Northeast C&D Landfill
Permit No. 3555050

Tier III Permit Modification Application for a Horizontal and Vertical Expansion of Existing C & D Landfill

Volume 2 of 2

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16219107.00 | August 2023

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TIER III PERMIT MODIFICATION APPLICATION

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Appendix C

Slope Stability and Final Cover Veneer Slope Analysis

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Slope Stability and Final Cover Veneer Slope Analysis

Northeast Landfill

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August 2023
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This Slope Stability Analysis and Final Cover Veneer Analysis has been prepared in accordance with good engineering practice including consideration of industry standards and the requirements of the Oklahoma Department of Environmental Quality.

Prepared by:

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Vice President/Business Unit Director
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1.0 INTRODUCTION

SCS Engineers, on behalf of N.E. Land Fill, LLC, is submitting the necessary documents for a Tier III permit modification to horizontally and vertically expand the existing C&D landfill (landfill), located at 2601 N. Midwest Boulevard in Spencer, Oklahoma County. (see application narrative, Figure 1).

The existing C&D landfill (landfill) permit boundary contains 90.1 acres, of which 67.7 acres has been or will be developed for C&D waste disposal under Permit No. 3555050. The proposed expansion will have a permit boundary of 73.2 acres, of which 53.5 acres will be developed for disposal of C&D waste. The combined total property boundary area (existing and expansion) is 163.3 acres, out of which 121.2 acres will be available for C&D waste disposal upon obtaining approval of the permit application.

SCS Engineers (SCS) has completed a global slope stability analysis of the proposed landfill expansion. The slope stability analyses presented in this Appendix were performed on the critical slopes of the foundation soils, waste mass, final cover and liner systems for the expanded landfill. This Appendix includes the following analyses:

- Excavation Slope Stability;
- Foundation and Waste Slope Stability (Interim Conditions, Static and Seismic Analyses);
- Foundation and Waste Slope Stability (Final Conditions, Static and Seismic Analyses);
- Liner System Veneer Stability (During Construction); and
- Final Cover System Veneer Stability (Final Conditions, Static and Seismic Analyses).

2.0 STABILITY ANALYSIS

2.1 LANDFILL GEOMETRICS AND SCENARIOS

The key landfill dimensions used in these analyses are as follows:

- Maximum final cover slope was assumed to be at 4 horizontal to 1 vertical (4H:1V),
- Permanent excavation slopes (i.e., slopes that will be lined) will be graded to no steeper than 3H:1V, and
- Proposed maximum top of final cover elevation will be at 1,408.0 feet above mean sea level.

2.2 METHOD OF ANALYSIS

Analyses were performed to calculate the overall stability of the interim and final slopes of the landfill. Specifically, the following slope stability analyses were performed in this submittal:

- Excavation stability following cell construction;
- Stability of waste slopes and foundation soils during filling – interim conditions (block mode);
- Stability of waste slopes and foundation soils after closure – final conditions (circular mode);
- Veneer stability of liner system during cell construction; and
- Veneer stability of final cover system – final conditions.

As presented in Attachment C-3 (also in Section 2.5), the landfill is located within a seismic impact zone as defined by DEQ Rule 252:515-1-2. Therefore, both static and seismic stability analyses were performed in this submittal for final and interim conditions.

Interim and final conditions stability analyses include both circular and block failure modes, which provide factors of safety (FSs) against failure of the constructed landfill, C&D waste, the critical interface of the liner and final cover systems, and the underlying foundation soils.

Slope stability analyses were performed using the computer program PCSTABL5M (FHWA, 1995). This program uses two-dimensional limit equilibrium methods to calculate a FS against shear failure for slope sections analyzed. The PCSTABL5M program uses an automatic search routine to generate multiple shear failure surfaces for both circular failures and block or wedge-type failure modes until the surface with the lowest FS-value (i.e., critical failure surface) is found. The analytical methods used for the circular and sliding block failure modes in the slope stability analysis are the Modified Bishop and Modified Janbu methods, respectively. Circular failure search mode was used to evaluate excavation stability, and stability under interim and final conditions, while sliding block failure mode was used to analyze stability of the critical interfaces in the bottom liner system.

A minimum acceptable FS of 1.5 was utilized for global static slope stability analyses under final conditions. The recommended minimum FS for the conditions analyzed are consistent with the recommendations from the Corps of Engineers "Design and Construction of Levees" manual (EM 1110-2-1913) and EPA's "Technical Guidance Manual for Design of Solid Waste Disposal Facilities." A minimum acceptable FS of 1.3 was assumed for global static slope stability analyses under interim conditions.

Seismic slope stability analyses were performed consistent with a guidance document prepared for the U.S. Environmental Protection Agency (USEPA), "RCRA Subtitle D (258) Seismic Deformation Design Guidance for Municipal Solid Waste Landfill Facilities" (USEPA, 1995). Consistent with this guidance document, the peak horizontal acceleration (a_{max}) is estimated using the peak ground acceleration (PGA). For NELF, due to shallow bedrock and relatively stiff soils, a_{max} is assumed to be equal to PGA. A seismic slope stability analysis is performed to evaluate the yield acceleration (k_y). The yield acceleration (k_y) is the horizontal acceleration that will lead to a factor of safety of 1.0 (i.e., marginally stable condition) for the potential slip surface. Then, k_y is compared to a_{max}. If the k_y is greater than a_{max}, it is concluded that the landfill will not likely undergo permanent deformations. If k_y is less than a_{max}, then the landfill will likely undergo permanent deformations and a displacement analysis needs to be performed to estimate the magnitude of the permanent deformations. In this submittal, the seismic deformation is estimated using the "k_y/a_{max} versus permanent displacements" curve by Makdisi and Seed (1978) as presented in the USEPA guidance document (USEPA, 1995). This chart is presented in Attachment C-4.

Cross sections selected for analyses, input parameters and assumptions, and results of the analyses are presented in the following sections. PCSTABL5M output files are presented in Attachment C-4.

Stability of the liner and final cover systems in veneer mode are discussed in Sections 3.2 and 3.3. Stability of the liner system during construction is evaluated in the veneer mode. The limit equilibrium method of Koerner and Soong (1998) is used to analyze the stability of the liner system on the 3H:1V side slopes. The results are presented in Attachment C-5. A minimum FS of 1.5 was assumed for static veneer stability.

Stability of the final cover system is also evaluated using the same method used for liner system stability in veneer mode. This analysis is performed for both static and seismic conditions. The results are also presented in Attachment C-5. A minimum FS of 1.5 and 1.0 was assumed for static and seismic veneer stability, respectively.

2.3 SECTIONS SELECTED FOR ANALYSIS

Slope stability analyses were performed for selected critical cross-sections of the landfill. The locations of these cross sections were selected based on review of the proposed excavation grades and the final cover grading plan. A critical slope section is considered to have a maximum waste height, a maximum exterior slope angle, and a perimeter berm. All slope sections except the interim slopes are buttressed by the excavation and the landfill perimeter, including a perimeter berm of various heights.

Drawings C1.1 and C1.2 in Attachment C-1 include plan views of the landfill showing where the various sections were cut. Drawings C1.3 through C1.4 show the analyzed sections. Profiles of the sections can also be seen on the model outputs provided in Attachment C-4.

One cross section was selected for excavation stability analysis on the southwest corner of Phases 11 and 14 (Section AA'). This cross section was selected as the most critical because the excavation cut is deepest in this area. The stability of this slope was analyzed under undrained (short-term) conditions.

Slope stability analyses under final conditions (waste stability, foundation soils stability, and liner stability) were performed for two cross sections at final grades (Sections AA' and BB'). The analyses were performed on these sections assuming that the landfill has reached its maximum height. Section BB′, passing though the maximum waste height and also with a relatively low perimeter berm height, was analyzed in both circular and block failure modes. Section AA' was analyzed in both circular and waste block modes to analyze the condition with cell floor sloping towards the west with relatively high waste height since the waste does not reach maximum height in these areas of the landfill (Phases 11 and 14).

Interim fill condition was analyzed using cross section BB′, using the south end of this section within the lateral expansion area (i.e., referred to as cross section BB'). This end of the cross section assumes Phase 12 is constructed and C&D waste placed with a 3H:1V slope in this phase is abutting to the existing C&D area. This analysis was performed to evaluate the interim stability of this area. This phase was selected since it was the most critical interim case based on the preliminary analyses done for the proposed phases.

2.4 INPUT PARAMETERS AND ASSUMPTIONS

2.4.1 Foundation Soils

A Hydrogeological and Geotechnical Investigation Report for the landfill expansion area is prepared as part of this permit application and is provided in Appendix B. According to this investigation, the proposed landfill expansion is located within the Permian-age sandstone known as the Garber Sandstone and is underlain by the Wellington Formation which is also of Permian age. Both the Garber Sandstone and the Wellington Formation consist of lenticular beds of massive appearing, cross-bedded sandstone irregularly inter-bedded with shale which is part sandy to silty. As part of this hydrogeological and geotechnical investigation, geotechnical testing was done on soil samples obtained during the site subsurface exploration conducted from February 2020 to March 2020.

During this site exploration, 16 borings were advanced between 35 to 101 feet in depth. To characterize the proposed expansion area in terms of geotechnical properties, samples were collected from boreholes drilled during this investigation. A total of 17 samples were collected from 13 boreholes. The following tests were conducted on these samples: moisture content, particle-size analysis, percent fines, Atterberg Limits, soil classification, moisture-density relationship (select samples), ad hydraulic conductivity (select samples). These test results were used to classify the soils according to the USCS and evaluate physical properties of the soils. These results are summarized in Table C2.1 of Attachment C-2 of this Appendix as obtained from the Hydrogeological and Geotechnical Report. As seen in Table C2.1, the foundation soils consist of sandy lean clay (CL), silty sand (SM), clayey sand (SC), poorly graded sand with silt (SP-SM) silty clay, sandy silty clay (CL-ML) sandy clay, silty sand, sand, shale, sandstones, and siltstone.

Standard Penetration Tests (SPTs) were also performed at select borings, which are presented in Attachment B of the Hydrogeological and Geotechnical Report, during the subsurface investigation. SPTs performed during the subsurface investigation are also depicted in the geological cross sections presented in Attachment C-2. As seen in Attachment C-2 figures, relatively hard material (i.e., 50/5", over 50 blows for less than 5-inch penetration) was encountered at 10 feet to 40 feet below subgrade elevations in the borings within the expansion area. Above this relatively hard material (but still below subgrade elevations), recorded SPTs varies from 10 to 42, in the borings SPTs were recorded. If the

SPTs recorded in these expansion area borings (EB-2, EB-3, EB-4, EB-6, and EB-7) are averaged, an average SPT of 25 is estimated.

Based on these observations, the foundation soils could be analyzed as two layers in the stability models. The top of the high SPT material (i.e., lower layer) was conservatively assumed at el. 1,150 ft. Above this elevation, below subgrade soil (i.e., upper layer) is assumed to have an average SPT of 25.

2.4.1.1 Shear Strength Properties of Foundation Soils – Undrained Shear Strength

Undrained shear strength is used in short-term slope stability analyses such as cell excavation stability. In this submittal, undrained shear strength of foundation soils are estimated with empirical correlations published in the literature using SPT numbers. Unconfined compressive strength is a soil property commonly used for undrained conditions. SPT versus unconfined compressive strength (qu) correlations are presented in Attachment C-2 (Figure C2.1, Table C2.2, and Table C2.3) and estimated qu and corresponding cohesion values are presented in Table 1.

