE berm face (ft); and

α = post-settlement slope between the culvert segment at the MSE berm face and the drop inlet structure (ft/ft).

CALCULATION PARAMETERS

The stratigraphic conditions at the CIL site, listed from top to bottom, are: (i) a dredge layer; (ii) the alluvium deposit; (iii) the Columbia Formation; (iv) the Potomac Formation; and (v) bedrock. A complete description of the consolidation parameters for each of these layers is provided in the Geotechnical Characterization Report (GeoSyntec, 2003). The consolidation parameters used herein are as follows.

	Dredge/Alluvium Deposits	Potomac Formation	Columbia Formation
Modified Coefficient of Consolidation, $C_{c\varepsilon}$	0.24	0.16	-
Modified Coefficient of Recompression, $C_{r\varepsilon}$	0.068	0.03	-
Unit Weight, γ (psf)	95	120	125

The calculation parameters z, and h_w, are each functions of the location being analyzed, which is defined by x, z, and R. See Analysis Section for further description of points analyzed.

The applied load is based on the perimeter berm configuration and soil unit weights at the location being analyzed. For this calculation two loading scenarios are investigated. The first loading scenario corresponds to the MSE berm on the north side of Phase III. The second loading scenario corresponds to a typical multiple-tier berm cross section along either the Delaware or Christina Rivers. For each MSE berm configuration, the modeled loading scenario is a simplified version of the actual configuration. The design Cross Sections and model loading investigated are identified as Section A-A' and B-B', on Attachments 3, and 4, respectively. Plan locations of the Cross Sections are presented in Attachment 5. For this analysis, the unit weight of the MSE berm is conservatively assumed to be 120 pcf.

Stormwater outlet culvert design elevations (*Elv. A*), slopes ($\beta_{1,2}$), are obtained from Appendix VIb.-I.8 for each of the five affected stormwater outlet culvert locations. Lengths ($x_{1,2}$) are obtained from Attachments 6 and 7.

ANALYSIS

For this calculation, settlements are estimated at 8-ft horizontal increments for 160-ft along Cross Sections A-A' and B-B'. Segment length is based on typical reinforced concrete pipe length, and the total distance analyzed is based on the approximate horizontal distance from the stormwater drop inlet structures to the adjacent Delaware River.

Vertically, the foundation soils are divided into multiple sub-layers for analysis. The settlement within each sub-layer is based on the thickness of the layer, and σ'_{vo} and $\Delta\sigma$ at the

center of the sub-layer. For this calculation the dredge/alluvium deposits are divided into four sub-layers, while the Potomac Formation is divided into two sub-layers. This leads to a total of 126 settlement points analyzed per cross section (21-horizontal by 6-vertical). The subsurface stratigraphy for Cross Sections A-A' and B-B' are presented in Attachments 8 and 9, respectively. Stratigaraphy is based on information provided in the Geotechnical Characterization Report (GeoSyntec, 2003).

Increase in vertical stress, σ_z, at each settlement point is estimated using equation 5 and the principle of superposition. A spreadsheet model is used to compute the stress increase at each point analyzed. A partial summary of the computation results are presented in Attachments 10and 11, under the column $\Delta\sigma_{v1}$. Hand computation of the stress increase with Layer 5 for Cross Section A-A', at a depth below ground surface of z = 133 ft and a horizontal distance x = 164 ft is presented in Attachment 12.

Settlement within the dredge/alluvium and Potomac Formation are estimated at each of the 126 settlement points using equations 2 and 4. For the Potomac formation the re-compression index was used to calculate the settlement. The spreadsheet model used to perform the calculations is presented in Attachment 10 for Cross Section A-A' and in Attachment 11 for Cross Section B-B'. A hand computation of the settlement within Layer 5 for Cross Section A-A', at a depth below ground surface of z = 133 ft and a horizontal distance of x = 164 ft is presented in Attachment 13. Total settlement at the base of the modeled load is calculated as the sum of the settlements within each layer. Total settlement results are presented graphically for Cross Sections A-A' and B-B' in Attachment 14. For each 8-ft horizontal increment the total settlement at each end of the increment, and the slope between ends is summarized in Attachment 15.

RESULTS

The design parameters ΔH and α are identified in Attachment 15 and used for construction elevation design computations presented in Attachment 16. Computations for each of the six stormwater outlet culverts are presented in Attachment 16. For these computations, the design parameters ΔH and α are assumed to representative for any location along the MSE berm, corresponding to the typical loading scenario presented in Cross Sections A-A' and B-B'.

REFERENCES

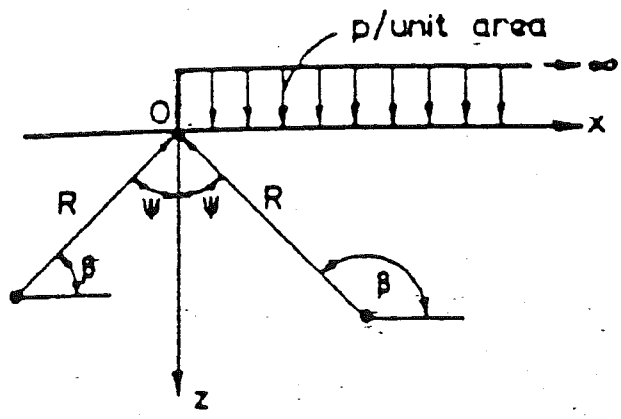
GeoSyntec Consultants, *"Geotechnical Characterization Report"*, Volume I, 2003.

Holtz, R.D., and Kovacs, W.D. (1981). *"An Introduction to Geotechnical Engineering"*, Prentice Hall, Inc., Englewood Cliffs, NJ, 1981.

Poulos, H.G., and Davies, E.H. *"Elastic Solutions for Soils and Rock Mechanics"*, John Wiley and Sons, New York, 1974.

ATTACHMENT 1

LOADING OVER ONE-HALF OF AN INFINITE SURFACE



$$\sigma_z = \frac{p}{\pi}\left(\beta + \frac{xz}{R^2}\right)$$

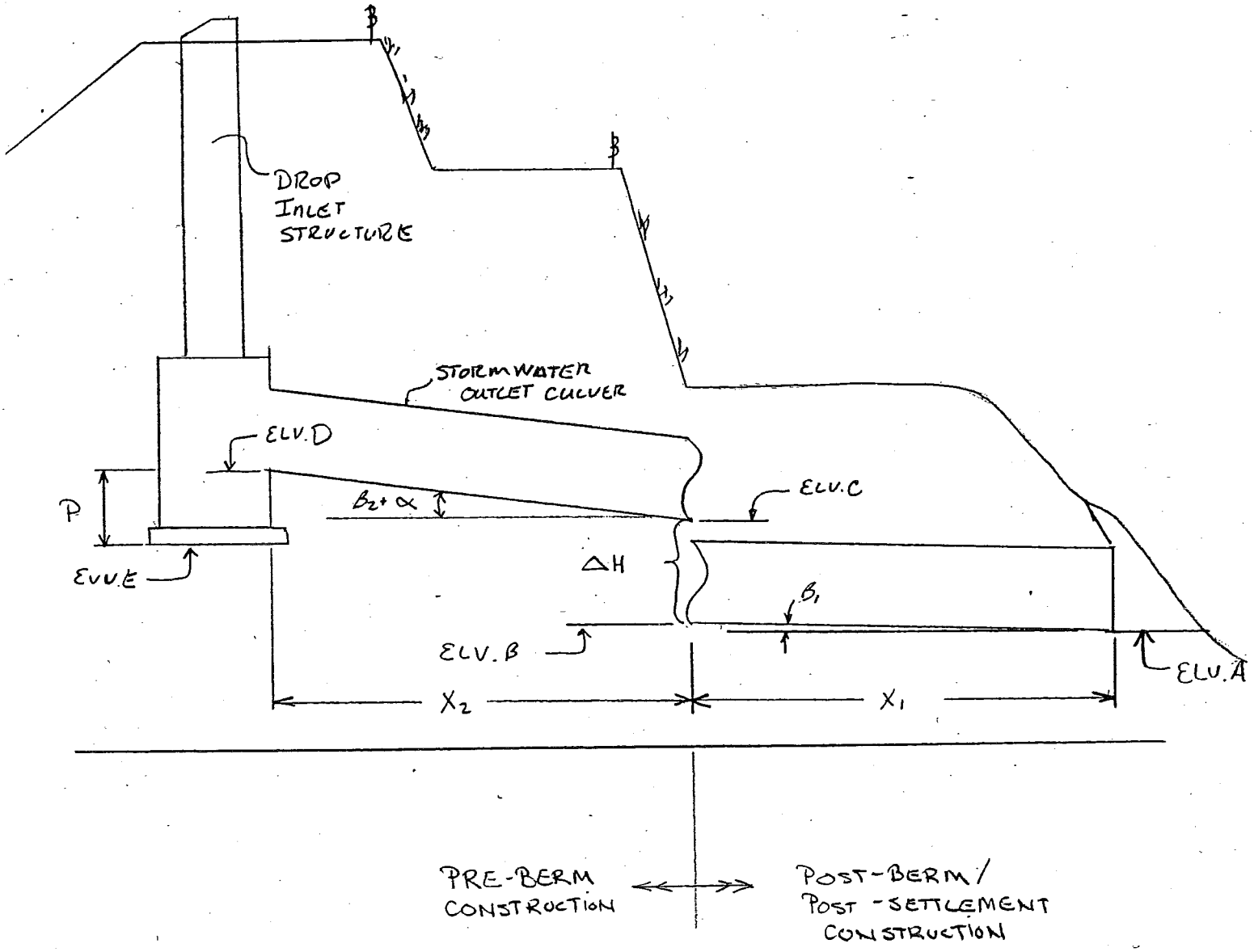
[After Poulos, and Davis, 1974]

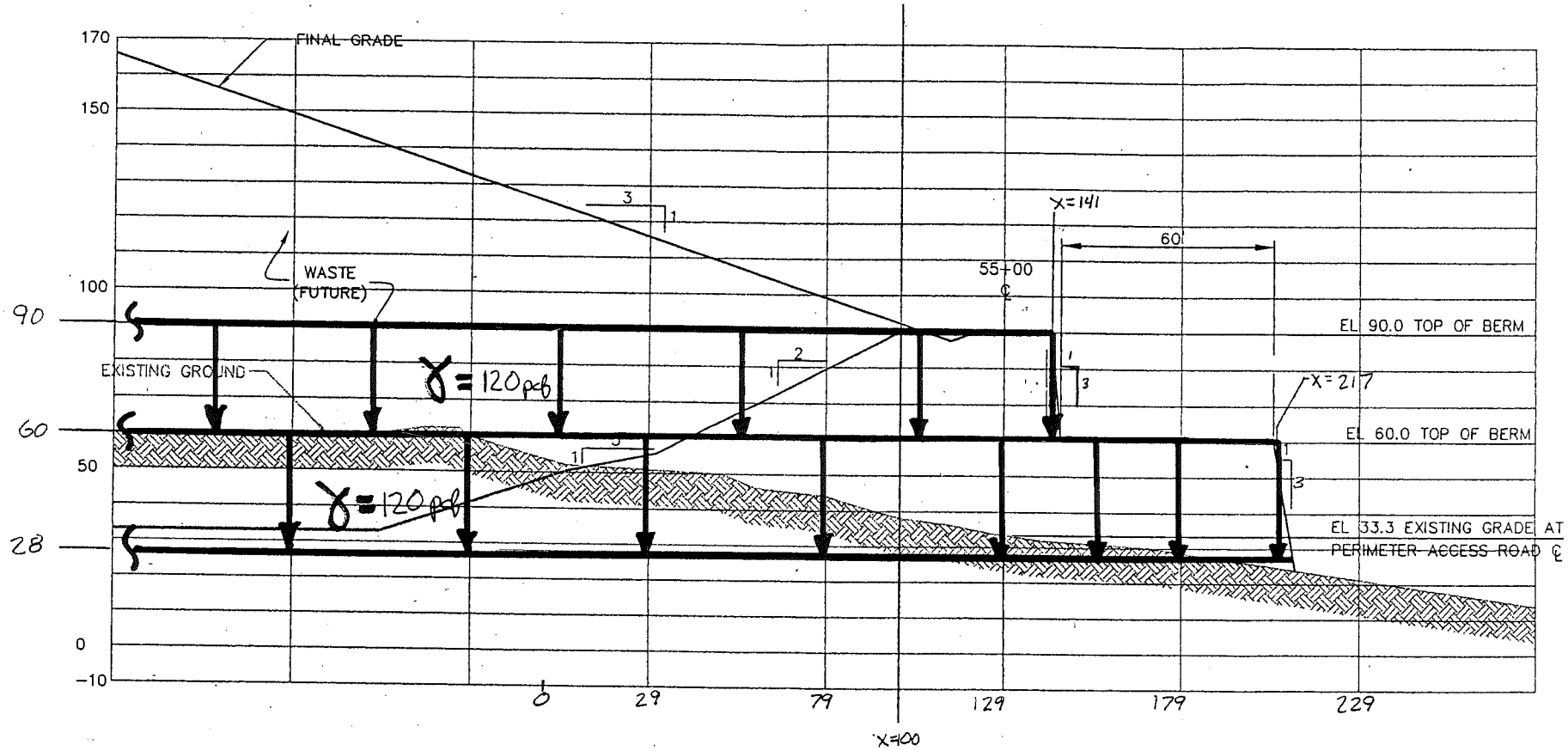
Written by: William M. Steier Date: 3/26/03 Reviewed by: RDE Date: 3/26/03

Client: DSWA Project: Cherry Island Landfill Project/Proposal No.: ME0250 Task No.: 2.9.2

ATTACHMENT 2

TYPICAL OUTLET CULVERT CROSS SECTION





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SECTION A–A'