Table 1. Foundation Soils – Undrained Shear Strength

Material	SPT	q_u (tsf)	c (1) (tsf)	c (psf)
Upper Layer	25	1.8 (2)	0.9	1,800
Lower Layer	+50	4 (3)	2	4,000

1. cohesion $c=q_u/2$
2. q_u as estimated from Figure C2.1 for clays of low plasticity and silts (Attachment C-2)
3. SPT>30, c=4,000 psf (see Tables C2.2 and C2.3 in Attachment C-2)

2.4.1.2 Shear Strength Properties of Foundation Soils – Drained Shear Strength

Drained shear strength properties of the foundation soils was used for stability analyses in interim and final conditions. In this submittal, drained shear strength of foundation soils are estimated with empirical correlations published in the literature using SPT numbers and Plasticity Index (PI) as shown in Attachment C-2.

Table 2. Foundation Soils – Drained Shear Strength

Material	SPT	Φ (°)
Upper Layer	25	25 (1)
Lower Layer	50	40

1. Average PI for upper layer (Table C2.1) = 14. Using Figure C2.2, an effective friction angle of 30 degrees is estimated, which is consistent with the SPT correlation table C2.4 in Attachment C-2. Conservatively, 25 degrees was selected for the analyses.
2. See Table C2.4 in Attachment C-2.
3. Cohesion = 0 (to be conservative).

2.4.2 Material Properties for Stability Analysis – Excavation Slope

Table 1 summarizes the unit weight and shear strength properties of foundation soils used for excavation stability. Attachment C-2 includes more information on these assumptions. Cell excavation stability is evaluated under undrained conditions (short-term).

Table 3. Summary of Geotechnical Shear Strength Properties – Excavation Slope

Material	γ (pcf)	c (psf)	Φ (°)
Foundation Soils (undrained)	120	1,800	0

The cross section analyzed for excavation stability is located on the western side slope of future Phase 11. Conservatively, upper layer undrained shear strength was used for this analysis.

2.4.3 Material Properties for Stability Analysis – Interim and Final Conditions

Table 4 summarizes the unit weight and shear strength properties used for interim waste slope and final slope conditions. Foundation soil shear strength properties under drained conditions are used for these analyses as summarized in Table 2.

Unit weight and shear strength of C&D waste were based on values reported in the literature as summarized in Table 4. Unit weight and shear strength properties for soil liner and final cover material summarized in Table 4 were also based on values reported in the literature.

Table 4. Summary of Geotechnical Strength Properties – Interim and Final Conditions

Material	γ (pcf)	c (pcf)	Φ (°)
Foundation Soils (drained) (1,2)	120	0	25
C&D Waste	70	400	35
Soil Liner/Final Cover Soils (3)	120	200	20

1. Cohesion = 0 (to be conservative).
2. Conservatively, Upper Layer properties reported above were also used for foundation soils in the global stability analyses.
3. Conservatively, the cohesion for the soil liner/final cover soils was assumed to be 100 pcf for veneer stability analyses.

2.4.4 Additional Slope Stability Analyses Assumptions

The slope stability analyses were performed based on the following assumptions:

- The analyses assumes that either a block-type failure surface occurs along the weakest interface of the liner system or, if a failure occurs within the waste mass or the foundation soil layer that a circular failure surface occurs.
- A liner system will be constructed to protect groundwater quality for the proposed landfill that will conform to specifications included in OAC 252:515-11 and consist from top to bottom of 1-foot of protective soil and 3-feet of recompacted clay.
- The representative friction angles for the interfaces of the proposed liner system is summarized in Table 4. Consistent with the recommendations of Stark and Choi (2004),

residual shear strengths are assigned to the side slopes and peak shear strength are assigned to the base of the liner system to satisfy a FS greater than 1.5.

- According to Federal guidance on the application of Subtitle D regulations, an acceptable factor of safety for long-term global static slope stability analyses is 1.5. For the temporary short-term slope stability condition such as the interim waste slope, a factor of safety of 1.3 is considered acceptable. An acceptable factor of safety for a static veneer stability analysis is 1.50 for the final cover system and 1.3 for the liner system (i.e., interim conditions).

- A safety factor 1.0 is the minimum value acceptable for seismic (i.e., psuedo-static) slope stability analyses.

- The highest ground water table as obtained from the Hydrogeological and Geological Investigation report was used for these stability analyses.

- Existing lined area of NELF has 3-ft thick recompacted clay liner and 1-ft protective cover with no geosynthetics or leachate collection system.

2.5 SEISMIC HAZARD LOADING

According to DEQ regulations (252:515-1-2), seismic impact zone means an area with a ten percent or greater probability that the maximum horizontal acceleration, which is depicted on a seismic hazard map, in lithified earth material (bedrock) will exceed 0.1g in 250 years. 10% probability of exceedance in 250 years is equivalent to 2% probability of exceedance in 50 years. The maximum horizontal acceleration is also referred to as peak ground acceleration (PGA).

The PGA for NELF is estimated to be 0.17g from U.S. Geological Survey (USGS) Unified Hazard Tool and USGS Hazard Map 2014 as presented in Attachment C-3. Therefore, the landfill is located in a seismic impact zone as defined by DEQ, and a seismic slope stability analysis needs to be performed. Due to shallow bedrock at the site, the design maximum horizontal acceleration (amax) is assumed to be equal to PGA for global stability analyses in circular and block modes.

It should be noted that USGS has a more recent seismic hazard map dated 2018. This 2018 dated seismic hazard map shows a similar PGA for the site. Since USGS Unified Hazard Tool is still using the 2014 dated USGS map, the PGA estimated using the 2014 seismic hazard map (i.e., 0.17g) was used in these analyses.

For final cover veneer analysis, a soft-soil amplification curve is used to estimate the amax. As shown in Attachment C-3, amax at the top of the landfill is estimated using the “peak outcrop acceleration versus amax” curve for soft soils and landfill sites as obtained from the USEPA Guidance Document (USEPA, 1995). As shown in Attachment C-3, an amax of 0.27g for a PGA of 0.17g is estimated for seismic veneer final cover stability analysis.

2.6 VENEER SLOPE STABILITY ANALYSIS OF LINER SYSTEM

Stability of the liner system (static) was evaluated using a veneer stability model within the final cover system using a set of equations and method developed by Koerner and Soong (1998). This analysis used the basic equations shown on the calculation spreadsheets in Attachment C-5.

For the sideslope liner system, the veneer slope stability analysis was performed based on the following assumptions:

- Maximum liner system slope was assumed to be at a 3H:1V slope, or 18.44 degrees.

- Length of the slope was assumed to be 111 feet (34 m, i.e., longest excavation slope length at 3H:1V, which is located in Phase 11).

- The average liner soil internal friction angle was assumed to be 20 degrees and 50 pcf (7.85 KN/m^3) cohesion to be conservative. The assumed friction angle is consistent with the literature values reported for compacted clayey soils.

The basic equations and calculations of the veneer slope stability analysis of the liner systems are presented in Attachment C-5.

2.7 VENEER SLOPE STABILITY ANALYSIS OF FINAL COVER SYSTEM

Stability of the final cover system (static and seismic) was evaluated using a veneer stability model within the final cover system using a set of equations and method developed by Koerner and Soong (1998). Basic equations are as shown on the calculation spreadsheets in Attachment C-5. The representative friction angles for the interfaces of the proposed final system were used in this analysis.

The veneer slope stability analysis was performed based on the following assumptions:

- Maximum final cover slope was assumed to be at a 4H:1V slope, or 14.04 degrees.

- Length of the slope was assumed to be 915 feet (279 m, longest 4H:1V slope of the expansion area).

- The average liner soil internal friction angle was assumed to be 20 degrees and 50 pcf (7.85 KN/m^3) cohesion to be conservative. The assumed friction angle is consistent with the literature values reported for compacted clayey soils.

The seismic veneer slope stability analysis of the final cover system is based on the same method (i.e., Koerner and Soong, 1998). The basic equations and calculations for the static and seismic veneer stability of the final cover system are shown on the calculation spreadsheets in Attachment C-5.

3.0 SLOPE STABILITY ANALYSES RESULTS

3.1 SLOPE STABILITY ANALYSES RESULTS – EXCAVATION, INTERIM, AND FINAL CONDITIONS

The results of the global static and seismic slope stability analyses for the various scenarios considered are presented in Tables 5 to 8. The locations of the critical failure surfaces for each cross-section are presented in Attachment C-4, in which detailed computer graphical printouts and output files for each model run are also presented.

Table 5. Stability Analyses Results – Excavation Stability

Cross Section	Output File Name	Slope Stability Analysis	Calculated Factor of Safety	Target Factor of Safety
AA′	nelf_xs_aa_circ (Excavation)	Undrained, Circular	2.67	1.30

Table 6. Stability Analyses Results – Interim Conditions, Static

Cross Section	Output File Name	Slope Stability Analysis	Calculated Factor of Safety	Target Factor of Safety
BB'	nelf_xs_b_ph12 WB	Block	2.29	1.30

1. This section is analyzed only in block mode due to relative low waste height, this section is not critical in circular mode.

Table 7. Stability Analyses Results – Final Conditions, Static

Cross Section	Output File Name	Slope Stability Analysis	Calculated Factor of Safety	Target Factor of Safety
AA'	nelf_xs_a_circ	Circular	2.88	1.50
AA'	nelf_xs_a_WB	Block	2.62	1.50
BB′	nelf_xs_b_circ	Circular	2.54	1.50
BB′	nelf_xs_b_block	Block	2.45	1.50

Table 8. Stability Analyses Results – Interim and Final Conditions, Seismic

Cross Section	Output File Name	Slope Stability Analysis	Minimum Yield Acc. ky (g)	Peak Horizontal Acceleration amax (g)	ky/a max	Deformation Analysis Required?	Deformation (in)	Acceptable (?)
BB'	nelf_xs_b_ph12 wb (seismic)	Block[1]	0.25	0.17	>1	No	-	Yes
AA′	nelf_xs_aa'_circ (seismic)	Circular [2]	0.33	0.17	>1	No	-	Yes

AA′	nelf_xs_a_WB (Seismic)	Block[2]	0.30	0.17	>1	No	-	Yes
BB′	nelf_xs_b_circ (Seismic)	Circular[2]	0.27	0.17	>1	No	-	Yes
BB′	nelf_xs_b_block (Seismic)	Block[2]	0.28	0.17	>1	No	-	Yes

1. Indicates slope stability analysis conducted on interim conditions.
2. Indicates slope stability analysis conducted on final conditions.

As presented in Table 5, the calculated FS for excavation stability analysis are greater than the minimum acceptable value of 1.3. The calculated FS for static interim conditions are greater than the minimum acceptable value of 1.3 as shown in Table 6. As presented in Table 7, the calculated FSs for the global static slope stability analysis (final conditions) are greater than the minimum acceptable value of 1.5.

Interface friction angles used in the block-type failure mode are considered typical and conservative for the analyzed interfaces. Should there be a different interface present due to selection of materials not considered before, the global slope stability analyses should be reevaluated during construction in order to validate the requirements of the FS values.

Under both circular and block failure surface mode (static - final conditions), the calculated factors of safety are greater than 2.45.

Results of the seismic stability analyses, presented in Table 8, indicate that the calculated yield accelerations for final conditions were greater than the peak horizontal acceleration (i.e., 0.17g) at the site. Therefore, permanent deformations are not anticipated when subjected to the PGA.

The results of the global stability analyses indicate that the proposed excavation, interim waste fill slopes and the final waste fill slopes are stable under the conditions analyzed.

3.2 VENEER SLOPE STABILITY ANALYSIS RESULTS – LINER SYSTEM

The results of the veneer slope stability analysis of the sideslope liner system is presented in Attachment C-5. As shown in Attachment C-5, utilizing the values and assumptions stated in the attachment, a factor of safety of 1.94 was estimated for the sideslope liner system. The results of the veneer slope stability analysis for the proposed liner system indicates that the slope is stable under the conditions analyzed.