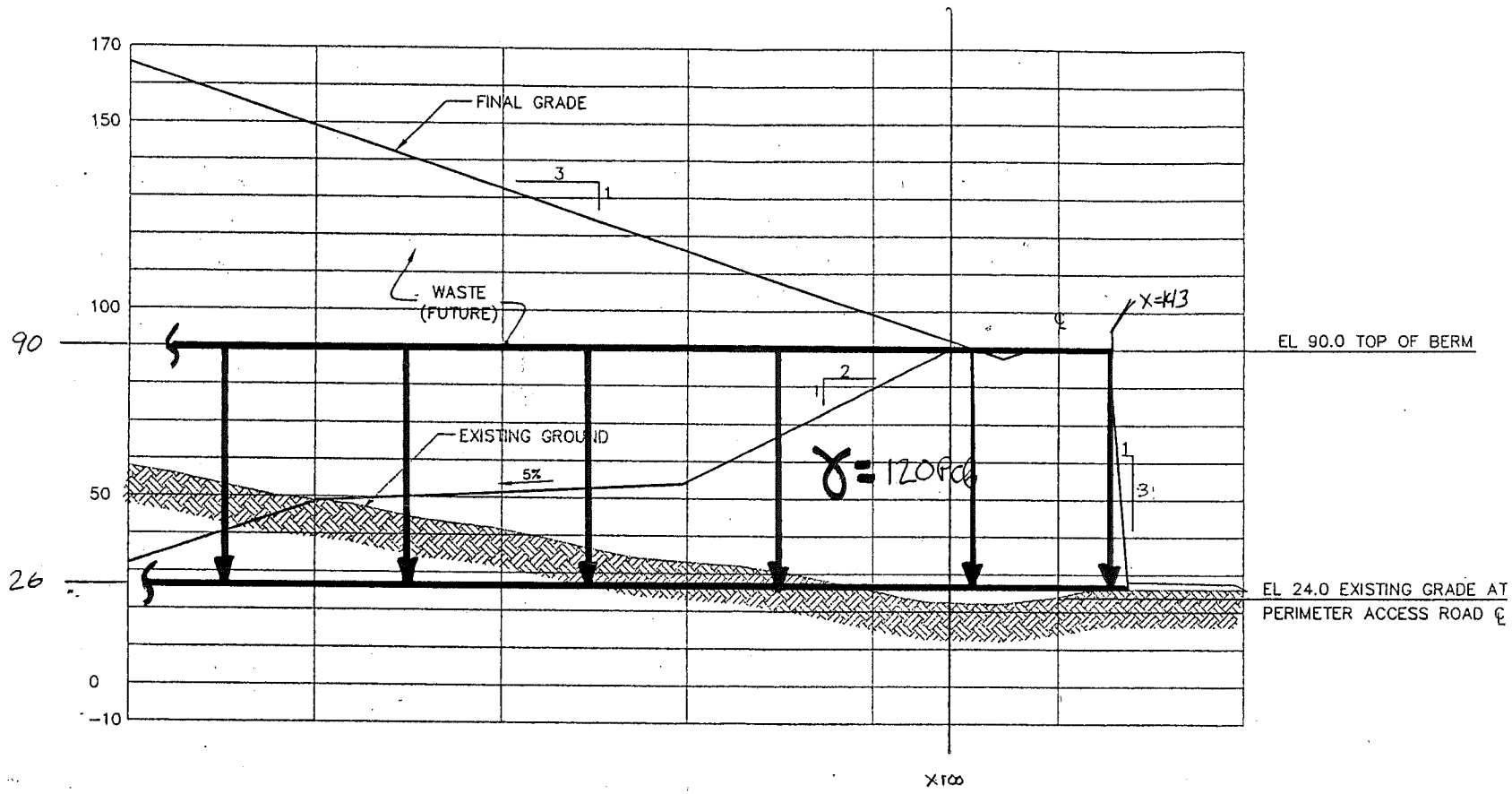
GEOSYNTEC CONSULTANTS
COLUMBIA, MARYLAND

PROJECT NO.	ME0250	FILE NO.	0250F614
DOCUMENT NO.		FIGURE NO.	ATTACHMENT 3

LMM 3/26/03

PMC 3/26/03

8/24



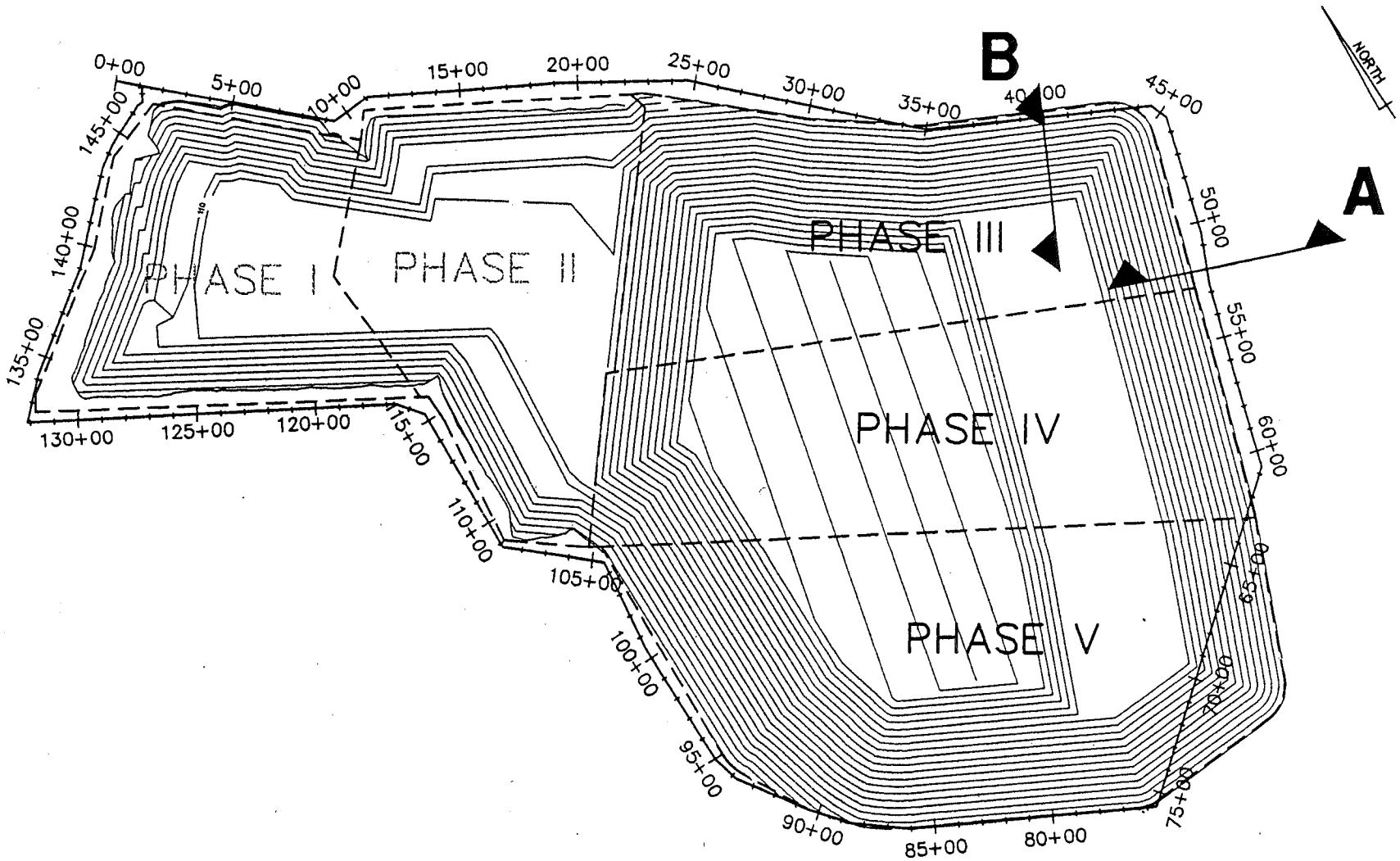
WMS 3/26/03 9/24
RDE 3/26/03

Scale: H=V=1:30

SECTION B–B'

GEOSYNTEC CONSULTANTS
COLUMBIA, MARYLAND

PROJECT NO.	ME0250	FILE NO	0250F614
DOCUMENT NO.		FIGURE	TACHMENT 4



450 225 0 450

SCALE: 1" = 450'

GEOSYNTEC CONSULTANTS

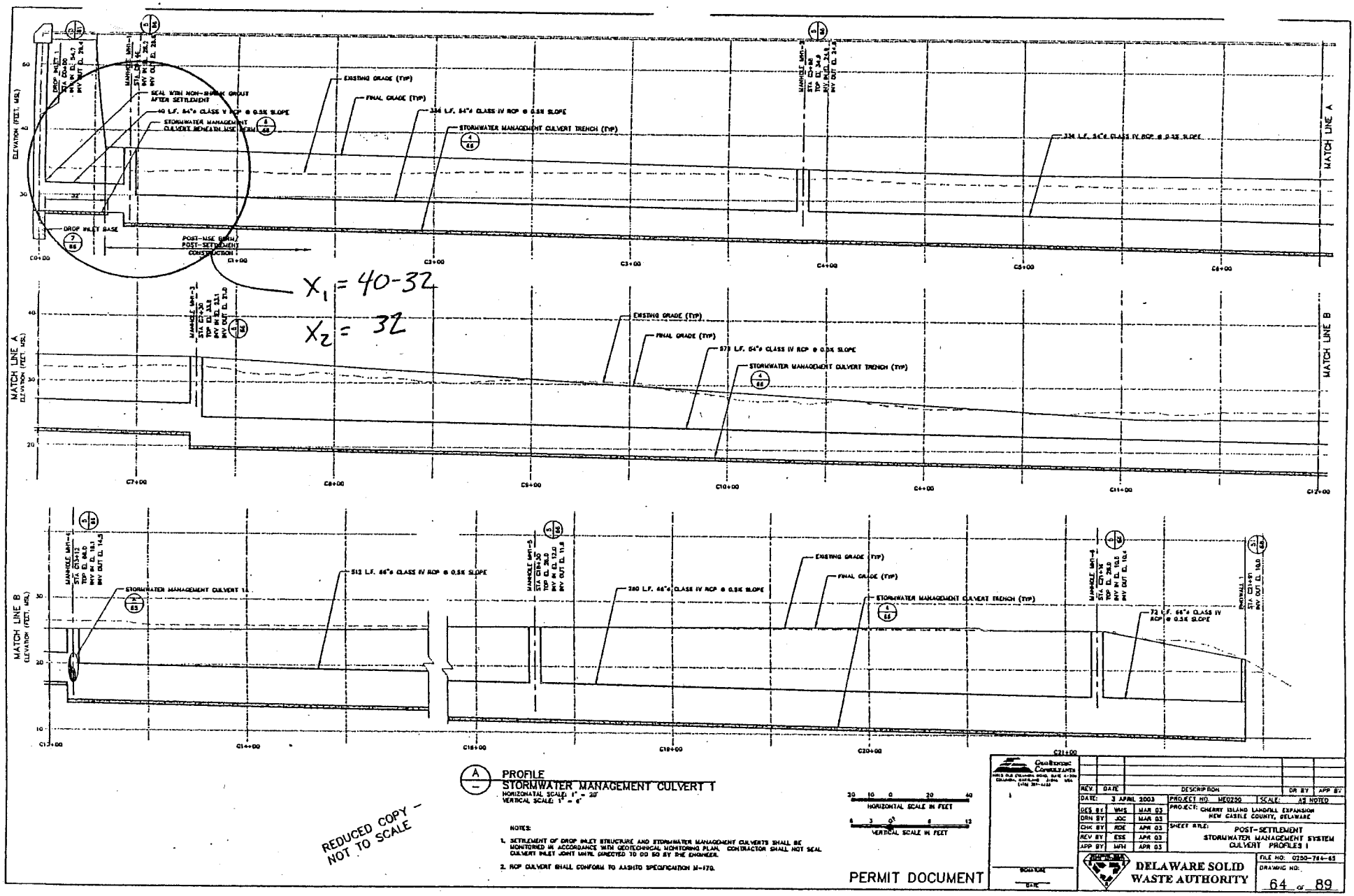
COLUMBIA, MARYLAND

FIGURE NO.	ATTACHMENT 5
PROJECT NO.	ME0250
DOCUMENT NO.	
FILE NO.	0250F614

WMS 3/26/03

RMS 3/24/03

10/24



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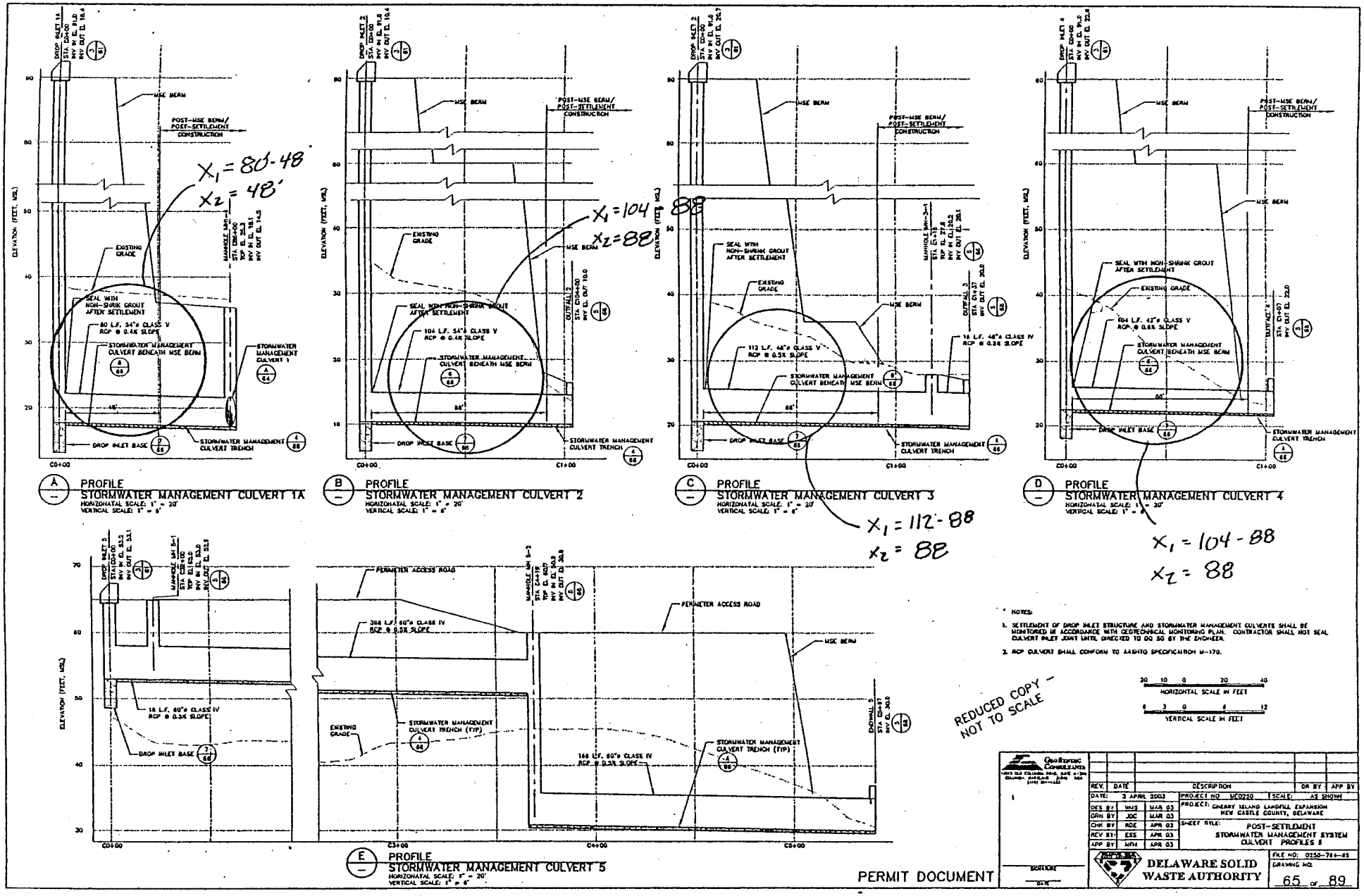
ATTACHMENT 6
DESIGN PARAMETERS: x_1, x_2

12/24
3/26/03
3/26/03

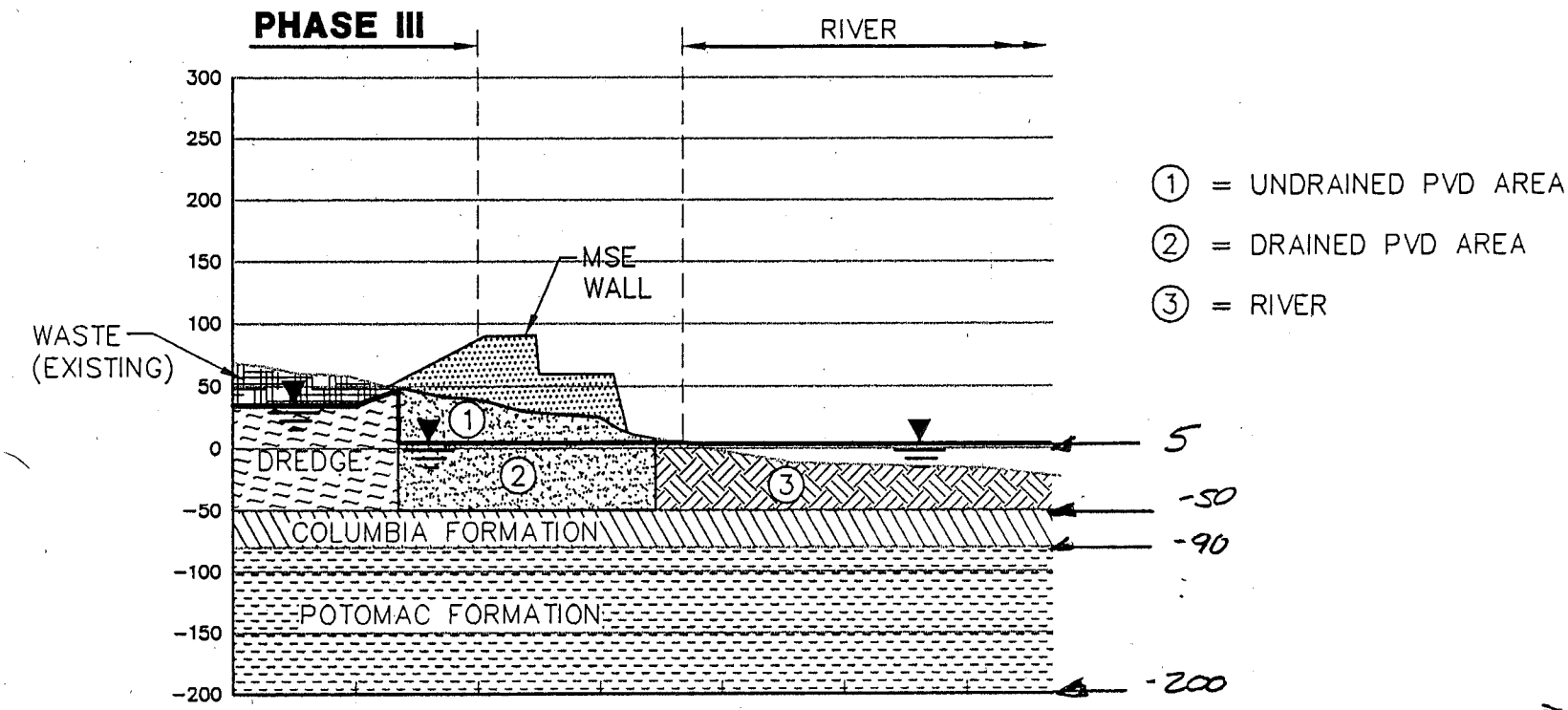


ATTACHMENT 7
DESIGN PARAMETERS: x_1, x_2

11/24
3/26/03
3/26/03

P:\cadd\0250\0250-700-post100percent\0250-764-65.dwg Wed Apr 02 15:42:56 2003 GeoSyntec Consultants, MD (JAB)