3.3 VENEER SLOPE STABILITY ANALYSIS RESULTS – FINAL COVER SYSTEM

The results of the veneer slope stability (static and seismic) analysis of the final cover system are presented in Attachment C5. The basic equations and calculations are shown on the calculation spreadsheets in Attachment C-5. As shown in Attachment C-5, static and seismic factor of safety of 2.63 and 1.24, respectively. Based on the static and seismic analyses, the proposed final cover system is stable under static and seismic conditions analyzed.

4.0 CONCLUSIONS

The following general conclusions were presented in this Appendix:

- The slope stability of the proposed landfill excavation slopes, interim side slopes, and final side slopes are acceptable as designed for both static and seismic conditions.
- The veneer stability of the bottom liner and final cover systems is acceptable as designed for both static and seismic conditions.

5.0 REFERENCES

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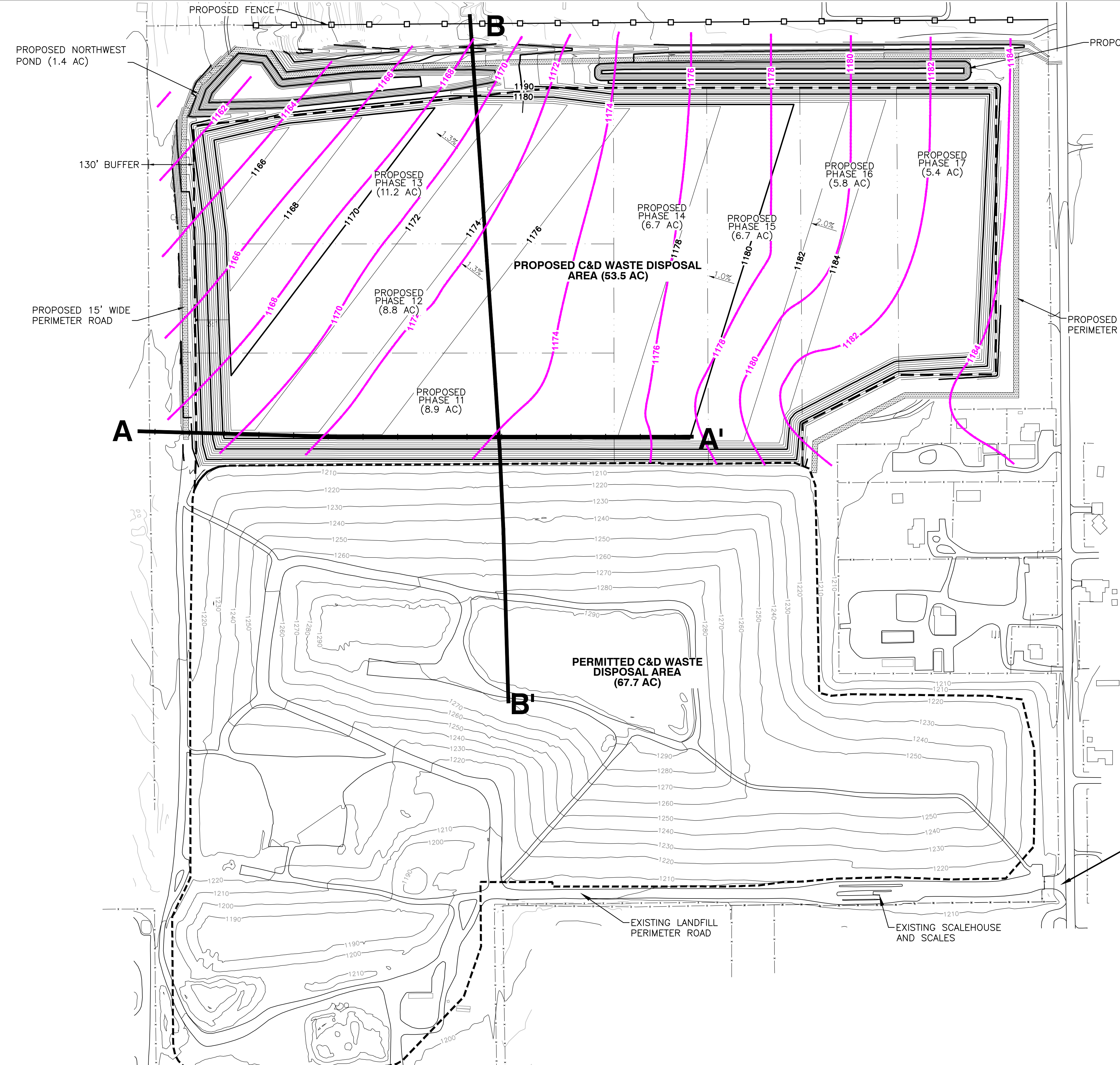
Attachment C-1

Sections Selected for Analysis



N

0 150 300

SCALE IN FEET

LEGEND

	EXISTING C&D LANDFILL PERMIT BOUNDARY (SEE NOTE 1)
	EXISTING C&D LANDFILL LIMITS OF WASTE
	PROPOSED C&D LANDFILL EXPANSION PERMIT BOUNDARY (SEE NOTE 1)
	PROPOSED C&D EXPANSION AREA LIMITS OF WASTE (SEE NOTE 2)
	PROPOSED C&D EXPANSION DISPOSAL AREA PHASE BOUNDARY
1190	PROPOSED 10' TOP OF SUBGRADE CONTOUR
1186	PROPOSED 2' TOP OF SUBGRADE CONTOUR
	PROPOSED PERIMETER ROAD
	PROPOSED FENCE
x	EXISTING FENCE
1210	EXISTING 10' CONTOUR (SEE NOTE 3)
	EXISTING 2' CONTOUR (SEE NOTE 3)
	EXISTING ROADS
1182	HIGHEST GROUNDWATER ELEVATION CONTOURS
A—A'	STABILITY CROSS-SECTION LOCATION

NOTES:

1. EXISTING AND PROPOSED C&D LANDFILL PERMIT BOUNDARY AREA:
   A. EXISTING C&D LANDFILL PERMIT BOUNDARY AREA = 90.1 AC.
   B. PROPOSED C&D LANDFILL PERMIT BOUNDARY AREA = 73.2 AC.
   C. TOTAL C&D LANDFILL PERMIT BOUNDARY (EXISTING AND EXPANSION) = 163.3 AC.
2. EXISTING AND PROPOSED C&D WASTE DISPOSAL BOUNDARY AREA:
   A. EXISTING C&D LANDFILL DISPOSAL AREA = 67.7 AC.
   B. PROPOSED C&D EXPANSION LANDFILL WASTE DISPOSAL AREA = 53.5 AC.
   C. TOTAL C&D LANDFILL DISPOSAL AREA (EXISTING AND EXPANSION) = 121.2 AC.
3. EXISTING CONTOURS ARE FROM AERIAL PHOTOGRAPHY PERFORMED BY COOPER AERIAL SURVEYS CO. ON 01/23/2023.

LICENSED PROFESSIONAL ENGINEER SANDEEP D. SARAF 32896 OKLAHOMA

8-18-23

FOR PERMITTING PURPOSES ONLY

REV | DATE | DESCRIPTION | BY

DRAWING TITLE: STABILITY SECTIONS LOCATION MAP 1

PROJECT TITLE: NORTHEAST LANDFILL TIER III PERMIT APPLICATION

CLIENT: N.E. LAND FILL, LLC NORTHEAST LANDFILL 2601 NORTH MIDWEST BLVD. SPENCER, OK 73084

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PH (817) 571-2288 FAX NO. (817) 571-2188

PROJ. NO. 16219107.00 | DSN. BY: SS | DWN. BY: JLJ | CHK. BY: RRK | Q/A RVW BY: SS | APP. BY: RRK

CADD FILE: C1.1 EXCAVATION & X-SECTIONS (2023)_8-3-23

DATE: 07/2023

SCALE: AS SHOWN

DRAWING NO. C1.1

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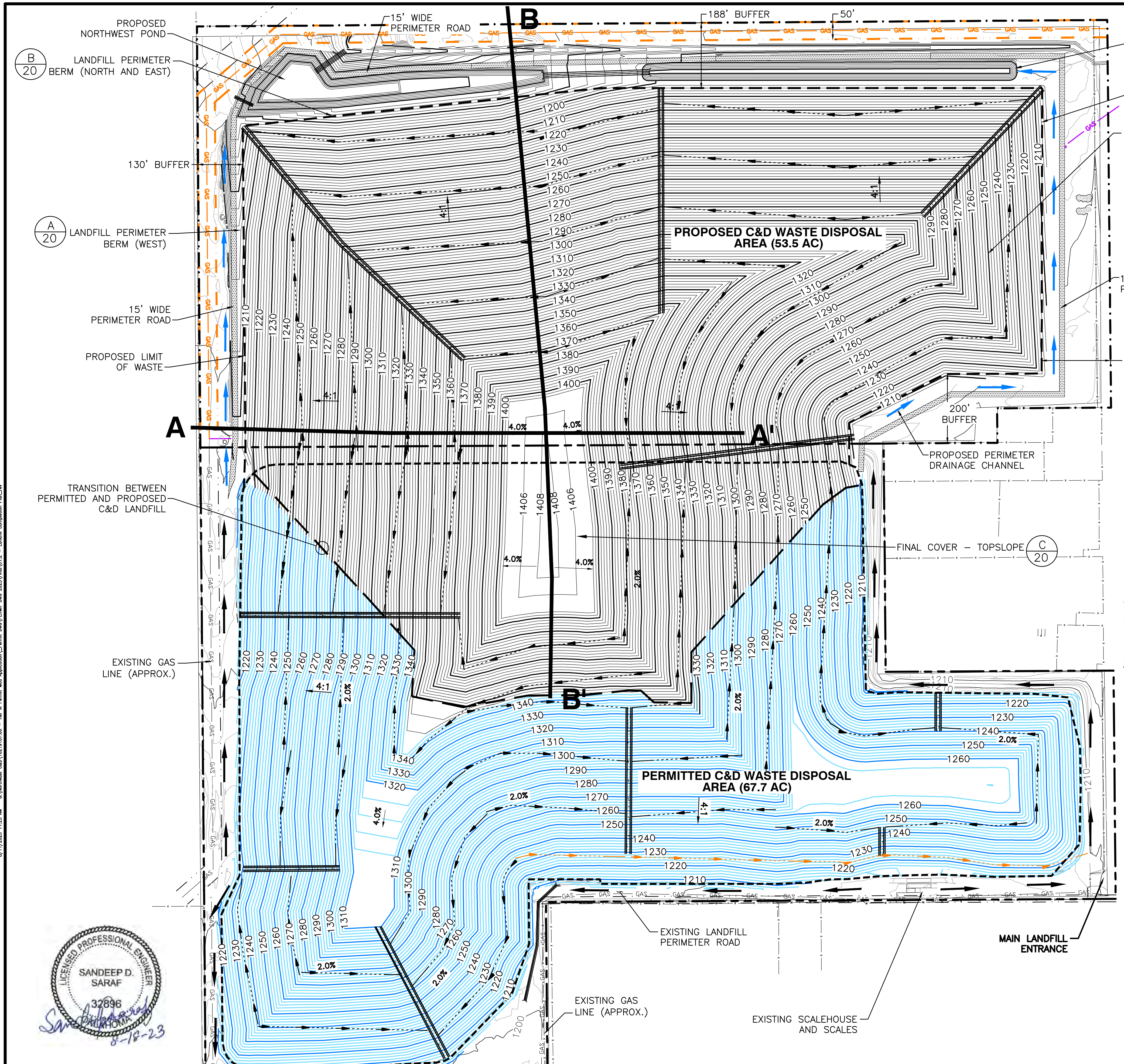