SECTION A-A'



LMS 3/26/03
RDO 3/26/03

13/24

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SCALE: 1" = 150'

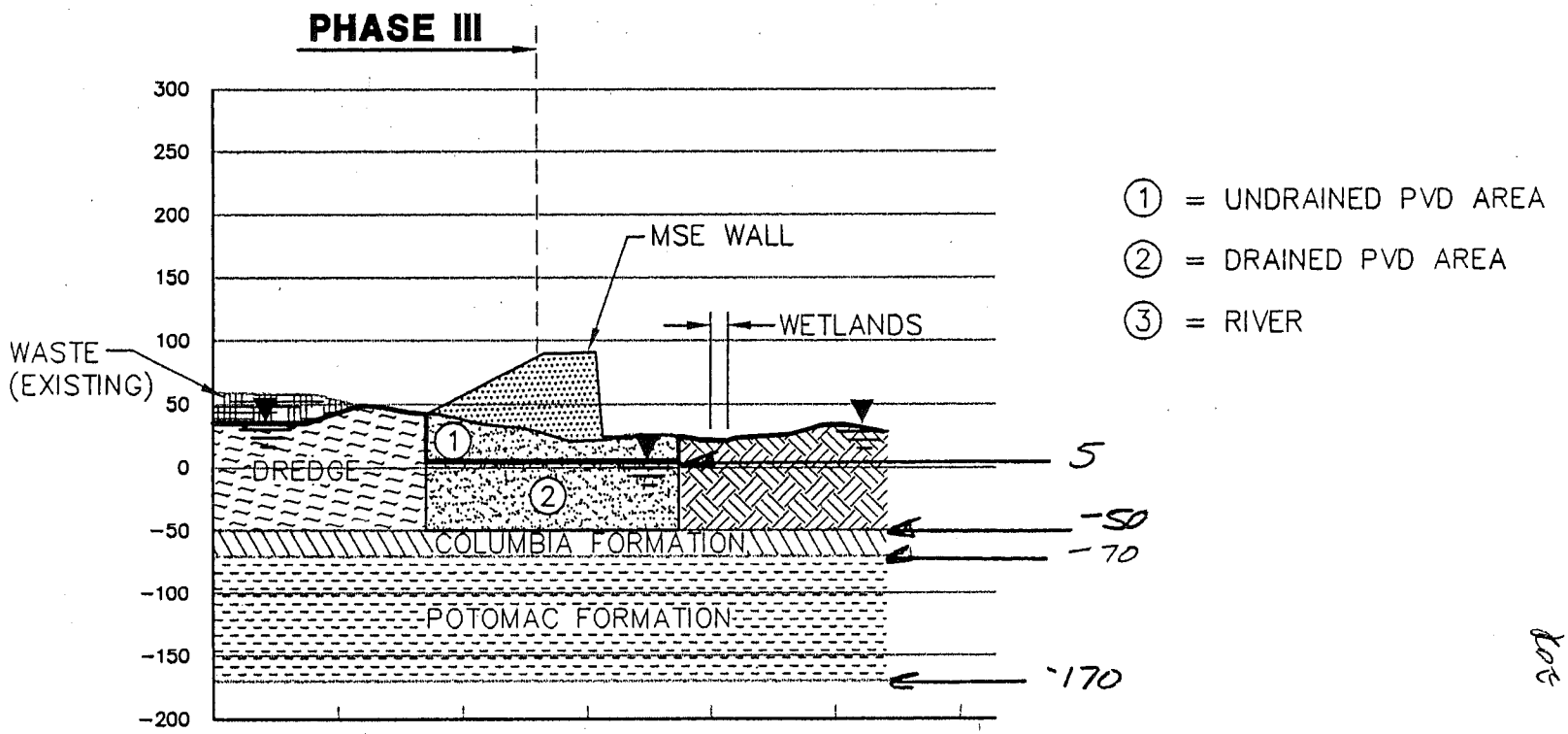
GEOSYNTEC CONSULTANTS
COLUMBIA, MARYLAND

FIGURE NO.	ATTACHMENT 8
PROJECT NO.	ME0250
DOCUMENT NO.	
FILE NO.	0250F614

14/24

WMS 3/26/03

SECTION B-B'



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SCALE: 1" = 150'

GEOSYNTEC CONSULTANTS

'MBIA, MARYLAND

FIGURE NO.	ATTACHMENT 9
PROJECT NO.	ME0250
DOCUMENT NO.	
FILE NO.	02[illegible]14

ATTACHMENT 10 -1
STORMWATER CULVERT SETTLEMENT ANALYSIS
(Section A-A')

Cherry Island Landfill
Wilmington, Delaware

Layer Information		Elevation Information			Settlement Parameters			x= 100		x= 132		x= 164	
Number	Formation Description	Elevation	Depth BGS	Description	σ_{v0}	σ'_{v0}	H	$\Delta\sigma_{v1}$[1]	δ_p	$\Delta\sigma_{v1}$[1]	δ_p	$\Delta\sigma_{v1}$[1]	δ_p
		ft	ft		psf	psf	ft	psf	ft	psf	ft	psf	ft
		28	0	Ground Surface									
Layer 1	Dredge	24	4	Middle of Layer	380	380	8	7182	2.49	6190	2.38	4468	2.12
Layer2	Dredge	15	13	Middle of Layer	1235	1235	10	7056	1.98	6084	1.85	4623	1.62
		5	23	Water Table									
Layer3	Dredge	-5	33	Middle of Layer	3135	2511	30	6785	4.09	5913	3.78	4758	3.32
Layer4	Dredge	-35	63	Middle of Layer	5985	3489	29	6430	3.16	5661	2.91	4643	2.56
	Columbia	-70	98	Middle of Layer	9940	5260	40	No Compression		No Compression		No Compression	
						See Hand Calculation						See Hand Calculation	
Layer5	Potomac	-107	135	Middle of Layer	14475	7486.2	36	5755	0.27	5094	0.24	4288	0.21
Layer6	Potomac	-162	190	Middle of Layer	21075	10654.2	75	5354	0.40	4783	0.36	4133	0.32
	Bottom of Potomac	-200	228										
							Total Settlement (ft)		12.39		11.52		10.15

Consolidation Parameters				
	Dredge	Potomac	Columbia	Units
Modified Coefficient of Consolidation, $C_{c\varepsilon}$ =	0.24	0.16	-	
Unit Weight, g =	95	120	125	pcf
Modified Coefficient of Reconsolidation Consolidation, $C_{r\varepsilon}$ =	0.068	0.03	-	

Notes:

1. Change in vertical stress from Equation 5
2. Primary settlement, Δh_p, from Equation 2.
3. σv_0 and $\sigma' v_0$ from Equation 4.
4. $C_{c\varepsilon}$ used for Dredge formation settlement calculations, and $C_{r\varepsilon}$ used for Potomac formation settlement calculations.

WMS 3/26/03
DJM 3/26/03
15/24

ATTACHMENT 10 -2
STORMWATER CULVERT SETTLEMENT ANALYSIS
(Section A-A')

Cherry Island Landfill
Wilmington, Delaware

Layer Information		Elevation Information			Settlement Parameters			x= 196		x= 228		x= 260	
Number	Formation Description	Elevation	Depth BGS	Description	σ_{v0}	σ'_{v0}	H	$\Delta\sigma_{v1}^{1}$	δ_p	$\Delta\sigma_{v1}^{1}$	δ_p	$\Delta\sigma_{v1}^{1}$	δ_p
		ft	ft		psf	psf	ft	psf	ft	psf	ft	psf	ft
		28	0	Ground Surface									
Layer 1	Dredge	24	4	Middle of Layer	380	380	8	3974	2.03	78	0.16	20	0.04
Layer2	Dredge	15	13	Middle of Layer	1235	1235	10	3934	1.49	538	0.38	55	0.05
		5	23	Water Table									
Layer3	Dredge	-5	33	Middle of Layer	3135	2511	30	3597	2.78	1346	1.34	301	0.35
Layer4	Dredge	-35	63	Middle of Layer	5985	3489	29	3382	2.05	1881	1.30	832	0.65
	Columbia	-70	98	Middle of Layer	9940	5260	40	No Compression		No Compression		No Compression	
						See Hand Calculati							
Layer5	Potomac	-107	135	Middle of Layer	14475	7486.2	36	3387	0.18	2490	0.13	1720	0.10
Layer6	Potomac	-162	190	Middle of Layer	21075	10654.2	75	3442	0.27	2762	0.23	2144	0.18
	Bottom of Potomac	-200	228										
						Total Settlement (ft)			8.80		3.54		1.37

Consolidation Parameters				
	Dredge	Potomac	Columbia	Units
Modified Coefficient of Consolidation, $C_{c\varepsilon}$ =	0.24	0.16	-	
Unit Weight, g =	95	120	125	pcf
Modified Coefficient of Reconsolidation Consolidation, $C_{r\varepsilon}$ =	0.068	0.03	-	

Notes:

1. Change in vertical stress from Equation 5
2. Primary settlement, Δh_p, from Equation 2.
3. σv_0 and $\sigma' v_0$ from Equation 4.
4. $C_{c\varepsilon}$ used for Dredge formation settlement calculations, and $C_{r\varepsilon}$ used for Potomac formati

16/2.4
WMS 3/26/03
RTM 3/26/03

ATTACHMENT 11 -1

STORMWATER CULVERT SETTLEMENT ANALYSIS
(Section B-B')

Cherry Island Landfill
Wilmington, Delaware

Layer Information		Elevation Information			Settlement Parameters			x= 100		x= 132		x= 164	
Number	Formation Description	Elevation	Depth BGS	Description	σ_{v0}	σ'_{v0}	H	$\Delta\sigma_{v1}$ [1]	δ_p	$\Delta\sigma_{v1}$ [1]	δ_p	$\Delta\sigma_{v1}$ [1]	δ_p
		ft	ft		psf	psf	ft	psf	ft	psf	ft	psf	ft
	Ground Surface	26	0	Ground Surface	0	0							
Layer 1	Dredge	22	4	Middle of Layer	380	380	8	7679	2.55	7613	2.54	11	0.02
					855	855							
Layer2	Dredge	13	13	Middle of Layer	1235	1235	10	7639	2.06	6762	1.95	261	0.20
		5	21	Water Table									
Layer3	Dredge	-7	33	Middle of Layer	3135	2386	30	7261	4.37	5360	3.68	1347	1.40
Layer4	Dredge	-35	61	Middle of Layer	5795	3299	27	6492	3.06	4703	2.49	2277	1.48
	Columbia	-59	85	Middle of Layer	8375	4381	20	No Compression		No Compression		No Compression	
Layer5	Potomac	-98	124	Middle of Layer	13105	6678	58	5424	0.45	4275	0.37	3021	0.28
Layer6	Potomac	-150	176	Middle of Layer	19345	9673	43	4989	0.23	4145	0.20	3262	0.16
	Bottom of Potomac	-170											
							Total Settlement (ft)		12.72		11.23		3.54

Consolidation Parameters				
	Dredge	Potomac	Columbia	Units
Modified Coefficient of Consolidation, $C_{c\varepsilon}$ =	0.24	0.16	-	
Unit Weight, g =	95	120	125	pcf
Modified Coefficient of Reconsolidation Consolidation, $C_{r\varepsilon}$ =	0.068	0.03	-	

Notes:

1. Change in vertical stress from Equation 5
2. Primary settlement, Dp, from Equation 2.
3. σv_0 and $\sigma' v_0$ from Equation 4.
4. $C_{c\varepsilon}$ used for Dredge formation settlement calculations, and $C_{r\varepsilon}$ used for Potomac formation settlement calculations.

12/24
WMS 3/26/03
DTM 3/26/03

ATTACHMENT 11 -2

STORMWATER CULVERT SETTLEMENT ANALYSIS
(Section B-B')

Cherry Island Landfill
Wilmington, Delaware

Layer Information		Elevation Information			Settlement Parameters			x= 196		x= 228		x= 260	
Number	Formation Description	Elevation	Depth BGS	Description	σ_{v0}	σ'_{v0}	H	$\Delta\sigma_{vi}'$	δ_p	$\Delta\sigma_{vi}'$	δ_p	$\Delta\sigma_{vi}'$	δ_p
		ft	ft		psf	psf	ft	psf	ft	psf	ft	psf	ft
	Ground Surface	26	0	Ground Surface	0	0							
Layer 1	Dredge	22	4	Middle of Layer	380	380	8	1	0.00	0	0.00	0	0.00
					855	855							
Layer2	Dredge	13	13	Middle of Layer	1235	1235	10	22	0.02	6	0.00	2	0.00
		5	21	Water Table									
Layer3	Dredge	-7	33	Middle of Layer	3135	2386	30	265	0.33	81	0.10	33	0.04
Layer4	Dredge	-35	61	Middle of Layer	5795	3299	27	881	0.67	364	0.29	173	0.14
	Columbia	-59	85	Middle of Layer	8375	4381	20	No Compression		No Compression		No Compression	
Layer5	Potomac	-98	124	Middle of Layer	13105	6678	58	1957	0.19	1218	0.13	760	0.08
Layer6	Potomac	-150	176	Middle of Layer	19345	9673	43	2450	0.13	1783	0.09	1279	0.07
	Bottom of Potomac	-170											
							Total Settlement (ft)		1.34		0.61		0.33

Consolidation Parameters				
	Dredge	Potomac	Columbia	Units
Modified Coefficient of Consolidation, $C_{c\varepsilon}$ =	0.24	0.16	-	
Unit Weight, g =	95	120	125	pcf
Modified Coefficient of Reconsolidation Consolidation, $C_{r\varepsilon}$ =	0.068	0.03	-	

Notes:

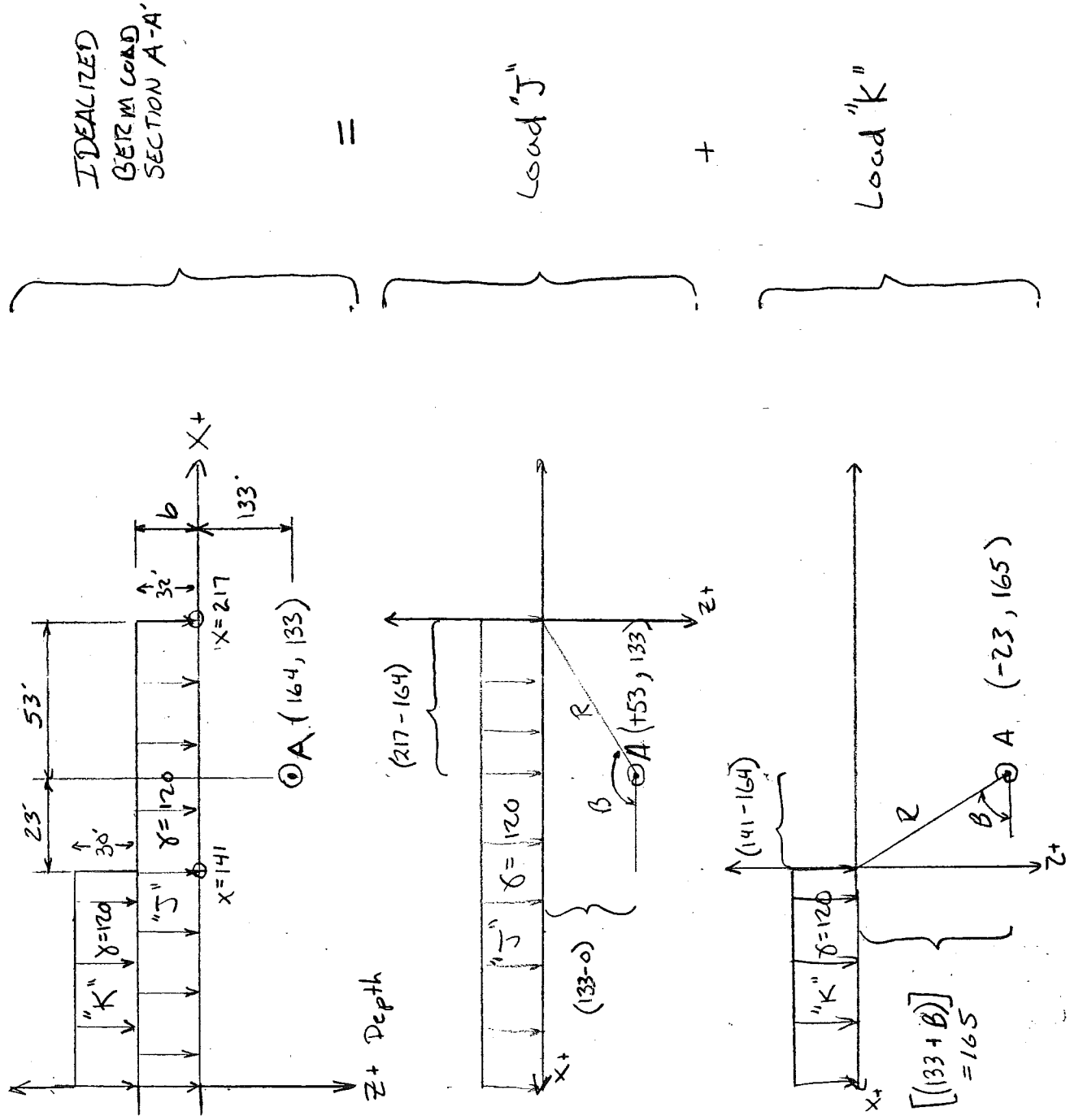
1. Change in vertical stress from Equation 5
2. Primary settlement, Dp, from Equation 2.
3. σv_0 and $\sigma' v_0$ from Equation 4.
4. $C_{c\varepsilon}$ used for Dredge formation settlement calculations, and $C_{r\varepsilon}$ used for Potomac formation s

18/24
WMS 3/26/03
DTM 3/26/03

Written by: (J) STEIER Date: 03/03/26 (YY/MM/DD) Reviewed by: D. MANDEVILLE Date: 03/03/26 (YY/MM/DD)

Client: DSWA Project: CIL Project/Proposal No.: ME0250 Task No.: 2.9

ATTACHMENT 12



ATTACHMENT 12 (CONT)

$$\sigma_{z\,TOTAL} = \sigma_{zJ} + \sigma_{zK}$$

$$\sigma_{zJ} = \frac{J}{\pi}\left(\beta + \frac{xz}{R^2}\right) = \frac{32' \cdot 120\,pcf}{\pi}\left[\left(\pi - \tan^{-1}\left(\frac{133}{53}\right)\right) + \frac{(133)(+53)}{133^2 + (-53)^2}\right]$$

$$= (1222.31)(1.95 + 0.344)$$

$$= 2803.8\ psf$$

$$\sigma_{zK} = \frac{K}{\pi}\left(\beta + \frac{xz}{R^2}\right) = \frac{30 \cdot 120}{\pi}\left[\left|\tan^{-1}\left(\frac{165}{-23}\right)\right| + \frac{(-23)(165)}{(23^2) + (165)^2}\right]$$

$$= 1{,}145.9\ (1.432 + -0.137)$$

$$= 1484.6\ psf.$$

$$\sigma_{z\,Total} = 2803.8 + 1484.6 = \underline{\underline{4{,}288\ psf}}$$

Written by: W STEIER Date: 03/03/26 (YY MM DD) Reviewed by: D. MANDEVILLE Date: 03/03/26 (YY MM DD)

Client: DSWA Project: CIL Project/Proposal No.: ME0250 Task No.: 2.9.

ATTACHMENT 13

LAYER 5: X=164, Z=135

$$\sigma'_{vo} = (\gamma z) - (h_w \gamma_w)$$

$$= \left(\begin{array}{l} (H_1 + H_2 + H_3 + H_4)\,\gamma_{dredge} \\ + (H_{columbia})\,\gamma_{columbia} \\ + (H_5)\,1/2\,\gamma_{potomac} \end{array} \right) - (135 - 23)(62.4)$$

$$= \left[(8 + 10 + 30 + 29)\,95 + (40)\,125 + \left(\frac{36}{2}\right) 120 \right] - (112 \cdot 62.4)$$

$$= (7315 + 5000 + 2160) - 6988.8$$

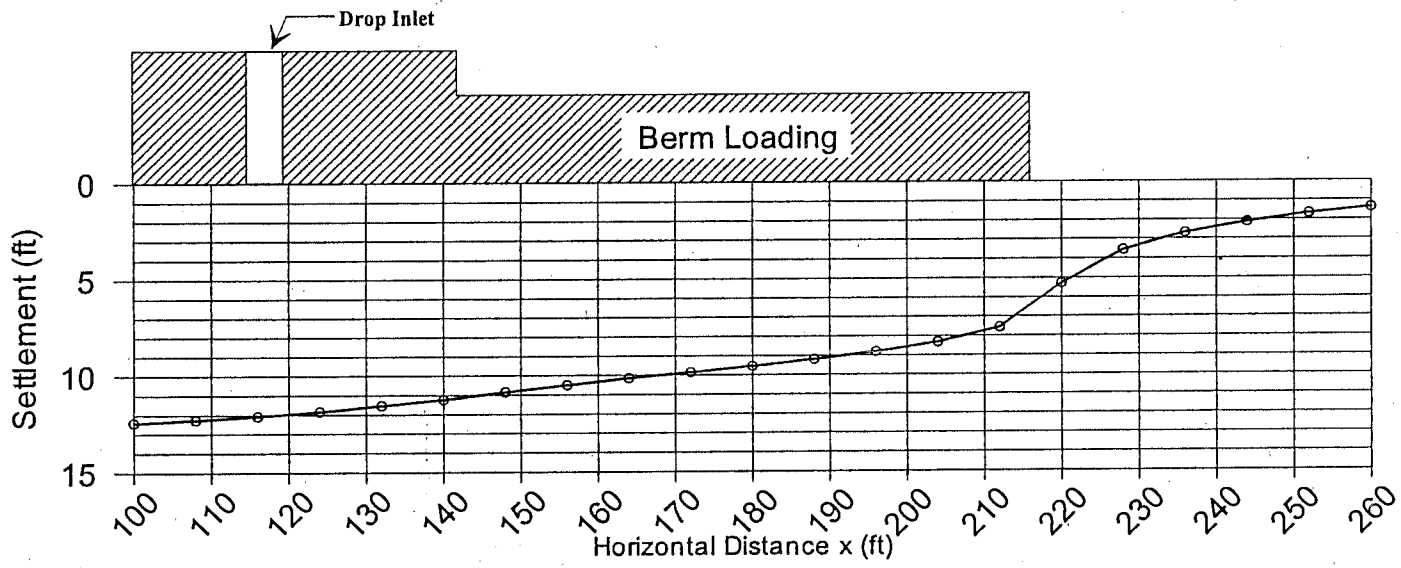
$$\sigma'_{vo} = \underline{\underline{7486.2}} \text{ psf}$$

$$d_p = C_{rc} H \log\left(\frac{\sigma'_{vo} + \Delta\sigma}{\sigma'_{vo}}\right)$$

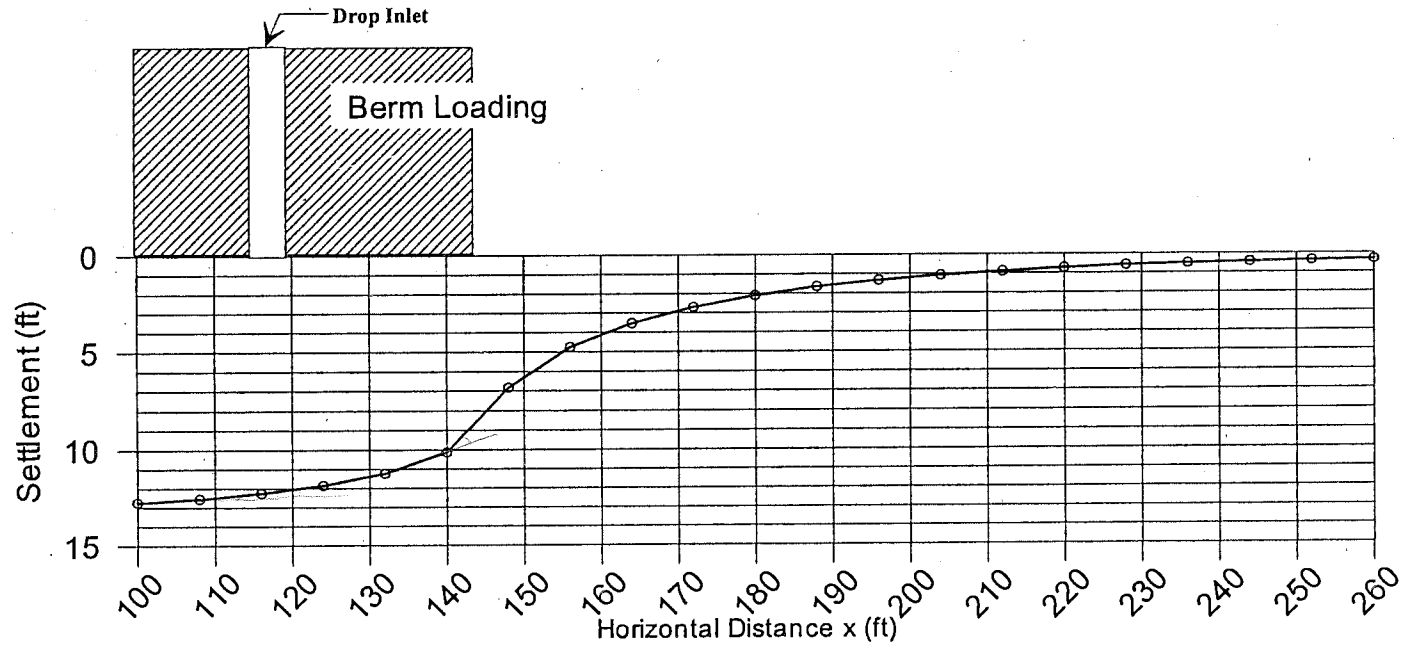
$$= (0.03)(36) \log\left(\frac{7468.2 + 4288}{7486.2}\right)$$

$$= \underline{\underline{0.21 \text{ ft}}}$$

Section A-A'



Section B-B'



GEOSYNTEC CONSULTANTS
10015 Old Columbia Road, Suite A-200
Columbia, Maryland 21046

STORMWATER OUTLET CULVERT SETTLEMENT PROFILES

ATTACHMENT 14

PROJECT: ME0250 Cherry Island

LMS 2/26/03 DTM 4/26/03

22/24

GeoSyntec Consultants

3/26/03

3/26/03

ATTACHMENT 15
STORMWATER OUTLET CULVERT SETTLEMENT SUMMARY

SECTION A-A'

X Position	Settlment[1]	Slope Forward $(X_j - X_{j+1})/L$	Notes
ft	ft	%	
100	12.39	--	
108	12.25	--	
116	**12.06**	3	Approximate location of Drop Inlet Structure
124	11.82	3.8	
132	11.52	3.7	
140	11.22	4.6	
148	10.85	4.4	
156	10.50	4.4	
164	10.15	3.9	
172	9.84	4	
180	9.52	4.3	
188	9.18	4.8	
196	8.80	6.1	
204	8.31	9.6	
212	**7.54**	28.4	**Design Parameter $\Delta H_{A-A'}$**
220	5.27	21.6	Modeled edge of MSE berm location, x= 217
228	3.54	10.9	
236	2.67	7	
244	2.11	5.4	
252	1.68	3.9	
260	1.37		

SECTION B-B'

X Position	Settlment[1]	Slope Forward $(X_j - X_{j+1})/L$	Notes
ft	ft	%	
100	12.72	--	
108	12.53	--	
116	**12.25**	5	Approximate location of Drop Inlet Structure
124	11.85	7.8	
132	11.23	13.8	
140	**10.13**	41.3	**Design Parameter $\Delta H_{B-B'}$**
148	6.83	26	Modeled edge of MSE berm location, x=143
156	4.75	15.1	
164	3.54	10.4	
172	2.71	7.5	
180	2.11	5.6	
188	1.66	4	
196	1.34	3.1	
204	1.09	2.4	
212	0.90	2	
220	0.74	1.6	
228	0.61	1.1	
236	0.52	0.9	
244	0.45	0.7	
252	0.39	0.8	
260	0.33		

Notes:

1. Settlement from Attachments 10 and 11.
2. Double boxed cells represent settlements values used to calculate α

$\alpha_{A-A'} = (7.54-12.06)/(-1)(212-116)(100) = 4.7$

$\alpha_{B-B'} = (10.13-12.25)/(-1)(140-116)(100) = 8.8$

ATTACHMENT 16
CONSTRUCTION DESIGN ELEVATION COMPUTATIONS

Culvert Section ID	Outlet Elevation[1] A ft-msl	Design Length[4] X_1 ft	Design Slope[1] β_1 ft/ft	Elevation B ft-msl	Settlement Parameter[2] $H_{A-A'}$ ft	Settlement Parameter[2] $H_{B-B'}$ ft	Elevation C[3] ft-msl
Culvert 1	28.2	8	0.005	28.2	--	10.1	38.4
Culvert 1a	18.1	32	0.004	18.2	--	10.1	28.4
Culvert 2	10	16	0.004	10.1	7.5	--	17.6
Culvert 3	20.2	24	0.005	20.3	--	10.1	30.5
Culvert 4	22	16	0.006	22.1	7.5	--	29.6
Culvert 5	NA	NA	NA	NA	NA	NA	NA

Culvert Section ID	Design Length[4] X_2 ft	Design Slope[2] β_2 ft/ft	Settlement Parameter[2] ($\alpha_{A-A'}$) ft/ft	Settlement Parameter[2] ($\alpha_{B-B'}$) ft/ft	Slope $\alpha+\beta_2$ ft/ft	Elevation D[5] ft-msl
Culvert 1	32	0.005	--	0.088	0.093	41.3
Culvert 1a	48	0.004	--	0.088	0.092	32.8
Culvert 2	88	0.004	0.047	--	0.051	22.1
Culvert 3	88	0.005	--	0.088	0.093	38.6
Culvert 4	88	0.006	0.047	--	0.053	34.3
Culvert 5	NA	NA	NA	NA	NA	NA

Notes:

1. From Appendix VIb-I.8
2. See Attachment 2 for definition of elevation, length and slope parameters.
2. From Attachment 15
3. From Equation 6
4. From Attachments 6 and 7.
5. From Equation 7

34/24
3/26/02
ATM
3/26/03

Appendix VIb-I.11

Stormwater Outlet Culvert Structural and Pipe Bedding Design

GEOSYNTEC CONSULTANTS

COMPUTATION COVER SHEET

Client: DSWA **Project:** Cherry Island Landfill **Project/Proposal #:** ME0250 **Task #:** 2.9.2

TITLE OF COMPUTATIONS **APPENDIX VIb-I.11: STORMWATER OUTLET CULVERT STRUCTURAL AND PIPE BEDDING DESIGN**

COMPUTATIONS BY:
Signature
Printed Name and Title: William M. Steier, P.E. Project Engineer
1 April 2003 DATE

ASSUMPTIONS AND PROCEDURES CHECKED BY:
(Peer Reviewer)
Signature
Printed Name and Title: Carlos Lazarte , P.E. Senior Engineer
1 April 2003 DATE

COMPUTATIONS CHECKED BY:
Signature
Printed Name and Title: Carlos Lazarte, P.E. Senior Engineer
1 April 2003 DATE

COMPUTATIONS BACKCHECKED BY:
(Originator)
Signature
Printed Name and Title: William M. Steier, P.E. Project Engineer
1 April 2003 DATE

APPROVED BY:
(PM or Designate)
Signature
Printed Name and Title: David Espinoza, P.E. Senior Engineer
4/3/2003 DATE

APPROVAL NOTES:
The calculations presented herein are suitable for a landfill elevation of 195 ft-msl. As shown in this calculation package, the design was performed for a more conservative grading configuration than that shown in Drawing 78 entitled "Landfill Final Development and Grading Plan" (Appendix VIb-A).

RDE 6/10/04

REVISIONS (Number and initial all revisions)

NO.	SHEET	DATE	BY	CHECKED BY	APPROVAL

APPENDIX VIb-I.11
STORMWATER OUTLET CULVERT STRUCTURAL AND PIPE BEDDING DESIGN

PURPOSE

The purpose of this calculation is to select the appropriate American Association of Highway and Transportation Organization (AASHTO) reinforced concrete pipe (RCP) classification, in accordance with AASHTO Specification M170 [AASHTO, 1994], and verify culvert bedding configuration for stormwater outlet culverts proposed for the Cherry Island Landfill expansion project. Stormwater outlet culverts will convey stormwater discharge from the drop inlets to the discharge points at the either the Christina or Delaware Rivers.

PROCEDURE

The design procedure for selection of the minimum culvert strength, and thereby the corresponding AASHTO M-170 RCP classification, is based on the following five-step procedure [American Concrete Pipe Association (ACPA), 1992].

1. estimate earth load;
2. estimate live load;
3. select bedding configuration;
4. estimate bedding factor; and
5. select minimum required strength of culvert.

The calculation parameters used in the five-step procedure described below are obtained from two critical design cross sections. The first critical cross section represents culvert segments laid beneath the CIL Expansion Project mechanically stabilized earth (MSE) berm, and the second critical cross section represents culvert segments laid parallel and away from the MSE berm. The first critical cross section is presented in Attachment 1 and the parameters obtained form this cross section are summarized in Attachment 2. The second critical cross section is presented in Attachment 3 and the parameters obtained from this cross section are summarized in the Attachment 4.