N

0 150 300
SCALE IN FEET

LEGEND

- EXISTING C&D LANDFILL PERMIT BOUNDARY (SEE NOTE 1)
- EXISTING C&D LANDFILL LIMITS OF WASTE
- PROPOSED C&D LANDFILL EXPANSION PERMIT BOUNDARY (SEE NOTE 1)
- PROPOSED C&D EXPANSION AREA LIMITS OF WASTE (SEE NOTE 2)
- PROPOSED EASEMENT
- GAS — PROPOSED GAS LINE
- PROPOSED PERIMETER ROAD
- PROPOSED DOWNCHUTES
- PROPOSED DRAINAGE SWALE (TYPE A)
- PROPOSED DRAINAGE SWALE (TYPE B)
- PROPOSED FENCE
- x — EXISTING FENCE
- 1340 — 10' FINAL GRADES IN PERMITTED C&D DISPOSAL AREA
- 2' FINAL GRADES IN PERMITTED C&D DISPOSAL AREA
- 1210 — PROPOSED 10' FINAL GRADES (C&D DISPOSAL AREA)
- PROPOSED 2' FINAL GRADES (C&D DISPOSAL AREA)
- EXISTING ROADS
- 1210 — EXISTING 10' CONTOUR (SEE NOTE 3)
- EXISTING 2' CONTOUR (SEE NOTE 3)
- EXISTING EASEMENT (APPROX., SEE NOTE 4)
- GAS — EXISTING GAS LINE (APPROX., SEE NOTE 4)
- EXISTING DRAINAGE CHANNEL AND FLOW DIRECTION
- PROPOSED DRAINAGE CHANNEL AND FLOW DIRECTION (SEE NOTE 5)
- PROPOSED CULVERTS
- A—A' STABILITY CROSS-SECTION LOCATION

NOTES:

1. EXISTING AND PROPOSED C&D LANDFILL PERMIT BOUNDARY AREA:
   A. EXISTING C&D LANDFILL PERMIT BOUNDARY AREA = 90.1 AC.
   B. PROPOSED C&D LANDFILL PERMIT BOUNDARY AREA = 73.2 AC.
   C. TOTAL C&D LANDFILL PERMIT BOUNDARY (EXISTING AND EXPANSION) = 163.3 AC.
2. EXISTING AND PROPOSED C&D WASTE DISPOSAL BOUNDARY AREA:
   A. EXISTING C&D LANDFILL DISPOSAL AREA = 67.7 AC.
   B. PROPOSED C&D EXPANSION LANDFILL WASTE DISPOSAL AREA = 53.5 AC.
   C. TOTAL C&D LANDFILL DISPOSAL AREA (EXISTING AND EXPANSION) = 121.2 AC.
3. EXISTING CONTOURS ARE FROM AERIAL PHOTOGRAPHY PERFORMED BY COOPER AERIAL SURVEYS CO. ON 01/23/2023.
4. EXISTING EASEMENT AND UTILITY LINES INFORMATION ARE FROM THE PLAT OF SURVEY, DEVELOPED BY MASON SURVEYING & CONSULTING INC., DATED 02/17/2022.
5. REFER TO DRAWING 23 FOR PROPOSED STORMWATER CHANNEL TABLE.

FOR PERMITTING PURPOSES ONLY

REV	DATE	DESCRIPTION	BY

DRAWING TITLE: STABILITY SECTIONS LOCATION MAP 2

PROJECT TITLE: NORTHEAST LANDFILL TIER III PERMIT MODIFICATION APPLICATION

CLIENT: N.E. LAND FILL, LLC NORTHEAST LANDFILL 2601 NORTH MIDWEST BLVD. SPENCER, OK 73084

SCS ENGINEERS
STEARNS, CONRAD AND SCHMIDT CONSULTING ENGINEERS
1901 CENTRAL DRIVE, SUITE 550, BEDFORD, TX 76021
PH (817) 571-2288 FAX NO. (817) 571-2188

PROJ. NO. 16219107.00 | DSN. BY: SS | CHK. BY: DS | Q/A RVW BY: SS
DWN. BY: SDS | APP. BY: RRK

CADD FILE: C1.2 – LANDFILL COMPLETION PLAN_REV
DATE: 08/2023
SCALE: AS SHOWN
DRAWING NO. C1.2

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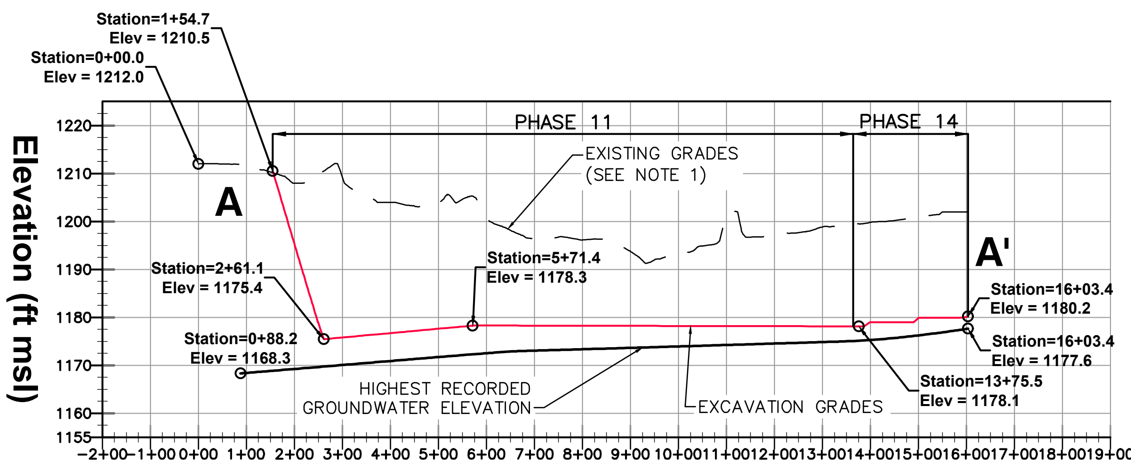
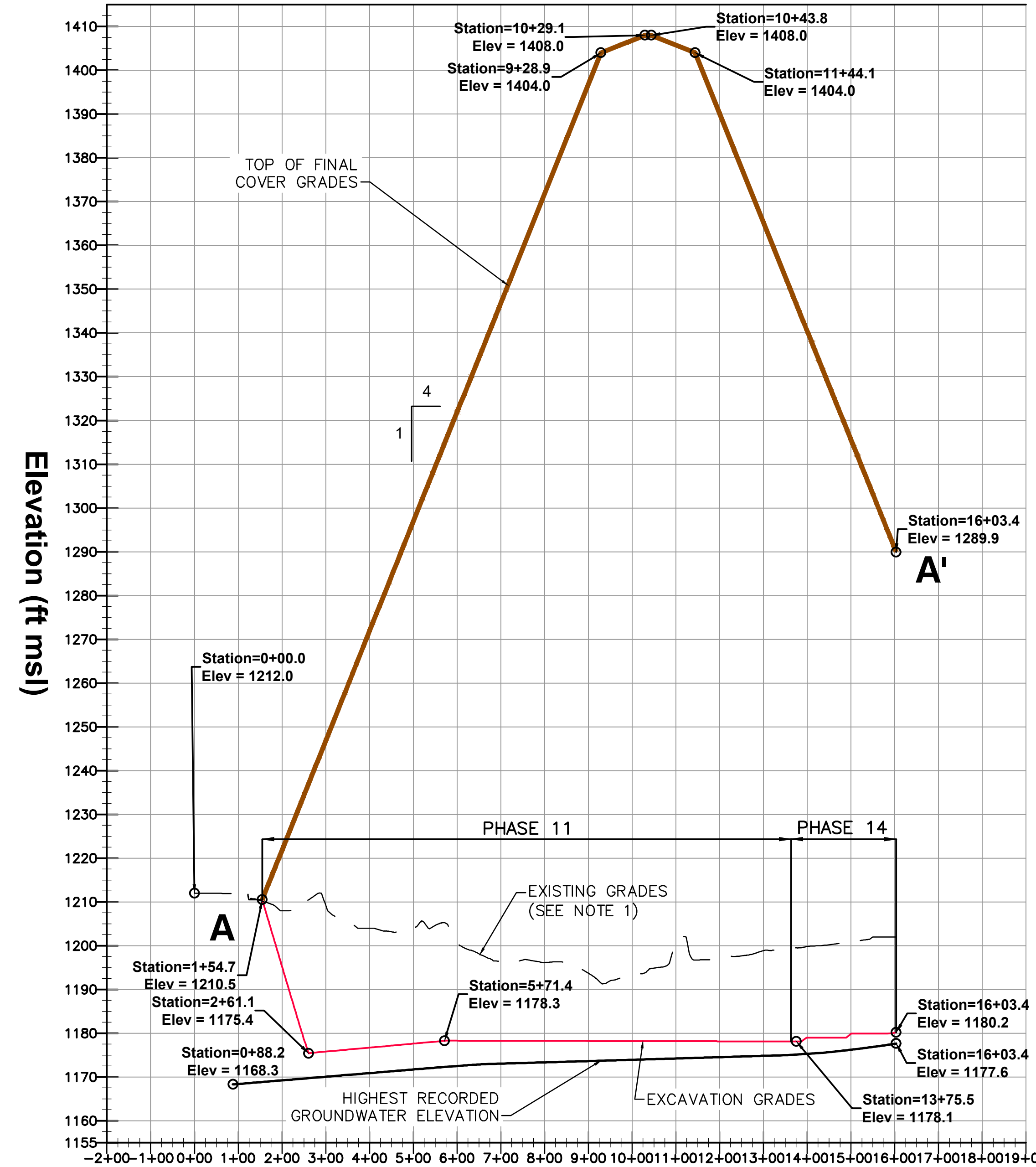


Section A-A' (Excavation)



Section A-A' (Final Conditions)

0 20 40
VERTICAL SCALE IN FEET

0 200 400
HORIZONTAL SCALE IN FEET

LEGEND

EXISTING GRADE (SEE NOTE 1)

PROPOSED EXCAVATION

PROPOSED FINAL COVER

HIGHEST RECORDED GROUNDWATER ELEVATION CONTOUR

NOTES:

1. EXISTING GRADES ARE FROM AERIAL PHOTOGRAPHY PERFORMED BY COOPER AERIAL SURVEYS CO. ON 01/23/2023.

FOR PERMITTING PURPOSES ONLY

REV	DATE	DESCRIPTION	BY

DRAWING TITLE: STABILITY CROSS SECTION A-A'

PROJECT TITLE: NORTHEAST LANDFILL TIER III PERMIT APPLICATION

CLIENT: N.E. LAND FILL, LLC NORTHEAST LANDFILL 2601 NORTH MIDWEST BLVD. SPENCER, OK 73084

SCS ENGINEERS
STEARNS, CONRAD AND SCHMIDT CONSULTING ENGINEERS
1901 CENTRAL DRIVE, SUITE 550, BEDFORD, TX 76021
PH (817) 571-2288 FAX NO. (817) 571-2188

PROJ. NO. 16219107.00 | DSN. BY: SS | DWN. BY: JLJ | CHK. BY: RRK | Q/A RVW BY: SS | APP. BY: RRK

CADD FILE: C1.1 EXCAVATION & X-SECTIONS (2023)_8-3-23

DATE: 07/2023

SCALE: AS SHOWN

DRAWING NO. C1.3

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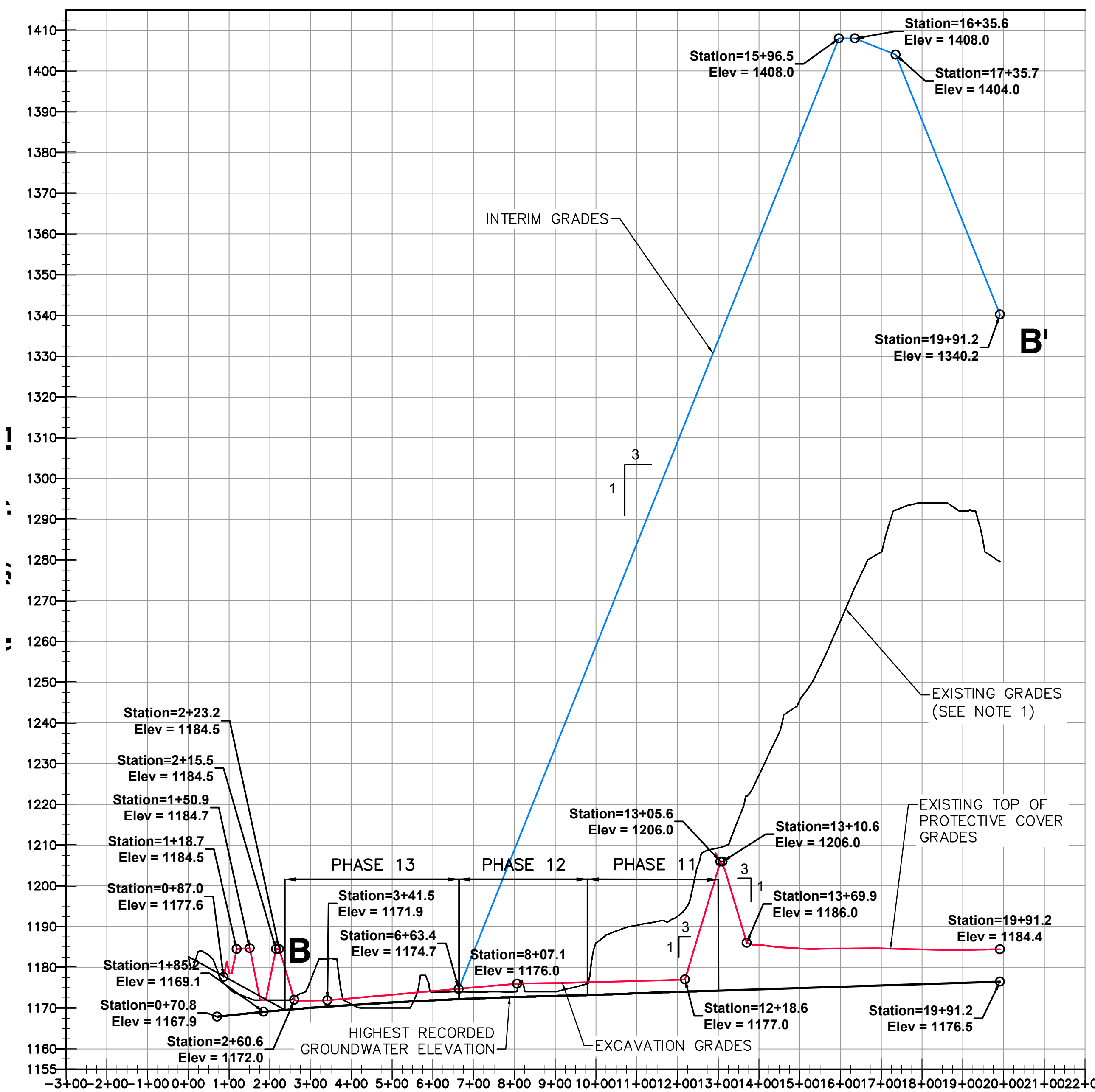
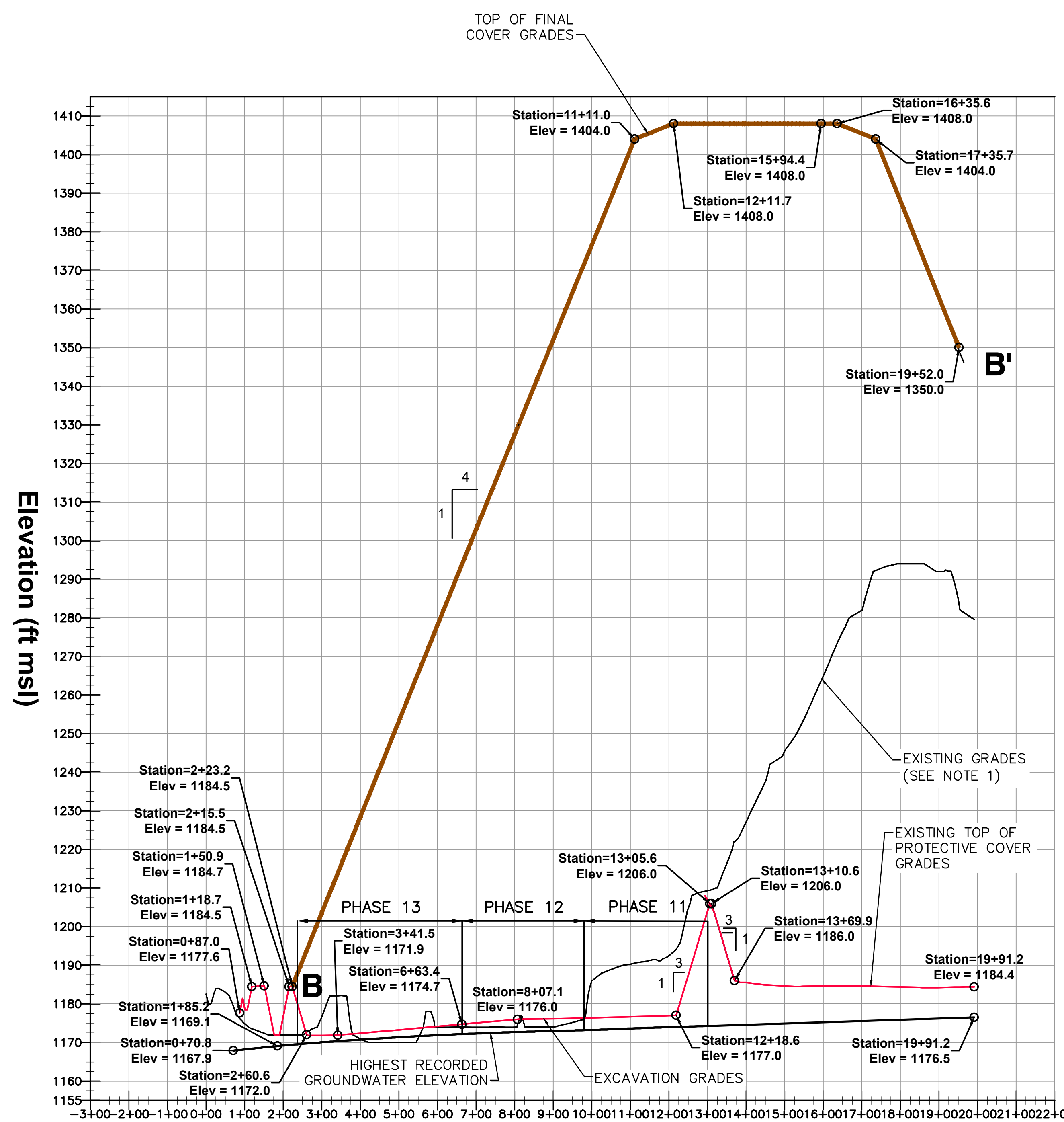


S Section B-B' (Interim Conditions)



S Section B-B' (Final Conditions)

LICENSED PROFESSIONAL ENGINEER
SANDEEP D. SARAF
32896
OKLAHOMA
8-18-23

0 20 40
VERTICAL SCALE IN FEET

0 200 400
HORIZONTAL SCALE IN FEET

LEGEND

- EXISTING GRADE (SEE NOTE 1)
- PROPOSED EXCAVATION/EXISTING TOP OF PROTECTIVE COVER
- PROPOSED FINAL COVER
- INTERIM GRADE
- HIGHEST RECORDED GROUNDWATER ELEVATION CONTOUR

NOTES:

1. EXISTING CONTOURS ARE FROM AERIAL PHOTOGRAPHY PERFORMED BY COOPER AERIAL SURVEYS CO. ON 01/23/2023.

FOR PERMITTING PURPOSES ONLY

REV	DATE	DESCRIPTION	BY

DRAWING TITLE: STABILITY CROSS SECTION B-B'

PROJECT TITLE: NORTHEAST LANDFILL TIER III PERMIT APPLICATION

CLIENT: N.E. LAND FILL, LLC NORTHEAST LANDFILL 2601 NORTH MIDWEST BLVD. SPENCER, OK 73084

SCS ENGINEERS
STEARNS, CONRAD AND SCHMIDT CONSULTING ENGINEERS
1901 CENTRAL DRIVE, SUITE 550, BEDFORD, TX 76021
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PROJ. NO. 16219107.00 | DSN. BY: SS | CHK. BY: JLJ | DWN. BY: RRK | APP. BY: | Q/A RVW BY: SS

CADD FILE: C1.1 EXCAVATION & X-SECTIONS (2023)_8-3-23

DATE: 07/2023

SCALE: AS SHOWN

DRAWING NO. C1.4

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Attachment C-2

Material Properties and Supporting Information

TABLE C2.1
Geotechnical Sample Summary

Boring	Depth	Soil Classification	Soil Description	Moisture Content (%)	% Passing # 200 Sieve	Liquid Limit (%)	Plasitic Limit (%)	Plasticity Index (%)	Optimum Moisture (%)	Max Dry Density (pcf)	Hydraulic Conductivity (cm/sec)
Method		D2487	D2487	D2216	D1140	D4318	D4318	D4318	D698	D698	D5084
EB-2	4'-8'	CL	Reddish Brown & Brown Sandy Lean Clay	8.9	59.1	28	13	15	DNR	DNR	DNR
EB-3	0-3'	CL	Reddish Brown Lean Clay W/Sand	16.8	71.5	35	15	20	DNR	DNR	DNR
	10'-14'	CL	Reddish Brown Sandy Lean Clay	14.6	57	31	14	16	DNR	DNR	DNR
	25'-27'	SP-SM	Reddish Brown Poorly Graded Sand W/Silt	6.7	10.2	CNBD	CNBD	Non Plastic	DNR	DNR	DNR
EB-4	10'-12'	SM	Reddish Brown Silty Sand	13.1	47.9	CNBD	CNBD	Non Plastic	DNR	DNR	DNR
EB-6	0-5'	CL	Reddish Brown & Brown Sandy Lean Clay	19	57.6	30	15	15	DNR	DNR	DNR
	20'-25'	SP-SM	Reddish Brown Poorly Graded Sand W/Silt	21.7	7	CNBD	CNBD	Non Plastic	DNR	DNR	$5.06X10^{-4}$
EB-7	5'-10'	CL	Reddish Brown & Brown Sandy Lean Clay	17.3	68.7	31	15	16	DNR	DNR	$1.28X10^{-8}$
EB-8	15'-20'	SM	Reddish Brown Silty Sand	6.4	41.9	CNBD	CNBD	Non Plastic	DNR	DNR	DNR
EB-9	5'-8'	CL	Reddish Brown & Brown Sandy Lean Clay	15.1	50.6	23	15	8	DNR	DNR	DNR
PZ-1	10'-13'	ML	Reddish Brown Sandy Silt	11.5	59.1	CNBD	CNBD	Non Plastic	DNR	DNR	DNR
PZ-2	2'-5'	CL-ML	Brown & Reddish Brown Sandy Silty Clay	10.7	51.4	23	16	7	DNR	DNR	DNR
	15'-17'	SM	Reddish Brown Silty Sand	9.2	33.4	CNBD	CNBD	Non Plastic	DNR	DNR	DNR
PZ-4	5'-10'	SC	Reddish Brown Clayey Sand	21.5	35.6	25	15	10	DNR	DNR	$2.83X10^{-7}$
PZ-5	0-5'	CL	Brown & Reddish Brown Sandy Lean Clay	17.8	63.6	26	15	10	DNR	DNR	DNR
PZ-6	2'-5'	CL	Reddish Brown & Brown Sandy Lean Clay	17.6	68.8	37	15	22	15.4	112.1	$2.05X10^{-8}$
PZ-7	6'-8'	CL	Reddish Brown & Brown Lean Clay W/Sand	18.4	72	32	16	16	14.1	114.3	DNR