STEP 1: ESTIMATE EARTH LOAD

The earth load acting on the buried culvert consists of loads induced by the mechanically stabilized earth (MSE) berm and from the culvert trench backfill. The general equation for earth load acting on the culvert is as follows:

$$W_e = W_b + W_t \qquad (1)$$

$$W_b = w_b B_c \tag{2}$$

where: W_e = total vertical earth load (lbs/lf);
W_b = vertical load due to the MSE berm (lbs/lf);
W_t = load induced by trench backfill (lbs/lf);
w_b = vertical stress induced by the MSE berm (psf);
B_c = culvert exterior diameter = (1.0 ft + d) (ft); and
d = culvert interior diameter (ft).

The vertical stress induced by the MSE berm is a function of: (i) height and backfill unit weight of the MSE berm; and (ii) the culvert location in relationship to the MSE berm. The following equations are used to estimate the vertical stress induced on the culvert by the MSE berm.

The total vertical stress at the base of the MSE berm is estimated using the following equation.

$$w_{b(base)} = \gamma_b \; H_b \tag{3}$$

where: $w_{b(base)}$ = total vertical stress at the base of the berm (psf);
γ_b = unit weigh of MSE berm backfill = 105 (pcf); and
H_b = height of the MSE berm (ft).

Because the culverts will not be located directly at the base of the MSE berm, the total vertical stress on the culvert is less than $w_{b(base)}$. For this calculation the culvert is assumed to be set within an elastic half-space and the reduced stress, w_b, is calculated using the following elastic solution for loading over one-half of an infinite surface [Poulos and Davis, 1974]:

$$w_b = \frac{w_{b(base)}}{\pi}\left(\beta + \frac{xz}{R^2}\right) \tag{4}$$

$$R^2 = x^2 + z^2 \tag{5}$$

$$\beta = \pi - \tan^{-1}\left(\left|\frac{z}{x}\right|\right) \text{ for culvert segments beneath the MSE berm} \tag{6}$$

$$\beta = \tan^{-1}\left(\left|\frac{z}{x}\right|\right) \text{ for culvert segments away from the MSE berm} \tag{7}$$

where: w_b = vertical stress (psf) induced by the MSE berm at location defined by the distances x, z, and R (ft) and angle β (rad);

x = distance from the face of the MSE berm to the last culvert segment beneath the MSE berm, or to the culvert centerline for segments away from the MSE berm (ft) [note that x is positive under the MSE berm and negative outside of the MSE berm];

z = depth from top of culvert to base of MSE berm (ft);

$\left|\frac{z}{x}\right|$ = absolute value of (z/x); and

π = 3.14

Graphical representation of parameters x, z, R, and angle β are presented in Attachment 5.

The vertical load induced by the trench backfill, W_t (lbs/linear ft), is estimated using a design table prepared by ACPA, and is presented in Attachment 6. The trench backfill load is a function of the following parameters:

where: K = Rankine coefficient of lateral earth pressure (non-dimensional) ;

μ' = friction coefficient the backfill material (non-dimensional);

γ_t = trench backfill unit weight = 110 (pcf);

H_t = height of trench backfill (ft);

B_d = width of trench at top of pipe (ft) (assumed to be 2-times the culvert exterior diameter); and

d = culvert interior diameter (in).

For the case of the culvert beneath the MSE berm, a constant H_t is selected. For the case of the culvert away from the MSE berm a minimum and a maximum value, $H_{t(min)}$ and $H_{t(max)}$, are considered. Design loads from the tables ($W_{t(100)}$) are summarized for four different backfill classifications, which include: sand and gravel ($K\mu'$ = 0.165), saturated topsoil ($K\mu'$ = 0.150); clay ($K\mu'$ = 0.130), and saturated clay ($K\mu'$ = 0.110). For this calculation, the backfill is assumed to have the characteristics of saturated topsoil or $K\mu'$ = 0.150. Design loads are based on a trench backfill unit weigh of 100 pcf. For other backfill unit weights, the design load is adjusted as follows:

$$W_t = W_{t(100)} \frac{\gamma_t}{100} \tag{8}$$

STEP 2: ESTIMATE LIVE LOAD

The vertical live load acting on the culvert, W_l (lbs/ linear foot), is estimated using a design table prepared by ACPA, and is presented in Attachment 7. The vertical live load acting on the culvert is a function of the following parameters:

H_t = total height of fill above the top of the pipe (ft)
= $H_b + H_t$ for culverts located beneath the MSE berm;
= $H_{t(min)}$ for culverts located away from the MSE berm; and
d = culvert interior diameter (in).

STEP 3: SELECT BEDDING CONFIGURATION

Culvert bedding provides foundation support and affects the allowable applied to the culvert. Bedding factors are estimated from a design chart and methodology prepared by the Water Environment Federation (WEF) of the American Society of Civil Engineers [WEF 1992], which is presented in Attachment 8. Bedding factors are a function of the backfill type and placement adjacent to the culvert. For culvert segments beneath the MSE berm, "Class A" trench bedding (i.e., concrete cradle) will be used for construction. For culvert segments parallel or away from the MSE berm, "Class B" bedding (i.e., compacted granular material) will be used for construction. A discussion of the actual bedding factors selected for this design are presented in Step 4.

STEP 4: ESTIMATE BEDDING FACTOR

The "Class A" bedding factor, B_f, varies from 2.8 for plain concrete to 4.8 for reinforced concrete. Values between these two limits are based on the percent of reinforcing, P (or equivalently, reinforcement ratio). The percent of reinforcing is the ratio of the cross sectional area of the transverse reinforcement to the area of concrete (per linear foot). The area of concrete is defined as the zone between the lowest point of the culvert and the centerline of the reinforcement, which is placed at least 3-in. above the bottom of the cradle section. A graphical depiction of P is presented in Attachment 9.

The "Class A" trench bedding factor can be related to P as follows [WEF, 1992]:

$$B_f = 2.33 \times (P - 0.4) + 3.4 \qquad (9)$$

For this design, the "Class A" concrete cradle bedding will be constructed of reinforced concrete. Reinforcement will be No. 7 rebar set 1-ft on center. Thickness of concrete between the centerline of the reinforcement and the bottom of the culvert will be 12 inches. The percent reinforcing selected for this calculation is 0.4 percent. Substituting into equation 9 leads to $B_f = 3.4$.

The "Class B" bedding factor is constant at $B_f = 1.9$. For conservatism, a $B_f = 1.5$ is used for "Class B" bedding factor in this calculation.

STEP 5: SELECT MINIMUM REQUIRED STRENGTH OF CULVERT

AASHTO Specification M-170 defines the RCP classification in terms of the $D_{0.01}$ load, which is defined as follows:

> *"The maximum three-edge-bearing test load [AASHTO T-280] supported by a concrete pipe before a crack having a width of 0.01 in. occurs measured throughout the a continuous length of 1 ft or more measured parallel to the longitudinal axis of the pipe barrel expressed as a D-Load."*

The D-Load concept provides a strength classification of pipe independent of pipe diameter [ACPA, 1992]. The required three-edge-bearing strength of circular reinforced concrete pipe, expressed as a D-Load is computed as follows [ACPA, 1992]:

$$D_{0.01} = \left[\frac{(W_l + W_e)}{B_f \; d} \right] \tag{10}$$

CALCULATION

Calculation of the induced loads and allowable $D_{0.01}$ load on culvert segments and verification of the trench bedding presented are Attachments 10 (i.e. beneath the MSE berm) and 11 (i.e., away or parallel to the MSE berm). Calculations are prepared using the design parameters obtained from Attachments 2 and 4.

RESULTS

Using calculated $D_{0.01}$ load from Attachments 10 and 11, the corresponding required AASHTO-M170 RCP classifications are selected for design (see Attachment 12 for AASHTO-M170 $D_{0.01}$ loading criteria). The following is a summary of the final design RCP classifications and the bedding criteria.

- For culverts beneath the MSE berm – AASHTO Class V with "Class A" bedding, percent reinforcement $P = 0.4$.
- For culvert parallel, or away from the MSE berm – AASHTO Class IV with "Class B" bedding, compacted granular material (i.e., Delaware Department of Transportation Select Aggregate G, Type 1 [DELDOT, 2001]).

REFERENCES

AASHTO, "Standard Specifications for Transportation Materials and Methods of Sampling and Testing", AASHTO, Washington D.C., 1994.

ACPA, *"Concrete Pipe Design Manual"*, American Concrete Pipe Association, Vienna, Virginia, 1992.

DELDOT, *"Specifications for Road and Bridge Construction"*, Delaware Department of Transportation, Wilmington, Delaware, 2001.

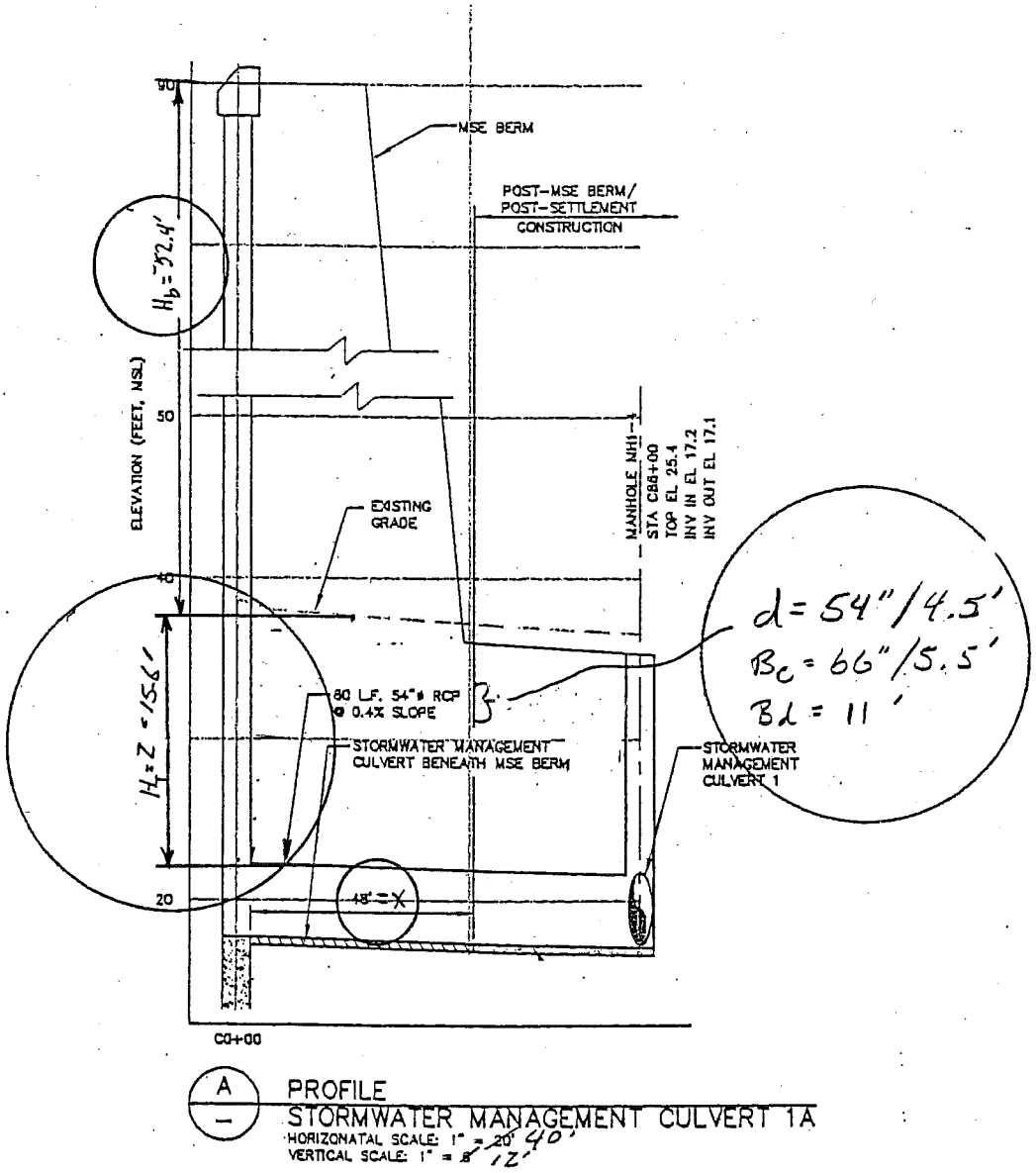
Poulos, H.G., and Davies, E.H., *"Elastic Solutions for Soil and Rock Mechanics"*, John Wiley and Sons, New York, 1974.

WEF, *"Design and Construction of Urban Stormwater Management Systems"*, American Society of Civil Engineers, Reston, Virginia, 1992.

Written by: William M. Steier Date: 4/4/03 Reviewed by: C. LAZARTE Date: 4/4/03

Client: DSWA Project: Cherry Island Landfill Project/Proposal No.: ME0250 Task No.: 2.9.2

ATTACHMENT 1
CULVERT LOCATED BENEATH THE MSE BERM
CRITICAL DESIGN PROFILE

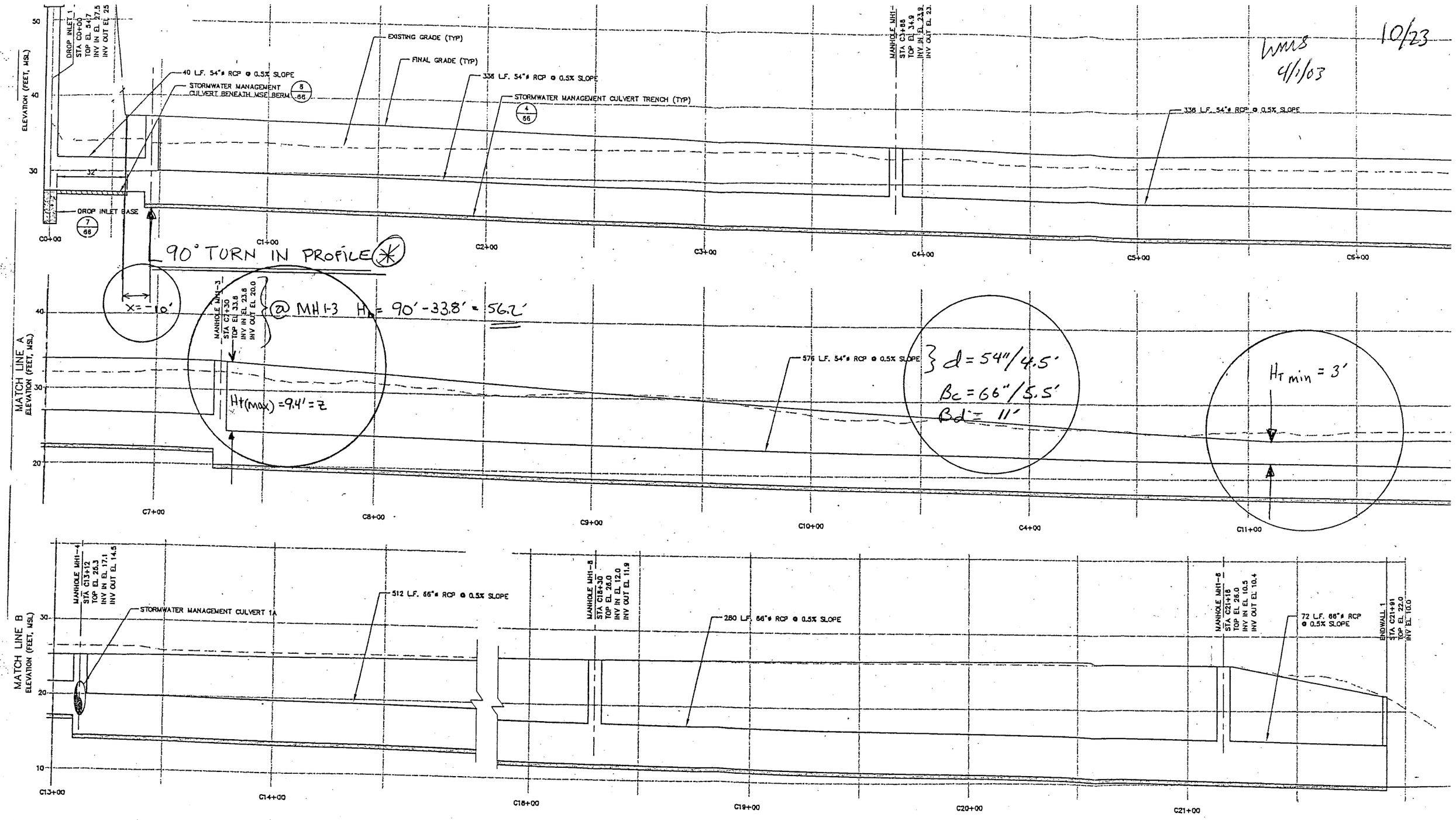


A — PROFILE
STORMWATER MANAGEMENT CULVERT 1A
HORIZONATAL SCALE: 1" = ~~20'~~ 40'
VERTICAL SCALE: 1" = ~~8'~~ 12'