DNR = Did Not Run on this Sample
CNBD = Could Not Be Determined

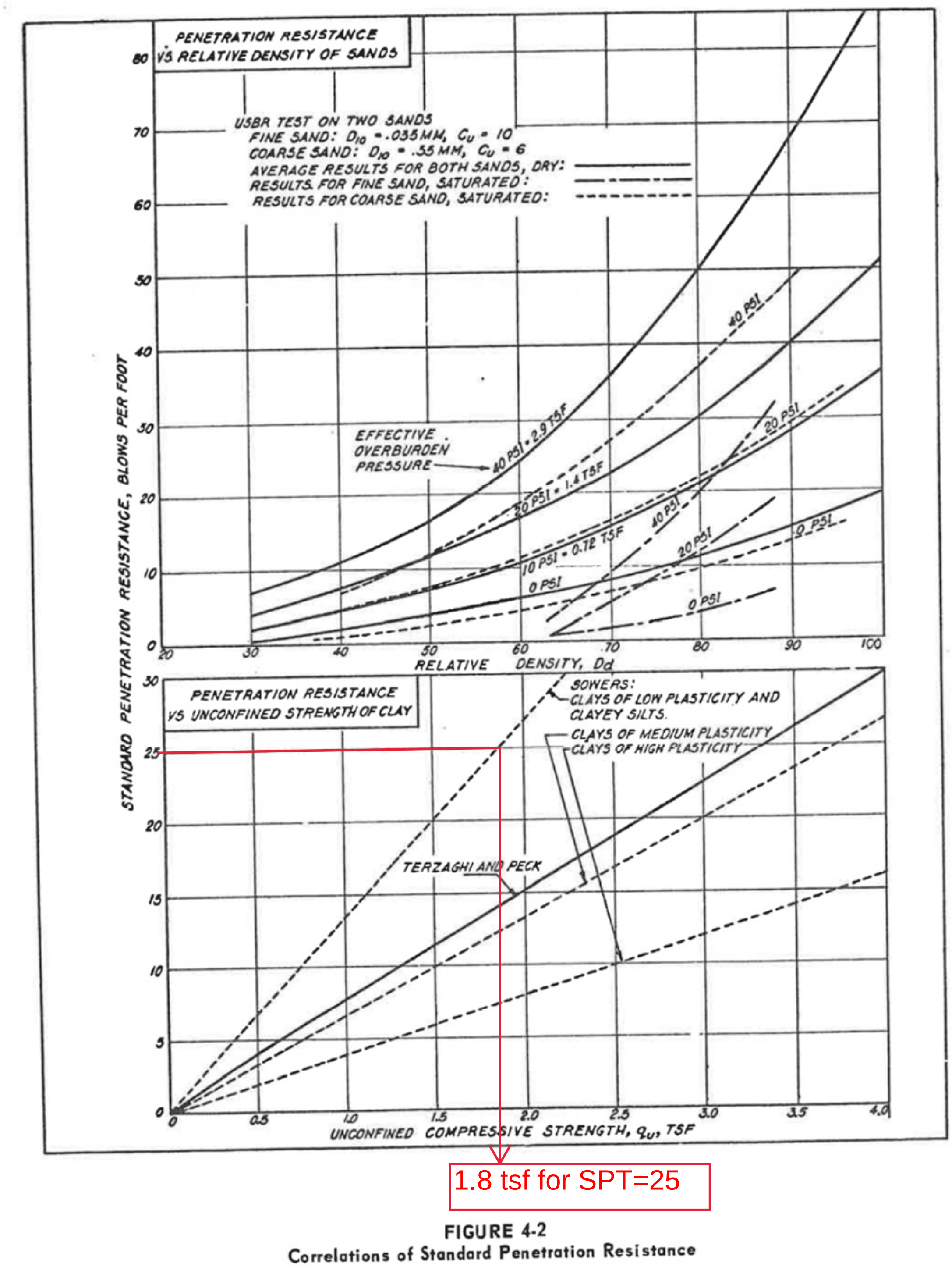


Figure C2.1. SPT versus unconfined compressive strength (q_u) correlation from NAVFAC Design Manual 7.01

Table C2.2. SPT – Soil Strength Correlations -I

Table 2. *Estimated values of soil friction and cohesion based on uncorrected Standard Penetration Test (SPT) blow counts, taken from Karol (1960). Although bereft of overburden corrections, these simple correlations were generally used for shallow foundation investigations.*

Soil Type and SPT Blow Counts		Undisturbed Soil Cohesion (psf)	Undisturbed Soil Friction Angle (°)
Cohesive soils			
Very soft	(<2)	250	0
Soft	(2–4)	250–500	0
Firm	(4–8)	500–1,000	0
Stiff	(8–15)	1,000–2,000	0
Very stiff	(15–30)	2,000–4,000	0
Hard	(>30)	4,000	0
Cohesionless soils			
Loose	(<10)	0	28
Medium	(10–30)	0	28–30
Dense	(>30)	0	32
Intermediate soils			
Loose	(<10)	100	8
Medium	(10–30)	100–1,000	8–12
Dense	(>30)	1,000	12

Undrained Shear Strength (short-term stability)

(Reference for Table C2.2: Rogers, J.D., *"Subsurface Exploration Using the Standard Penetration Test and the Cone Penetrometer Test"*, Environmental & Engineering Geoscience, Vol. XII, No. 2, May 2006.)

Table C2.2. SPT – Soil Strength Correlations -II

Table 17.3 Approximate Correlation of Standard Penetration Number and Consistency of Clay

Standard penetration number, *N*	Consistency	Unconfined compression strength kN/m^2	Unconfined compression strength lb/ft^2
0		0	0
	Very soft		
2		25	500
	Soft		
4		50	1000
	Medium stiff		
8		100	2000
	Stiff		
16		200	4000
	Very stiff		
32		400	8000
>32	Hard	>400	>8000

(Reference for Table C2.3: Das, B. M., *"Principles of Geotechnical Engineering"*, 5th Edition, 2002)

Undrained Shear Strength (short-term stability)

To be conservative, stability analyses were performed assuming the clay is normally consolidated. For drained analysis (long-term), effective friction angle was estimated based on the plasticity index (PI) using the following relationship (EPRI, 1990):

$\sin\phi' = 0.8 - 0.094 \ln(PI)$; for foundation soils:

Average PI = 14

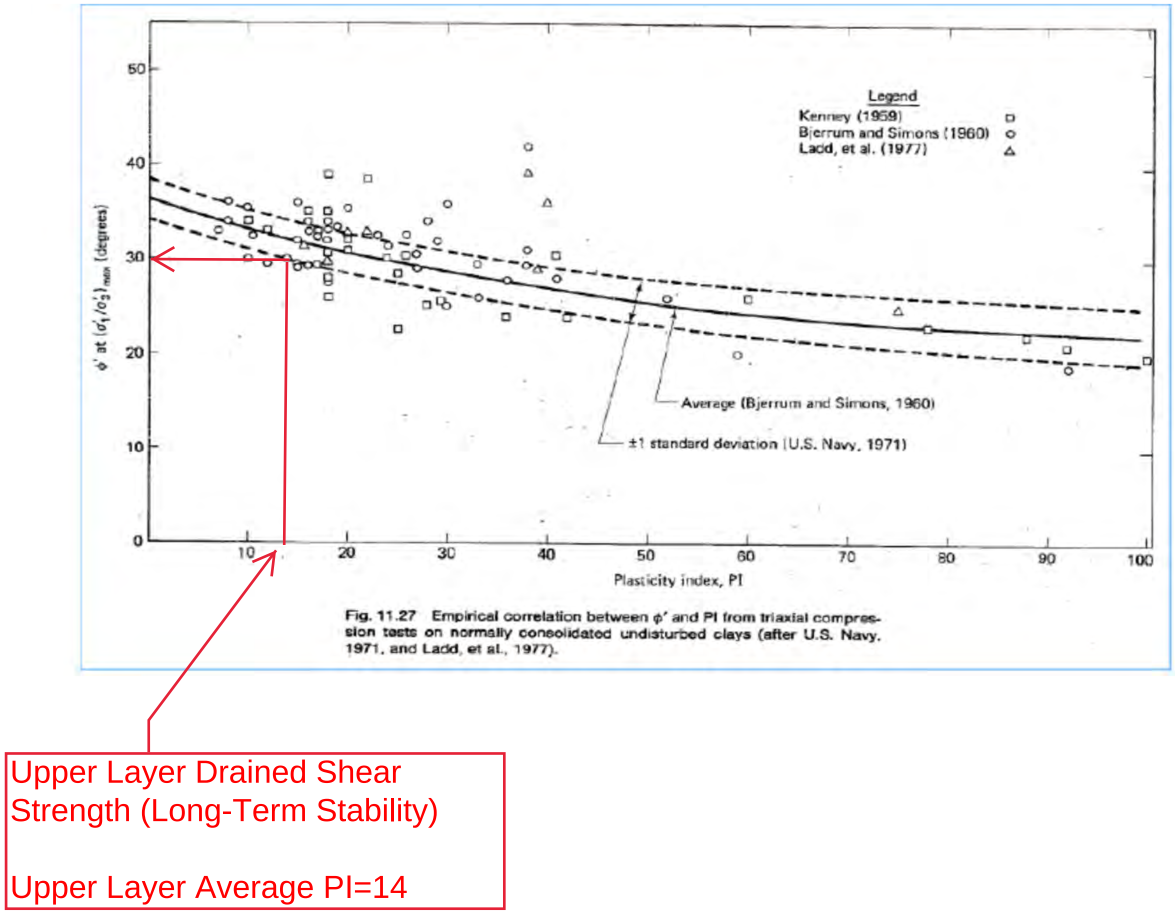


Fig. 11.27 Empirical correlation between φ' and PI from triaxial compression tests on normally consolidated undisturbed clays (after U.S. Navy, 1971, and Ladd, et al., 1977).

Table C2.3. SPT – Soil Strength Correlations -III

Friction Angle Based on SPT

Table 34 presents baseline relationships for evaluating the drained friction angle of cohesionless soils. This table is based on data for relatively clean sands. Given this, selected values of ϕ' based on SPT N values should be reduced by 5° for clayey sands and the value from the table should be increased by 5° for gravelly sands.

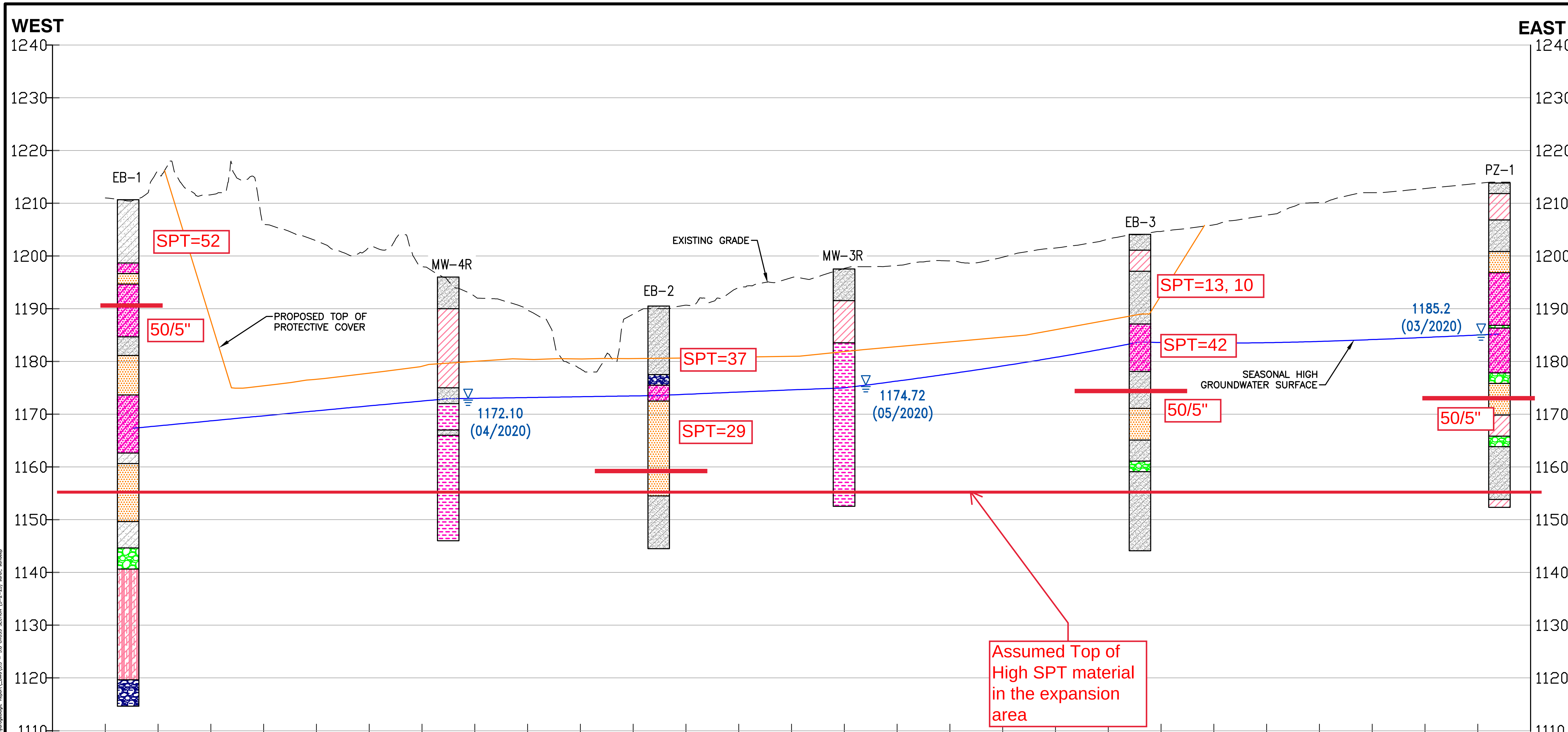
Table 34. Relationship among relative density, SPT N value, and internal friction angle of cohesionless soils (after Meyerhof, 1956).

State of Packing	Relative Density (%)	Standard Penetration Resistance, N (blows/300 mm)	Friction angle, ϕ' (°)
Very loose	<20	<4	< 30
Loose	20-40	4-10	30-35
Compact	40-60	10-30	35-40
Dense	60-80	30-50	40-45
Very dense	>80	>50	>45

(Reference for Table C2.4: FHWA, Geotechnical Engineering Circular No. 5, Evaluation of Soil and Rock Properties, FHWA-IF-02-034, April 2002.)

Upper Later Drained Shear Strength (Long-Term Stability)
Upper Layer Average SPT=25:
35 degrees -5 degrees = 30 degrees (clayey soil adjustment)

Lower Layer Average SPT= +50:
45 degrees -5 degrees = 40 degrees (clayey soil adjustment)

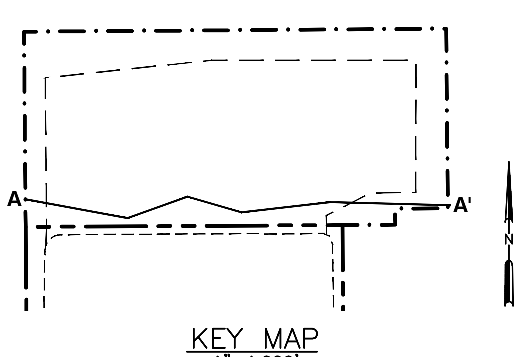


CROSS SECTION A-A'

0 10 20
VERTICAL SCALE IN FEET

0 100 200
HORIZONTAL SCALE IN FEET

GROUNDWATER OBSERVED		
BORING ID	DURING DRILLING	AFTER 24 HOURS
EB-1	1168.65	1170.22
MW-4R	1154.00	NA
EB-2	1172.51	1173.85
MW-3R	1162.30	NA
EB-3	1171.10	1180.76
PZ-1	1179.84	1185.95



KEY MAP
1"=4,000'

LEGEND:

- EXISTING GRADE
- PROPOSED TOP OF PROTECTIVE COVER
- SEASONAL HIGH GROUNDWATER SURFACE
- SILTY CLAY
- SANDY CLAY
- CLAYEY SAND
- SAND
- CLAY
- SILTY SAND
- SANDSTONE
- CLAYEY SILT
- 1185.91 SEASONAL HIGH GROUNDWATER LEVEL IN PIEZOMETER

REV DATE DESCRIPTION BY

DRAWING TITLE: CROSS SECTION A-A'

PROJECT TITLE: NORTHEAST LANDFILL TIER III PERMIT MODIFICATION APPLICATION

CLIENT: N.E. LAND FILL, LLC
2601 NORTH MIDWEST BLVD.
SPENCER, OK 73084

SCS ENGINEERS
STEARNS, CONRAD AND SCHMIDT CONSULTING ENGINEERS
1901 CENTRAL DRIVE, SUITE 550, BEDFORD, TX 76021
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PROJ. NO. 16219107.00 | DSN. BY: RF | DWN. BY: JJ | CHK. BY: RRK | Q/A RVW BY: RF | APP. BY: RRK

CADD FILE: 3.3 - 3.8 CROSS SECTION (5-2-23)

DATE: 07/2023

SCALE: AS SHOWN

FIGURE NO. 3.3

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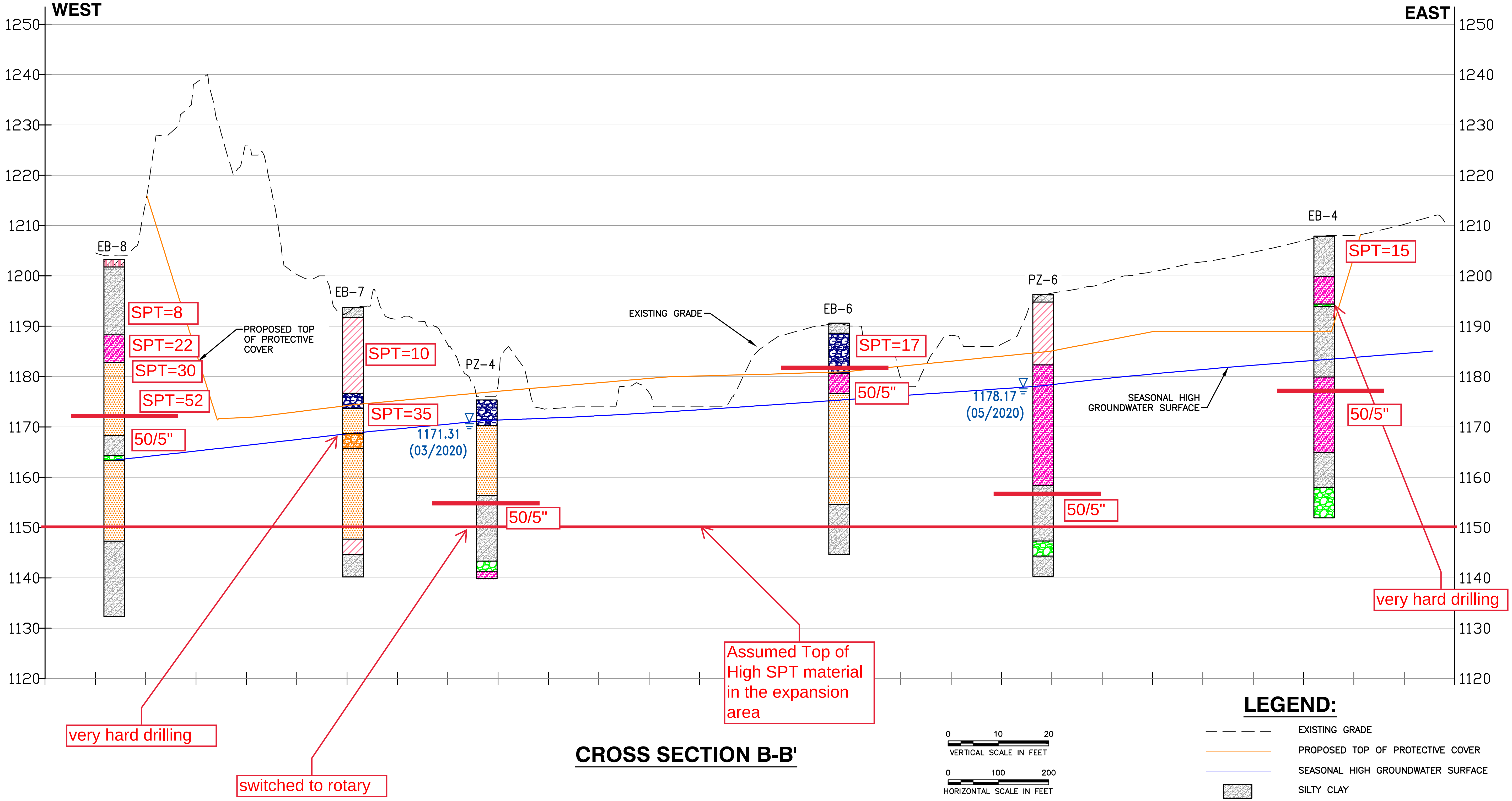
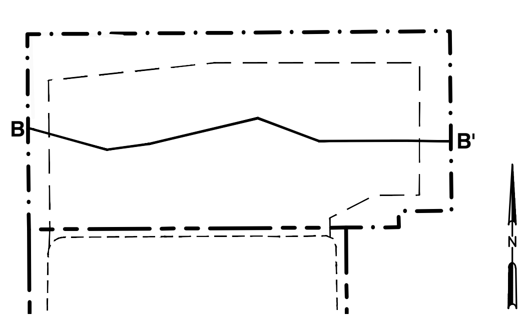


CROSS SECTION B-B'

0 10 20
VERTICAL SCALE IN FEET

0 100 200
HORIZONTAL SCALE IN FEET

GROUNDWATER OBSERVED		
BORING ID	DURING DRILLING	AFTER 24 HOURS
EB–8	1161.28	1162.67
EB–7	1165.70	1168.78
PZ–4	1169.32	1170.36
EB–6	1170.12	1177.23
PZ–6	1166.32	1177.45
EB–4	1177.91	1183.50



KEY MAP
1"=4,000'

LEGEND:

- EXISTING GRADE
- PROPOSED TOP OF PROTECTIVE COVER
- SEASONAL HIGH GROUNDWATER SURFACE
- SILTY CLAY
- SANDY CLAY
- CLAYEY SAND
- SAND
- CLAY
- SILTY SAND
- SANDSTONE
- CLAYEY SILT
- WEATHERED SANDSTONE
- 1178.17 SEASONAL HIGH GROUNDWATER LEVEL IN PIEZOMETER

REV | DATE | DESCRIPTION | BY

DRAWING TITLE: CROSS SECTION B-B'

PROJECT TITLE: NORTHEAST LANDFILL TIER III PERMIT MODIFICATION APPLICATION

CLIENT: N.E. LAND FILL, LLC 2601 NORTH MIDWEST BLVD. SPENCER, OK 73084

SCS ENGINEERS
STEARNS, CONRAD AND SCHMIDT CONSULTING ENGINEERS
1901 CENTRAL DRIVE, SUITE 550, BEDFORD, TX 76021
PH (817) 571-2288 FAX NO. (817) 571-2188