WMS 4/1/03

ATTACHMENT 2
DESIGN PARAMETERS FOR CULVERTS LOCATED BENEATH THE MSE BERM

Parameters Obtained from Attachment 1	Value	Units
Height of Perimeter Berm, H_b =	52.4	ft
Culvert Interior Diameter, d =	4.5	ft
Culvert Exterior Diameter, B_c =	5.5	ft
Trench Width, B_d =	11	ft
Distance, x =	48	ft
Distance, z =	15.6	ft
Height of Fill in Trench, H_t =	15.6	ft
Total Height of Fill Above Top of Pipe, $H_l = H_b + H_t$ =	68.0	ft



WMS 4/1/03

10/23

ATTACHMENT 3
CULVERT LOCATED AWAY FROM THE MSE BERM
CRITICAL DESIGN PROFILE

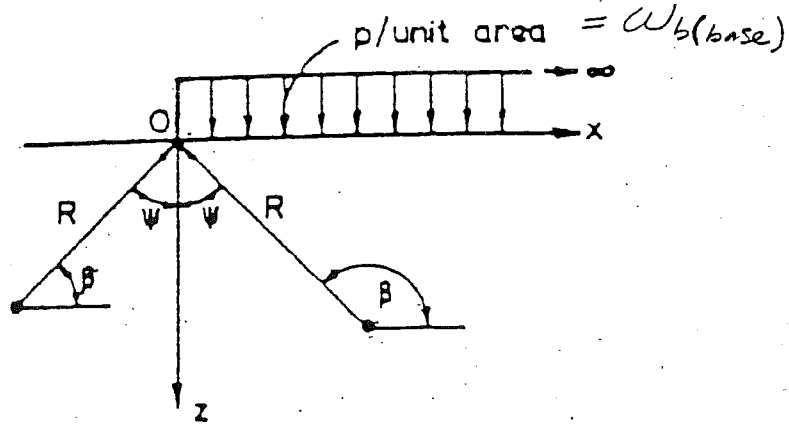
WW 4/1/03

ATTACHMENT 4
DESIGN PARAMETERS FOR CULVERTS LOCATED AWAY FROM MSE BERM

Parameters Obtained from Attachment 3	Value	Units
Height of Perimeter Berm, H_b =	56.2	ft
Culvert Inner Diameter, d =	4.5	ft
Culvert Exterior Diameter, B_c =	5.5	ft
Trench Width, B_d =	11	ft
Distance, x =	-10	ft
Distance, z =	9.4	ft
Height of Fill in Trench, $H_{t(max)}$ =	9.4	ft
Total Height of Fill Above Top of Pipe, $H_l = H_{t(min)}$ =	3.0	ft

ATTACHMENT 5

VERTICAL STRESS DUE TO A UNIFORM LOAD OVER HALF OF THE INFINITE SURFACE



$$\sigma_z = \frac{p}{\pi}\left(\beta + \frac{xz}{R^2}\right)$$

$$\sigma_z = \omega_b$$

$$p = \omega_b(\text{base})$$

[After Poulos, and Davis, 1974]

ATTACHMENT 6-1
VERTICAL LOAD INDUCED BY TRENCH BACKFILL ON CULVERTS LOCATED BENEATH THE MSE BERM

TABLE 27

54"

BACKFILL LOADS ON CIRCULAR PIPE IN TRENCH INSTALLATION

* 100 POUNDS PER CUBIC FOOT BACKFILL MATERIAL — LOADS IN POUNDS PER LINEAR FOOT

A — SAND AND GRAVEL $K\mu'$—0.165

HEIGHT OF BACKFILL H ABOVE TOP OF PIPE, FEET	TRENCH WIDTH AT TOP OF PIPE 7'-0"	7'-6"	8'-0"	8'-6"	9'-0"	9'-6"	10'-0"	11'-0"	12'-0"	13'-0"	TRANSITION WIDTH
5	3118	3238									7'- 3"
6	3658	3954	4030								7'- 7"
7	4173	4518	4880								8'- 0"
8	4665	5057	5451	5790							8'- 5"
9	5134	5573	6014	6456	6765						8'-10"
10	5581	6067	6555	7044	7534	7809					9'- 3"
11	6008	6546	7074	7609	8146	8683					9'- 6"
12	6415	6992	7571	8153	8737	9322	9507				9'- 8"
13	6803	7425	8049	8676	9306	9937	10330				9'- 9"
14	7114	7839	8508	9180	9855	10530	11150				9'-11"
15	7527	8235	8948	9664	10380	11110	11830	11970			10'- 1"
16	7864	8614	9370	10130	10890	11660	12430	12780			10'- 3"
17	8186	8977	9775	10580	11380	12200	13010	13600			10'- 5"
18	8492	9324	10160	11010	11860	12710	13570	14420			10'- 6"
19	8785	9657	10540	11420	12320	13210	14120	15230			10'- 7"
20	9064	9975	10890	11820	12760	13700	14640	16050			10'- 9"
21	9331	10280	11240	12200	13180	14160	15150	16860			10"-10"
22	9585	10570	11570	12570	13590	14610	15640	17680			11'- 0"
23	9827	10850	11880	12930	13980	15050	16120	18280	18490		11'- 1"
24	10060	11120	12190	13270	14360	15470	16580	18820	19310		11'- 3"
25	10280	11370	12480	13600	14730	15870	17020	19350	20120		11'- 4"
26	10490	11620	12760	13920	15080	16260	17450	19860	20930		11'- 5"
27	10690	11850	13030	14220	15420	16640	17870	20360	21750		11'- 7"
28	10880	12070	13280	14510	15750	17010	18270	20840	22580		11'- 8"
29	11060	12290	13520	14790	16070	17360	18660	21300	23380		11'- 9"
30	11240	12490	13770	15060	16370	17700	19040	21760	24190		11'-11"
31	11400	12690	13990	15320	16670	18030	19410	22200	25010		12'- 0"
32	11560	12880	14210	15570	16950	18350	19760	22630	25540	25840	12'- 1"
33	11710	13060	14420	15810	17230	18660	20100	23040	26030	26650	12'- 3"
34	11860	13230	14620	16040	17490	18950	20440	23440	26500	27440	12'- 3"
35	12000	13390	14820	16270	17740	19240	20760	23840	26970	28250	12'- 5"
36	12130	13550	15000	16480	17990	19520	21060	24210	27420	29090	12'- 6"
37	12250	13700	15180	16690	18220	19780	21360	24580	27860	29910	12'- 7"
38	12370	13840	15350	16890	18450	20040	21660	24940	28290	30720	12'- 9"
39	12490	13980	15510	17080	18670	20290	21940	25290	28710	31500	12'-10"
40	12600	14110	15670	17260	18880	20530	22210	25620	29110	32330	12'-11"

B — SATURATED TOP SOIL $K\mu'$—0.150

$d = 54''$

TRENCH WIDTH AT TOP OF PIPE = B_d 7'-0"	7'-6"	8'-0"	8'-6"	9'-0"	9'-6"	10'-0"	11'-0"	12'-0"	13'-0"	TRANSITION WIDTH	HEIGHT OF BACKFILL H ABOVE TOP OF PIPE, FEET = H_T
3150	3238									7'- 2"	5
3703	4000	4030								7'- 7"	6
4233	4579	4880								7'-11"	7
4740	5134	5529	5790							8'- 4"	8
5227	5668	6110	6554	6765						8'- 9"	9
5693	6181	6671	7161	7653	7809					9'- 2"	10
6139	6674	7210	7748	8287	8683					9'- 4"	11
6567	7147	7730	8315	8901	9507					9'- 6"	12
6976	7602	8231	8862	9494	10130	10330				9'- 8"	13
7369	8039	8713	9389	10070	10750	11150				9'- 9"	14
7745	8459	9177	9899	10620	11350	11970				9'-11"	15
8105	8863	9625	10390	11160	11930	12710	12780			10'- 1"	16
8450	9250	10060	10870	11680	12500	13320	13600			10'- 2"	17
8781	9623	10470	11320	12160	13040	13910	14420			10'- 4"	18
9098	9981	10870	11770	12670	13570	14480	15230			10'- 5"	19
9401	10320	11260	12190	13140	14090	15040	18050			10'- 6"	20
9692	10660	11630	12610	13590	14580	15580	16860			10'- 8"	21
9971	10970	11980	13000	14030	15060	16100	17680			10'- 9"	22
10240	11280	12330	13390	14460	15530	16610	18490			10'-10"	23
10490	11570	12660	13760	14870	15980	17110	19310			11'- 0"	24
10740	11850	12980	14120	15260	16420	17590	19940	20120		11'- 1"	25
10970	12120	13290	14460	15650	16850	18050	20480	20930		11'- 2"	26
11200	12380	13580	14800	16020	17260	18500	21020	21750		11'- 3"	27
11410	12630	13870	15120	16380	17660	18940	21540	22580		11'- 5"	28
11620	12870	14140	15430	16730	18040	19370	22040	23380		11'- 6"	29
11820	13100	14410	15730	17070	18420	19780	22540	24190		11'- 7"	30
12010	13320	14660	16020	17390	18780	20180	23020	25010		11'- 8"	31
12190	13540	14910	16300	17710	19130	20570	23480	25840		11'- 9"	32
12360	13740	15140	16570	18010	19470	20950	23940	26650		11'-11"	33
12530	13940	15370	16830	18310	19800	21310	24380	27440		12'- 0"	34
12690	14130	15590	17080	18590	20120	21670	24800	27990	28250	12'- 1"	35
12840	14310	15800	17320	18870	20430	22010	25220	28480	29090	12'- 2"	36
12990	14480	16010	17560	19130	20730	22350	25630	28970	29910	12'- 3"	37
13130	14650	16200	17780	19390	21020	22670	26020	29440	30720	12'- 4"	38
13260	14810	16390	18000	19640	21300	22990	26410	29890	31500	12'- 5"	39
13390	14960	16570	18210	19880	21580	23290	26780	30340	32330	12'- 7"	40

$K_A' = 0.15$

$B_d = 11.0$ ft

$d = 54''$

$H_T = 15.6$ ft

FROM ATTACHMENT 1

$$W_T = \left(\frac{15.6-15}{16-15}\right)\cdot(12780-11970) + 11970 = \underline{12456}\ \text{lb/ft}$$

GEOSYNTEC CONSULTANTS

Written by: W STEIER Date: 03/03/31 (YY MM DD) Reviewed by: C LAZARTE Date: 03/04/01 (YY MM DD)

Client: DSWA Project: CIC Project/Proposal No.: MEO256 Task No.: 2.4.2

Page 13 of 23

ATTACHMENT 6-2
VERTICAL LOAD INDUCED BY TRENCH BACKFILL ON CULVERTS LOCATED AWAY FROM THE MSE BERM

TABLE 27

54"

BACKFILL LOADS ON CIRCULAR PIPE IN TRENCH INSTALLATION

*100 POUNDS PER CUBIC FOOT BACKFILL MATERIAL — LOADS IN POUNDS PER LINEAR FOOT

A — SAND AND GRAVEL Kμ'—0.165

HEIGHT OF BACKFILL H ABOVE TOP OF PIPE, FEET	TRENCH WIDTH AT TOP OF PIPE 7'-0"	7'-6"	8'-0"	8'-6"	9'-0"	9'-6"	10'-0"	11'-0"	12'-0"	13'-0"	TRANSITION WIDTH
5	3118	3238									7'- 3"
6	3658	3954	4030								7'- 7"
7	4173	4518	4880								8'- 0"
8	4665	5057	5451	5790							8'- 5"
9	5134	5573	6014	6456	6765						8'-10"
10	5581	6067	6555	7044	7534	7809					9'- 3"
11	6008	6540	7074	7609	8146	8683					9'- 6"
12	6415	6992	7571	8153	8737	9322	9507				9'- 8"
13	6803	7425	8049	8676	9306	9937	10330				9'- 9"
14	7114	7839	8508	9180	9855	10530	11150				9'-11"
15	7527	8235	8948	9664	10380	11110	11830	11970			10'- 1"
16	7864	8614	9370	10130	10890	11660	12430	12780			10'- 3"
17	8186	8977	9775	10580	11380	12200	13010	13600			10'- 5"
18	8492	9324	10160	11010	11860	12710	13570	14420			10'- 6"
19	8785	9657	10540	11420	12320	13210	14120	15230			10'- 7"
20	9064	9975	10890	11820	12760	13700	14640	16050			10'- 9"
21	9331	10280	11240	12200	13180	14160	15150	16860			10'-10"
22	9585	10570	11570	12570	13590	14610	15640	17680			11'- 0"
23	9827	10850	11880	12930	13980	15050	16120	18280	18490		11'- 1"
24	10060	11120	12190	13270	14360	15470	16580	18820	19310		11'- 3"
25	10280	11370	12480	13600	14730	15870	17020	19350	20120		11'- 4"
26	10490	11620	12760	13920	15080	16260	17450	19860	20930		11'- 5"
27	10690	11850	13030	14220	15420	16640	17870	20360	21750		11'- 7"
28	10880	12070	13280	14510	15750	17010	18270	20840	22580		11'- 8"
29	11060	12290	13530	14790	16070	17360	18660	21300	23380		11'- 9"
30	11240	12490	13770	15060	16370	17700	19040	21760	24190		11'-11"
31	11400	12690	13990	15320	16670	18030	19410	22200	25010		12'- 0"
32	11560	12880	14210	15570	16950	18350	19760	22630	25540	25840	12'- 1"
33	11710	13060	14420	15810	17230	18660	20100	23040	26030	26650	12'- 3"
34	11860	13230	14620	16040	17490	18950	20440	23440	26500	27440	12'- 3"
35	12000	13390	14820	16270	17740	19240	20760	23840	26970	28250	12'- 5"
36	12130	13550	15000	16480	17990	19520	21060	24210	27420	29090	12'- 6"
37	12250	13700	15180	16690	18220	19780	21360	24580	27860	29910	12'- 7"
38	12370	13840	15350	16890	18450	20040	21660	24940	28290	30720	12'- 9"
39	12490	13980	15510	17080	18670	20290	21940	25290	28710	31500	12'-10"
40	12600	14110	15670	17260	18880	20530	22210	25620	29110	32330	12'-11"

54"

B — SATURATED TOP SOIL Kμ'—0.150

HEIGHT OF BACKFILL H ABOVE TOP OF PIPE, FEET H+(MAX)	TRENCH WIDTH AT TOP OF PIPE = Bd 7'-0"	7'-6"	8'-0"	8'-6"	9'-0"	9'-6"	10'-0"	11'-0"	12'-0"	13'-0"	TRANSITION WIDTH
5	3150	3238									7'- 2"
6	3703	4000	4030								7'- 7"
7	4233	4579	4880								7'-11"
8	4740	5134	5529	5790							8'- 4"
9	5227	5668	6110	6554	6765						8'- 9"
10	5693	6181	6671	7161	7653	7809					9'- 2"
11	6139	6674	7210	7748	8287	8683					9'- 4"
12	6567	7147	7730	8315	8901	9507					9'- 6"
13	6976	7602	8231	8862	9494	10130	10330				9'- 8"
14	7369	8039	8713	9389	10070	10750	11150				9'- 9"
15	7745	8459	9177	9899	10620	11350	11970				9'-11"
16	8105	8863	9625	10390	11160	11930	12710	12780			10'- 1"
17	8450	9250	10060	10870	11680	12500	13320	13600			10'- 2"
18	8781	9623	10470	11320	12180	13040	13910	14420			10'- 4"
19	9098	9981	10870	11770	12670	13570	14480	15230			10'- 5"
20	9401	10320	11260	12190	13140	14090	15040	16050			10'- 6"
21	9692	10660	11630	12610	13590	14580	15580	16860			10'- 8"
22	9971	10970	11980	13000	14030	15060	16100	17680			10'- 9"
23	10240	11260	12330	13390	14460	15530	16610	18490			10'-10"
24	10490	11570	12660	13760	14870	15980	17110	19310			11'- 0"
25	10740	11850	12980	14120	15280	16420	17590	19940	20120		11'- 1"
26	10970	12120	13290	14460	15650	16850	18050	20480	20930		11'- 2"
27	11200	12380	13580	14800	16020	17260	18500	21020	21750		11'- 3"
28	11410	12630	13870	15120	16380	17660	18940	21540	22580		11'- 5"
29	11620	12870	14140	15430	16730	18040	19370	22040	23380		11'- 6"
30	11820	13100	14410	15730	17070	18420	19780	22540	24190		11'- 7"
31	12010	13320	14660	16020	17390	18780	20180	23020	25010		11'- 8"
32	12190	13540	14910	16300	17710	19130	20570	23480	25840		11'- 9"
33	12360	13740	15140	16570	18010	19470	20950	23940	26650		11'-11"
34	12530	13940	15370	16830	18310	19800	21310	24380	27440		12'- 0"
35	12690	14130	15590	17080	18590	20120	21670	24800	27990	28250	12'- 1"
36	12840	14310	15800	17320	18870	20430	22010	25220	28480	29090	12'- 2"
37	12990	14480	16010	17560	19130	20730	22350	25630	28970	29910	12'- 3"
38	13130	14650	16200	17780	19390	21020	22670	26020	29440	30720	12'- 4"
39	13260	14810	16390	18000	19640	21300	22990	26410	29890	31500	12'- 5"
40	13390	14960	16570	18210	19880	21580	23290	26780	30340	32330	12'- 7"

$K\mu' = 0.150$

$B_d = 11.0$ ft

$d = 54''$

$H_{T_{max}} = 9.4$ ft

FROM ATTACHMENT 3 / $W_T = \left(\frac{9.4-9}{10-9}\right)(7809-6765) + 6765 = \underline{7183}$ lbs/LF

GEOSYNTEC CONSULTANTS

Written by: W. STEIER Date: 03/03/31 (YY MM DD) Reviewed by: C. LAZARTE Date: 03/04/01 (YY MM DD)

Client: DSWA Project: CIC Project/Proposal No.: MEDESA Task No.: 2.9.2

ATTACHMENT 7-1
VERTICAL LOAD INDUCED BY LIVE LOADING ON CULVERTS LOCATED BENEATH THE MSE BERM

HIGHWAY LOADS ON CIRCULAR PIPE

POUNDS PER LINEAR FOOT

PIPE SIZE D IN INCHES	B_c (ft.)	HEIGHT OF FILL H ABOVE TOP OF PIPE IN FEET = H_e = 68'													PIPE SIZE D IN INCHES
		0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	5.0	6.0	7.0	8.0	9.0	
12	1.33	3780	2080	1470	1080	760	550	450	380	290	230	190	160	130	12
15	1.63	4240	2360	1740	1280	900	660	540	450	350	280	230	190	160	15
18	1.92	4110	2610	1970	1460	1030	750	620	520	400	320	260	220	190	18
21	2.21	3920	2820	2190	1620	1150	840	690	580	450	360	300	250	210	21
24	2.50	4100	3010	2400	1780	1270	930	760	640	500	400	330	280	240	24
27	2.79	3880	2940	2590	1930	1380	1010	830	700	560	440	360	300	260	27
30	3.08	3620	2830	2770	2070	1480	1080	890	750	590	480	390	330	280	30
33	3.38	3390	2930	2950	2200	1580	1160	960	810	630	510	420	360	300	33
36	3.67	3190	2810	2930	2330	1670	1230	1020	860	670	550	450	380	330	36
39	3.96	3010	2670	2850	2440	1760	1290	1070	910	710	580	480	410	350	39
42	4.25	2860	2550	2770	2560	1840	1360	1130	950	750	610	510	430	370	42
48	4.83	2590	2330	2620	2480	1990	1470	1230	1040	820	670	560	470	410	48
54	5.42	2360	2150	2490	2360	2050	1580	1320	1120	890	730	610	520	440	54
60	6.00	2170	1990	2450	2250	1960	1680	1400	1190	950	780	650	560	480	60
66	6.58	2010	1850	2520	2160	1880	1640	1480	1260	1010	830	700	590	510	66
72	7.17	1870	1730	2580	2190	1810	1570	1510	1330	1060	880	740	630	540	72
78	7.75	1750	1630	2630	2240	1770	1520	1460	1390	1110	920	780	660	570	78
84	8.33	1650	1540	2730	2290	1810	1460	1410	1360	1160	960	810	690	600	84
90	8.92	1550	1460	2530	2330	1850	1470	1360	1310	1210	1000	850	720	630	90
96	9.50	1470	1380	2410	2290	1880	1500	1330	1270	1250	1040	880	750	650	96
102	10.08	1390	1320	2300	2190	1910	1530	1350	1240	1290	1070	910	780	680	102
108	10.67	1320	1260	2200	2090	1830	1560	1380	1230	1330	1110	940	810	700	108
114	11.25	1260	1200	2110	2010	1760	1540	1410	1260	1362	1140	970	830	730	114
120	11.83	1210	1150	2020	1930	1700	1480	1420	1280	1400	1170	990	860	750	120
126	12.42	1160	1100	1940	1860	1640	1430	1380	1300	1430	1200	1020	880	770	126
132	13.00	1110	1060	1870	1800	1580	1380	1330	1290	1460	1220	1040	900	790	132
138	13.58	1070	1020	1800	1730	1530	1340	1290	1250	1490	1250	1070	920	810	138
144	14.17	1020	980	1740	1670	1480	1300	1250	1210	1470	1280	1090	940	830	144

DATA:
1. Unsurfaced roadway.
2. Loads—AASHTO HS 20, two 16,000 lb. dual-tired wheels, 4 ft. on centers, or alternate loading, four 12,000 lb. dual-tired wheels, 4 ft. on centers with impact included.

NOTES:
1. Interpolate for intermediate pipe sizes and/or fill heights.
2. Critical loads:
   a. For H = 0.5 and 1.0 ft., a single 16,000 lb. dual-tired wheel.
   b. For H = 1.5 through 4.0 ft., two 16,000 lb. dual-tired wheels, 4 ft. on centers.
   c. For H > 4.0 ft. alternate loading.
3. Truck live loads for H = 10.0 ft. or more are insignificant. ← $H_e = 68' \Rightarrow W_e = 0$ lbs/LF

$D = d = 54''$
$H_e = 68$ ft } FROM ATTACHMENT 1

GEOSYNTEC CONSULTANTS

Written by: W. STEIGER Date: 03/03/31 Reviewed by: C. CATALANI Date: 03/04/01

Client: DSWA Project: CIC Project/Proposal No.: MC0250 Task No.: 2.9.2

ATTACHMENT 7-2
VERTICAL LOAD INDUCED BY LIVE LOADING ON CULVERTS LOCATED AWAY FROM THE MSE BERM

HIGHWAY LOADS ON CIRCULAR PIPE

POUNDS PER LINEAR FOOT

PIPE SIZE D IN INCHES	B_c (ft.)	HEIGHT OF FILL H ABOVE TOP OF PIPE IN FEET = H_e = 3'													PIPE SIZE D IN INCHES
		0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	5.0	6.0	7.0	8.0	9.0	
12	1.33	3780	2080	1470	1080	760	550	450	380	290	230	190	160	130	12
15	1.63	4240	2360	1740	1280	900	660	540	450	350	280	230	190	160	15
18	1.92	4110	2610	1970	1460	1030	750	620	520	400	320	260	220	190	18
21	2.21	3920	2820	2190	1620	1150	840	690	580	450	360	300	250	210	21
24	2.50	4100	3010	2400	1780	1270	930	760	640	500	400	330	280	240	24
27	2.79	3880	2940	2590	1930	1380	1010	830	700	560	440	360	300	260	27
30	3.08	3620	2830	2770	2070	1480	1080	890	750	590	480	390	330	280	30
33	3.38	3390	2930	2950	2200	1580	1160	960	810	630	510	420	360	300	33
36	3.67	3190	2810	2930	2330	1670	1230	1020	860	670	550	450	380	330	36
39	3.96	3010	2670	2850	2440	1760	1290	1070	910	710	580	480	410	350	39
42	4.25	2860	2550	2770	2560	1840	1360	1130	950	750	610	510	430	370	42
48	4.83	2590	2330	2620	2480	1990	1470	1230	1040	820	670	560	470	410	48
54	5.42	2360	2150	2490	2360	2050	1580	1320	1120	890	730	610	520	440	54
60	6.00	2170	1990	2450	2250	1960	1680	1400	1190	950	780	650	560	480	60
66	6.58	2010	1850	2520	2160	1880	1640	1480	1260	1010	830	700	590	510	66
72	7.17	1870	1730	2580	2190	1810	1570	1510	1330	1060	880	740	630	540	72
78	7.75	1750	1630	2630	2240	1770	1520	1460	1390	1110	920	780	660	570	78
84	8.33	1650	1540	2730	2290	1810	1460	1410	1360	1160	960	810	690	600	84
90	8.92	1550	1460	2530	2330	1850	1470	1360	1310	1210	1000	850	720	630	90
96	9.50	1470	1380	2410	2290	1880	1500	1330	1270	1250	1040	880	750	650	96
102	10.08	1390	1320	2300	2190	1910	1530	1350	1240	1290	1070	910	780	680	102
108	10.67	1320	1260	2200	2090	1830	1560	1380	1230	1330	1110	940	810	700	108
114	11.25	1260	1200	2110	2010	1760	1540	1410	1260	1362	1140	970	830	730	114
120	11.83	1210	1150	2020	1930	1700	1480	1420	1280	1400	1170	990	860	750	120
126	12.42	1160	1100	1940	1860	1640	1430	1380	1300	1430	1200	1020	880	770	126
132	13.00	1110	1060	1870	1800	1580	1380	1330	1290	1460	1220	1040	900	790	132
138	13.58	1070	1020	1800	1730	1530	1340	1290	1250	1490	1250	1070	920	810	138
144	14.17	1020	980	1740	1670	1480	1300	1250	1210	1470	1280	1090	940	830	144

DATA:
1. Unsurfaced roadway.
2. Loads—AASHTO HS 20, two 16,000 lb. dual-tired wheels, 4 ft. on centers, or alternate loading, four 12,000 lb. dual-tired wheels, 4 ft. on centers with Impact included.

NOTES:
1. Interpolate for intermediate pipe sizes and/or fill heights.
2. Critical loads:
   a. For H = 0.5 and 1.0 ft., a single 16,000 lb. dual-tired wheel.
   b. For H = 1.5 through 4.0 ft., two 16,000 lb. dual-tired wheels, 4 ft. on centers.
   c. For H > 4.0 ft. alternate loading.
3. Truck live loads for H = 10.0 ft. or more are insignificant.

$D = d = 54''$, $H_e = 3$ ft } FROM ATTACHMENT 3

$W_e = 1580$ LBS/LF

GEOSYNTEC CONSULTANTS

Written by: CJ STEINER Date: 03/03/31 Reviewed by: C. LAZARTE Date: 03/04/01

Client: DSWA Project: CIC Project/Proposal No.: MC0250 Task No.: 2.9.2

Written by: William M. Steier Date: 3/31/03 Reviewed by: C. CARARTE Date: 4/1/03

Client: DSWA Project: Cherry Island Landfill Project/Proposal No.: ME0250 Task No.: 2.9.2

ATTACHMENT 8
TRENCH BEDDING CLASSIFICATIONS

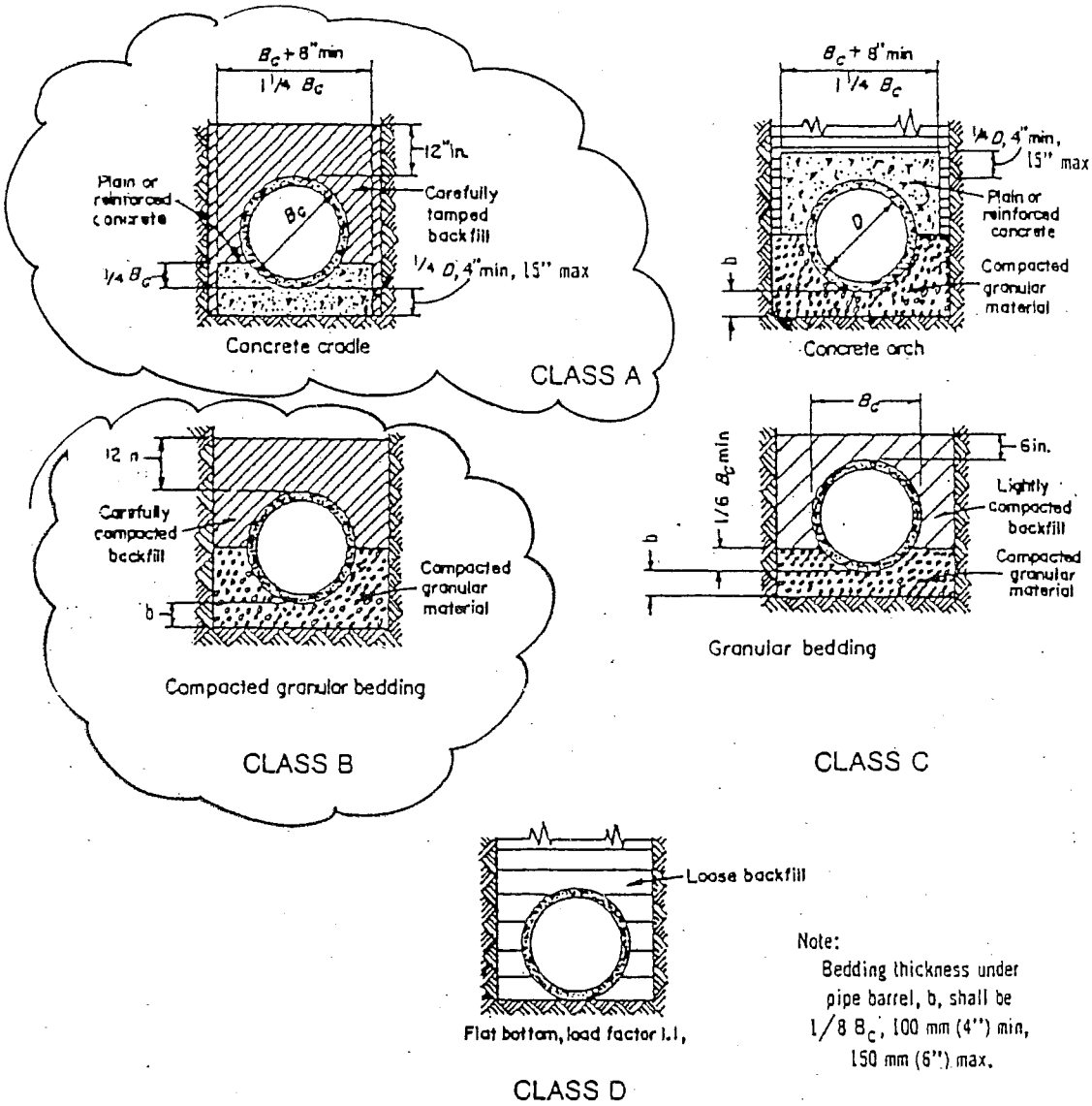


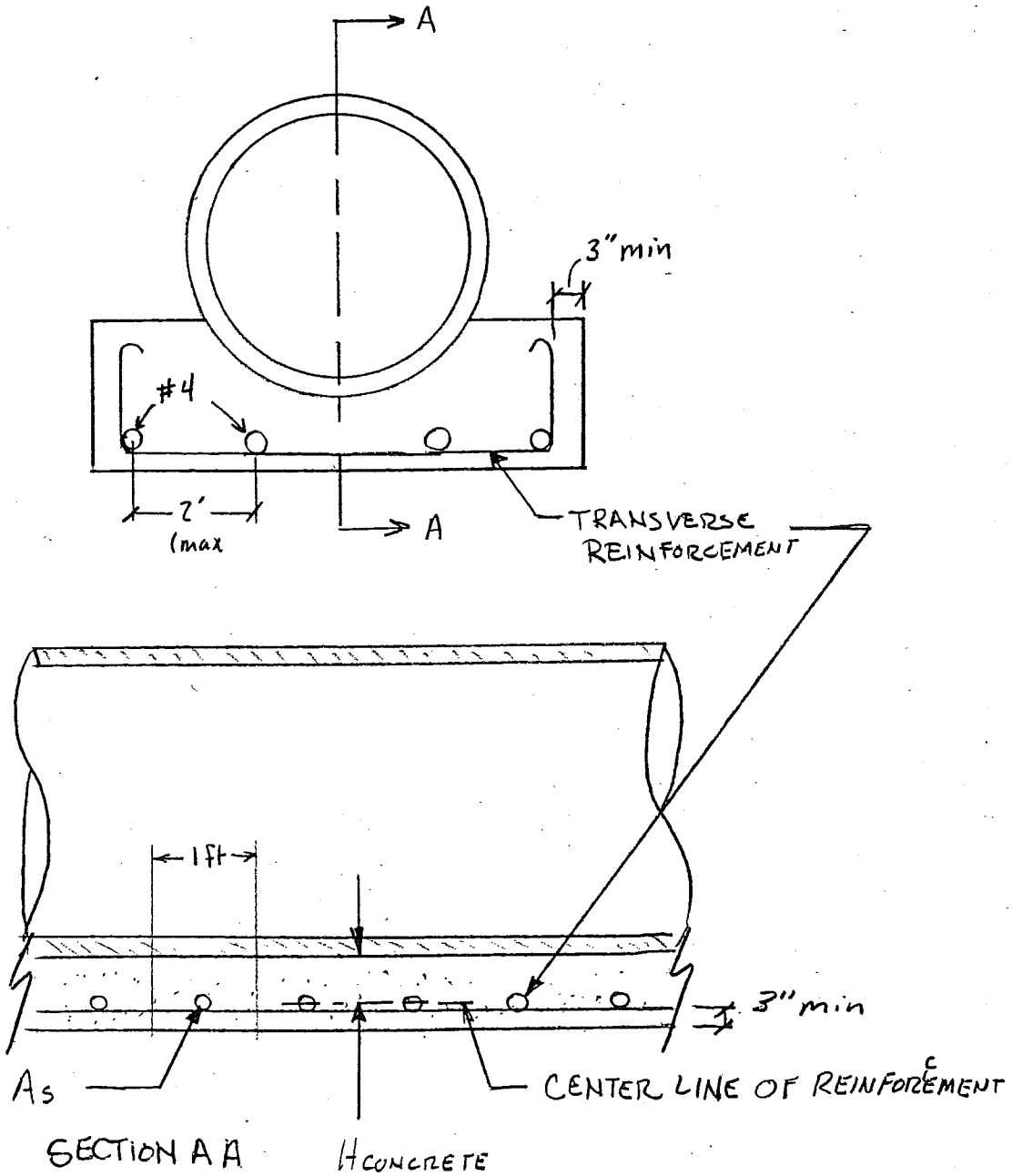
Figure 14.31—Classes of bedding for rigid sewer pipes in trench. NOTE: In rock trench, excavate at least 15 cm (6 in.) below bell of pipe except where concrete cradle is used (in. × 25.4 = mm) (ASCE, 1982).

(After WEF, 1992)

Written by: William M. Steier Date: 3/31/03 Reviewed by: C. LAZARTE Date: 4/1/03

Client: DSWA Project: Cherry Island Landfill Project/Proposal No.: ME0250 Task No.: 2.9.2

ATTACHMENT 9
DEFINITION OF PERCENT REINFORCING, P (1)



(1) FROM WEF, 1992, FOR THIS calculation REINFORCEMENT RATIO IS USED.

$$P = \frac{As}{H_{concrete} \times 1}$$

FOR: #7 REBAR @ 1' o.c.

$H_{concrete} = 12''$

$As = 0.6 \text{ in}^2$

$P = \frac{0.6}{12} = 0.4\%$

WM 4/1/03

ATTACHMENT 10
CALCULATIONS FOR CULVERT BENEATH MSE BERM

Calculation For Berm Pressure at Base, $W_{b(base)}$	Value	Units	Notes
1	Height of Perimeter Berm, H_b = 52.4	ft	From design cross section, Attachment 1
2	Unit Weight of Perimeter Berm Fill, γ = 105	pcf	Assumed
3	Berm Pressure at Base, $w_{b(base)}$ = 5,502	psf/lf	From Equation 3

Calculation For Berm Load, W_b	Value	Units	Notes
4	Berm Pressure at Base, $w_{b(base)}$ = 5,502	psf/lf	From Line 3
5	Distance, x = 48	ft	From design cross section, Attachment 1
6	Distance, z = 15.6	ft	From design cross section, Attachment 1
7	Angle, β = 2.827	rad	From Equation 6
8	Earth Pressure, w_b = 5,466	psf/lf	From Equation 4
9	Culvert Exterior Diameter, B_c = 5.5	ft	From design cross section, Attachment 1
10	Berm Load, W_b = 30,062	lbs/lf	From Equation 2

Calculation For Trench Load, W_t	Value	Units	Notes
11	Backfill Soil Parameter, $K\mu'$ = 0.15	--	Backfill soil assumed to be "Saturated Topsoil", see Attachment 6-1
12	Height of Fill in Trench, H_t = 15.6	ft	From design cross section, Attachment 1
13	Unit Weight of Backfill Soil , γ_t = 110	pcf	Assumed
14	Trench Width, B_d = 11	ft	Assumed minimum width = 2 x B_c
15	Trench Load, $W_{t(100)}$ = 12,456	lbs/lf	From design table, Attachment 6-1
16	Trench Load Adjusted, W_t = 13,702	lbs/lf	From Equation 8

WW 4/1/03

ATTACHMENT 10 (Cont.)
CALCULATIONS FOR CULVERT BENEATH MSE BERM

	Calculation For Total Earth Load, W_e	Value	Units	Notes
17	Berm Load, W_b =	30,062	lbs/lf	From Line 10
18	Trench Load, W_t =	13,702	lbs/lf	From Line 16
19	Total Earth Load, W_e =	43,764	lbs/lf	From Equation 1

	Calculation For Live Load, W_l	Value	Units	Notes
20	Vertical Separation, $H_l = H_b + H_t$ =	68	ft	From design cross section, Attachment 1
21	Culvert Interior Diameter, d =	4.5	ft	From design cross section, Attachment 1
22	Live Load, W_l =	0	lbs/lf	From design table, Attachment 7-1

	Calculation for Allowable Culvert Loading, $D_{0.01}$	Value	Units	Notes
23	Live Load, W_l =	0	lbs/lf	From Line 22
24	Total Earth Load, W_e =	43,764	lbs/lf	From Line 19
25	Bedding Factor, B_f =	3.4		Reinforcing percentage P = 0.4%, see Attachment 9; B_f from Equation 9
26	Culvert Interior Diameter, d =	4.5	ft	From design cross section, Attachment 1
27	Allowable Culvert Loading, $D_{0.01}$ =	2,860	lbs/lf/ft dia.	From Equation 10

WW 4/1/03

ATTACHMENT 11
CALCULATIONS FOR CULVERT AWAY FROM MSE BERM

	Calculation For Berm Pressure at Base, $W_{b(base)}$	Value	Units	Notes
1	Height of Perimeter Berm, H_b =	56.2	ft	From design cross section, Attachment 3
2	Unit Weight of Perimeter Berm Fill, γ =	105	pcf	Assumed
3	Berm Pressure at Base, $w_{b(base)}$ =	5,901	psf/lf	From Equation 3

	Calculation For Berm Load, W_b	Value	Units	Notes
4	Berm Pressure at Base, $w_{b(base)}$ =	5,901	psf/lf	From Line 3
5	Distance, x =	-10	ft	From design cross section, Attachment 3; conservative to use minimum distance
6	Distance, z =	9.4	ft	From design cross section, Attachment 3; use maximum distance
7	Angle, β =	0.754	rad	From Equation 7
8	Earth Pressure, w_b =	479	psf/lf	From Equation 4
9	Culvert Exterior Diameter, B_c =	5.5	ft	From design cross section, Attachment 3
10	Berm Load, W_b =	2,634	lbs/lf	From Equation 2

	Calculation For Trench Load, W_t	Value	Units	Notes
11	Backfill Soil Parameter, $K\mu'$ =	0.15	--	Backfill soil assumed to be "Saturated Topsoil", see Attachment 6-2
12	Height of Fill in Trench, $H_{t(max)}$ =	9.4	ft	From design cross section, Attachment 3; Conservative to use maximum H_t
13	Unit Weight of Backfill Soil , γ_t =	110	pcf	Assumed
14	Trench Width, B_d =	11	ft	Assumed minimum width = 2 x B_c
15	Trench Load, $W_{t(100)}$ =	7,183	lbs/lf	From design table, Attachment 6-2
16	Trench Load Adjusted, W_t =	7,901	lbs/lf	From Equation 8

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ATTACHMENT 11 (Cont.)
CALCULATIONS FOR CULVERT AWAY FROM MSE BERM

	Calculation For Total Earth Load, W_e	Value	Units	Notes
17	Berm Load, W_b =	2,634	lbs/lf	From Line 10
18	Trench Load, W_t =	7,901	lbs/lf	From Line 16
19	Total Earth Load, W_e =	10,535	lbs/lf	From Equation 1

	Calculation For Live Load, W_l	Value	Units	Notes
20	Vertical Separation, $H_l = H_{t(min)}$ =	3	ft	From design cross section, Attachment 3; conservative to use minimum H_t
21	Culvert Inner Diameter, d =	4.5	ft	From design cross section, Attachment 3; conservative to use minimum H_t
22	Live Load, W_l =	1,580	lbs/lf	From design table, Attachment 7-2

	Calculation for Allowable Culvert Loading, $D_{0.01}$	Value	Units	Notes
23	Live Load, W_l =	1,580	lbs/lf	From Line 22
24	Total Earth Load, W_e =	10,535	lbs/lf	From Line 19
25	Bedding Factor, B_f =	1.5		From Step 4
26	culvert interior diameter, d =	4.5	ft	From design cross section, Attachment 3
27	Allowable Culvert Loading, $D_{0.01}$ =	1,795	lbs/lf/ft dia.	From Equation 10

Written by: William M. Steier Date: 3/31/03 Reviewed by: C. LAZARTE Date: 4/1/03

Client: DSWA Project: Cherry Island Landfill Project/Proposal No.: ME0250 Task No.: 2.9.2

ATTACHMENT 12
AASHTO RCP CLASSIFICATION

TYPE V

TABLE 5 Design Requirements for Class V Reinforced Concrete Pipe[a]

NOTE—See Section 5 for the basis of acceptance specified by the purchaser.

The strength test requirements in pounds-force per linear foot of pipe under the three-edge-bearing method shall be either the D-load (test load expressed in pounds-force per linear foot per foot of diameter) to produce a 0.01-in. crack, or the D-loads to produce the 0.01-in. crack and the ultimate load as specified below, multiplied by the internal diameter of the pipe in feet.

D-load to produce a 0.01-in. crack 3,000
D-load to produce the ultimate load[a] 3,750

Internal Designated Diameter, in.	Reinforcement, in.²/linear ft of Pipe Wall											
	Wall A				Wall B				Wall C			
	Concrete Strength, 6,000 psi				Concrete Strength, 6,000 psi				Concrete Strength, 6,000 psi			
	Wall Thickness, in.	Circular Reinforcement[c] Inner Cage	Circular Reinforcement[c] Outer Cage	Elliptical Reinforcement[b]	Wall Thickness, in.	Circular Reinforcement[c] Inner Cage	Circular Reinforcement[c] Outer Cage	Elliptical Reinforcement[c]	Wall Thickness, in.	Circular Reinforcement[c] Inner Cage	Circular Reinforcement[c] Outer Cage	Elliptical Reinforcement[b]
12	[d]	—	—	—	1	0.10	—	—	2 2/12	0.07[e]	—	—
15	[d]	—	—	—	1 1/12	0.14	—	—	1	0.07[e]	—	—
18	[d]	—	—	—	1 1/12	0.19	—	0.16	1 1/12	0.10	—	—
21	[d]	—	—	—	1 2/12	0.24	—	0.21	1 1/12	0.10	—	—
24	[d]	—	—	—	1	0.30	—	0.24	1 2/12	0.12	0.07	0.13
27	[d]	—	—	—	1 1/12	0.38	0.23	0.42	1	0.14	0.08	0.16
30	[d]	—	—	—	1 1/12	0.41	0.23	0.46	1 1/12	0.18	0.11	0.20
33	[d]	—	—	—	1 2/12	0.46	0.28	0.51	1 1/12	0.23	0.14	0.25
36	[d]	—	—	—	1	0.50	0.30	0.56	1 2/12	0.27	0.16	0.30
42	[d]	—	—	—	1 4/12	0.60	0.36	0.67	1 5/12	0.36	0.22	0.40
48	[d]	—	—	—	1	0.73	0.44	0.81	1 7/12	0.47	0.28	0.52
54	[d]	—	—	—	[d]	—	—	—	1 9/12	0.58	0.35	0.64
60	[d]	—	—	—	[d]	—	—	—	1 10/12	0.70	0.42	0.78
66	[d]	—	—	—	[d]	—	—	—	1 11/12	0.84	0.50	0.93
72	[d]	—	—	—	[d]	—	—	—	2 2/12	0.99	0.59	1.10
78	[d]	—	—	—	[d]	—	—	—	[d]	—	—	—
84	[d]	—	—	—	[d]	—	—	—	[d]	—	—	—
90	[d]	—	—	—	[d]	—	—	—	[d]	—	—	—
96	[d]	—	—	—	[d]	—	—	—	[d]	—	—	—
102	[d]	—	—	—	[d]	—	—	—	[d]	—	—	—
108	[d]	—	—	—	[d]	—	—	—	[d]	—	—	—
114	[d]	—	—	—	[d]	—	—	—	[d]	—	—	—
120	[d]	—	—	—	[d]	—	—	—	[d]	—	—	—
126	[d]	—	—	—	[d]	—	—	—	[d]	—	—	—
132	[d]	—	—	—	[d]	—	—	—	[d]	—	—	—
138	[d]	—	—	—	[d]	—	—	—	[d]	—	—	—
144	[d]	—	—	—	[d]	—	—	—	[d]	—	—	—

TYPE IV

TABLE 4 Design Requirements for Class IV Reinforced Concrete Pipe[a]

NOTE—See Section 5 for the basis of acceptance specified by the purchaser.

The strength test requirements in pounds-force per linear foot of pipe under the three-edge-bearing method shall be either the D-load (test load expressed in pounds-force per linear foot per foot of diameter) to produce a 0.01-in. crack, or the D-loads to produce the 0.01-in. crack and the ultimate load as specified below, multiplied by the internal diameter of the pipe in feet.

D-load to produce a 0.01-in. crack 2,000
D-load to produce the ultimate load[a] 3,000

Internal Designated Diameter, in.	Reinforcement, in.²/linear ft of Pipe Wall											
	Wall A				Wall B				Wall C			
	Concrete Strength, 5,000 psi				Concrete Strength, 4,000 psi				Concrete Strength, 4,000 psi			
	Wall Thickness, in.	Circular Reinforcement[c] Inner Cage	Circular Reinforcement[c] Outer Cage	Elliptical Reinforcement[b]	Wall Thickness, in.	Circular Reinforcement[c] Inner Cage	Circular Reinforcement[c] Outer Cage	Elliptical Reinforcement[b]	Wall Thickness, in.	Circular Reinforcement[c] Inner Cage	Circular Reinforcement[c] Outer Cage	Elliptical Reinforcement[b]
12	1 9/12	0.13	—	—	2	0.07	—	—	2 2/12	0.07[e]	—	—
15	1 7/12	0.16	—	—	2 1/12	0.10	—	—	3	0.07[e]	—	—
18	2	0.17	—	0.13	2 1/12	0.14	—	0.11	3 1/12	0.07[e]	—	0.07[e]
21	2 1/12	0.23	—	0.21	2 2/12	0.20	—	0.17	3 1/12	0.07[e]	—	0.07[e]
24	2 1/12	0.29	—	0.27	3	0.27	—	0.23	3 2/12	0.07	0.07	0.08
27	2 2/12	0.33	—	0.31	3 1/12	0.31	—	0.25	4	0.08	0.07	0.09
30	2 2/12	0.38	—	0.35	3 1/12	0.35	—	0.28	4 1/12	0.09	0.07	0.10
33	[d]	—	—	—	3 2/12	0.27	0.16	0.30	4 1/12	0.11	0.07	0.12
36	[d]	—	—	—	4	0.30	0.18	0.33	4 2/12	0.14	0.08	0.15
42	[d]	—	—	—	4 1/12	0.35	0.21	0.39	5 1/12	0.20	0.12	0.22
48	[d]	—	—	—	5	0.42	0.25	0.47	5 9/12	0.26	0.16	0.29
54	[d]	—	—	—	5 1/12	0.50	0.30	0.55	6 1/12	0.34	0.20	0.38
					Concrete Strength, 5,000 psi							
60	[d]	—	—	—	6	0.59	0.35	0.66	6 7/12	0.41	0.25	0.46
66	[d]	—	—	—	6 1/12	0.69	0.41	0.77	7 1/12	0.51	0.31	0.57
									Concrete Strength, 5,000 psi			
72	[d]	—	—	—	7	0.79	0.47	0.88	7 9/12	0.61	0.37	0.68
78	[d]	—	—	—	[d]	—	—	—	8 1/12	0.71	0.43	0.79
84	[d]	—	—	—	[d]	—	—	—	8 9/12	0.83	0.51	0.94
90	[d]	—	—	—	[d]	—	—	—	[d]	—	—	—
96	[d]	—	—	—	[d]	—	—	—	[d]	—	—	—
102	[d]	—	—	—	[d]	—	—	—	[d]	—	—	—
108	[d]	—	—	—	[d]	—	—	—	[d]	—	—	—
114	[d]	—	—	—	[d]	—	—	—	[d]	—	—	—
120	[d]	—	—	—	[d]	—	—	—	[d]	—	—	—
126	[d]	—	—	—	[d]	—	—	—	[d]	—	—	—
132	[d]	—	—	—	[d]	—	—	—	[d]	—	—	—
138	[d]	—	—	—	[d]	—	—	—	[d]	—	—	—