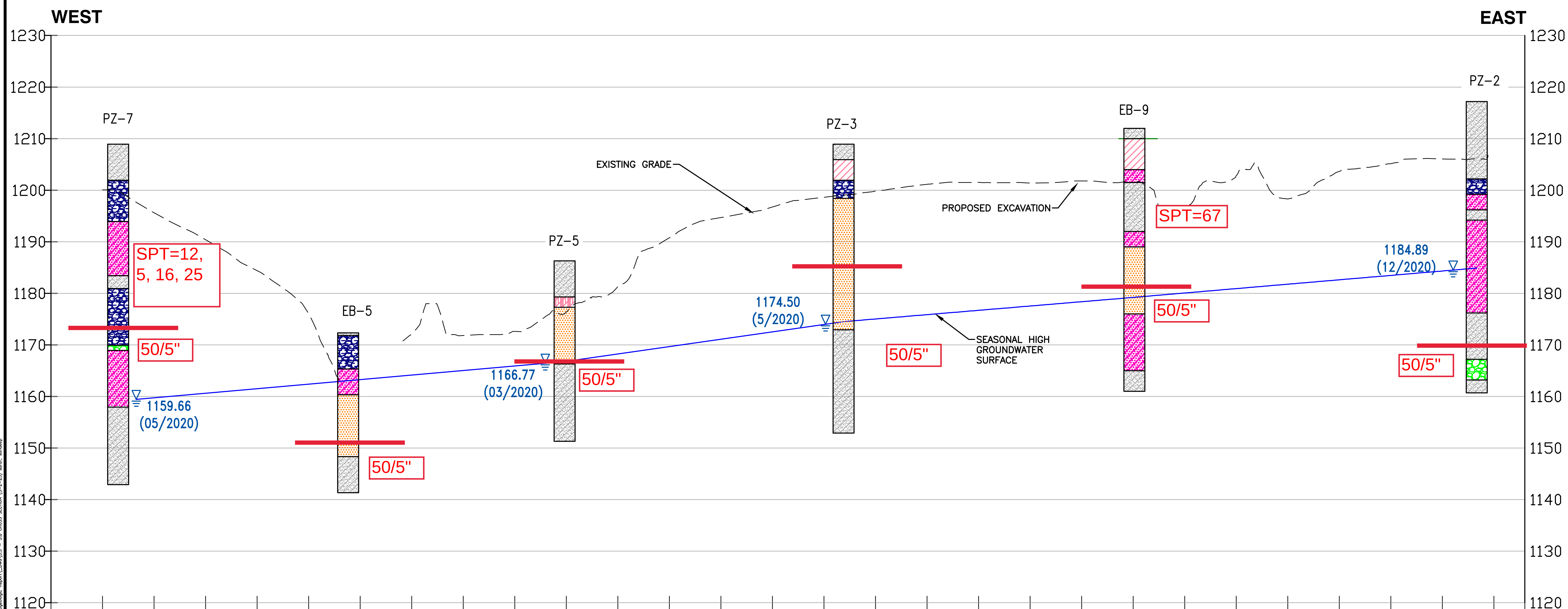
PROJ. NO. 16219107.00 | DSN. BY: RF | CHK. BY: RRK | DWN. BY: JLJ | APP. BY: RRK | Q/A RVW BY: RF

CADD FILE: 3.3 – 3.8 CROSS SECTION (5–2–23)

DATE: 07/2023

SCALE: AS SHOWN

FIGURE NO. 3.4

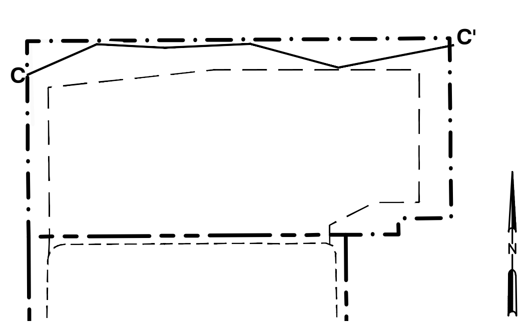


CROSS SECTION C-C'

0 10 20
VERTICAL SCALE IN FEET

0 100 200
HORIZONTAL SCALE IN FEET

GROUNDWATER OBSERVED		
BORING ID	DURING DRILLING	AFTER 24 HOURS
PZ–7	1158.91	1159.50
EB–5	1157.83	1159.31
PZ–5	1169.28	1166.54
PZ–3	1168.41	1173.33
EB–9	1176.00	1179.31
PZ–2	1183.19	1183.70



KEY MAP
1"=4,000'

LEGEND:

- EXISTING GRADE
- SEASONAL HIGH GROUNDWATER SURFACE
- SILTY CLAY
- SANDY CLAY
- CLAYEY SAND
- SAND
- CLAY
- SILTY SAND
- SANDSTONE
- CLAYEY SILT
- 1183.81 SEASONAL HIGH GROUNDWATER LEVEL IN PIEZOMETER

LICENSED PROFESSIONAL ENGINEER SANDEEP D. SARAF 32896 OKLAHOMA
8-12-23

DRAWING TITLE: CROSS SECTION C-C'

PROJECT TITLE: NORTHEAST LANDFILL TIER III PERMIT MODIFICATION APPLICATION

CLIENT: N.E. LAND FILL, LLC 2601 NORTH MIDWEST BLVD. SPENCER, OK 73084

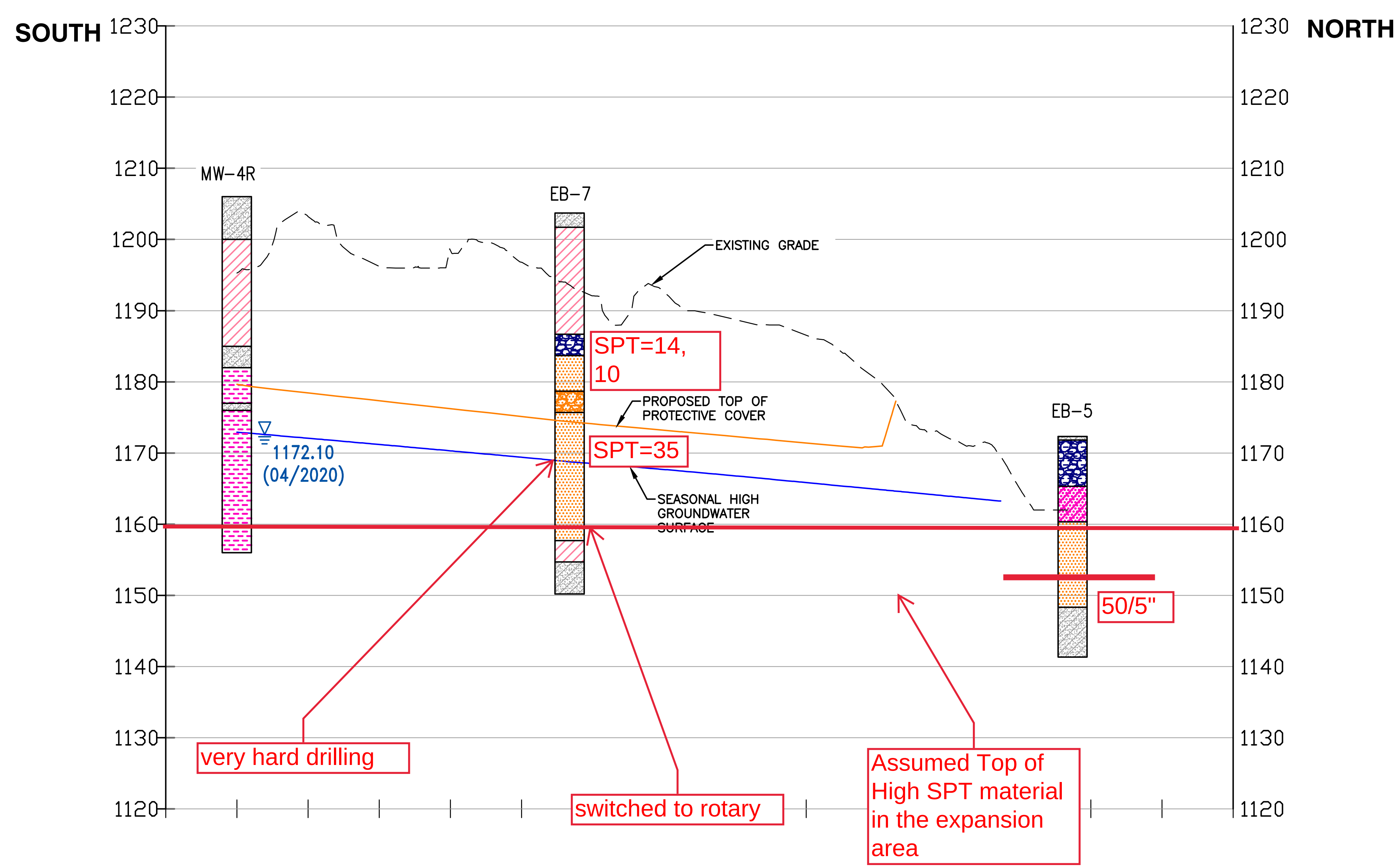
SCS ENGINEERS
STEARNS, CONRAD AND SCHMIDT CONSULTING ENGINEERS, INC.
1901 CENTRAL DRIVE, SUITE 550, BEDFORD, TX 76021
PH (817) 571-2288 FAX NO. (817) 571-2188

CADD FILE: 3.3 – 3.8 CROSS SECTION (5-2-23)

DATE: 07/2023

SCALE: AS SHOWN

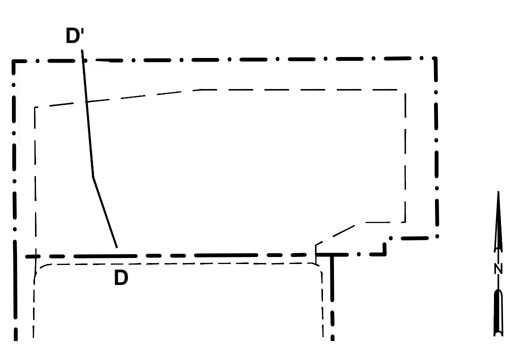
FIGURE NO. 3.5



CROSS SECTION D-D'

0 10 20
VERTICAL SCALE IN FEET

0 100 200
HORIZONTAL SCALE IN FEET



KEY MAP
1"=4,000'

GROUNDWATER OBSERVED		
BORING ID	DURING DRILLING	AFTER 24 HOURS
MW-4R	1154.00	NA
EB-7	1165.70	1168.78
EB-5	1157.83	1159.31

LICENSED PROFESSIONAL ENGINEER
SANDEEP D. SARAF
32896
OKLAHOMA
8-12-23

LEGEND:

- EXISTING GRADE
- PROPOSED TOP OF PROTECTIVE COVER
- SEASONAL HIGH GROUNDWATER SURFACE
- SILTY CLAY
- SANDY CLAY
- CLAYEY SAND
- SAND
- CLAY
- SILTY SAND
- CLAYEY SILT
- WEATHERED SANDSTONE
- 1165.15 SEASONAL HIGH GROUNDWATER LEVEL IN PIEZOMETER

REV | DATE | DESCRIPTION | BY

DRAWING TITLE: CROSS SECTION D-D'

PROJECT TITLE: NORTHEAST LANDFILL TIER III PERMIT MODIFICATION APPLICATION

CLIENT: N.E. LAND FILL, LLC 2601 NORTH MIDWEST BLVD. SPENCER, OK 73084

SCS ENGINEERS
STEARNS, CONRAD AND SCHMIDT
CONSULTING ENGINEERS
1901 CENTRAL DRIVE, SUITE 550, BEDFORD, TX 76021
PH (817) 571-2288 FAX NO. (817) 571-2188

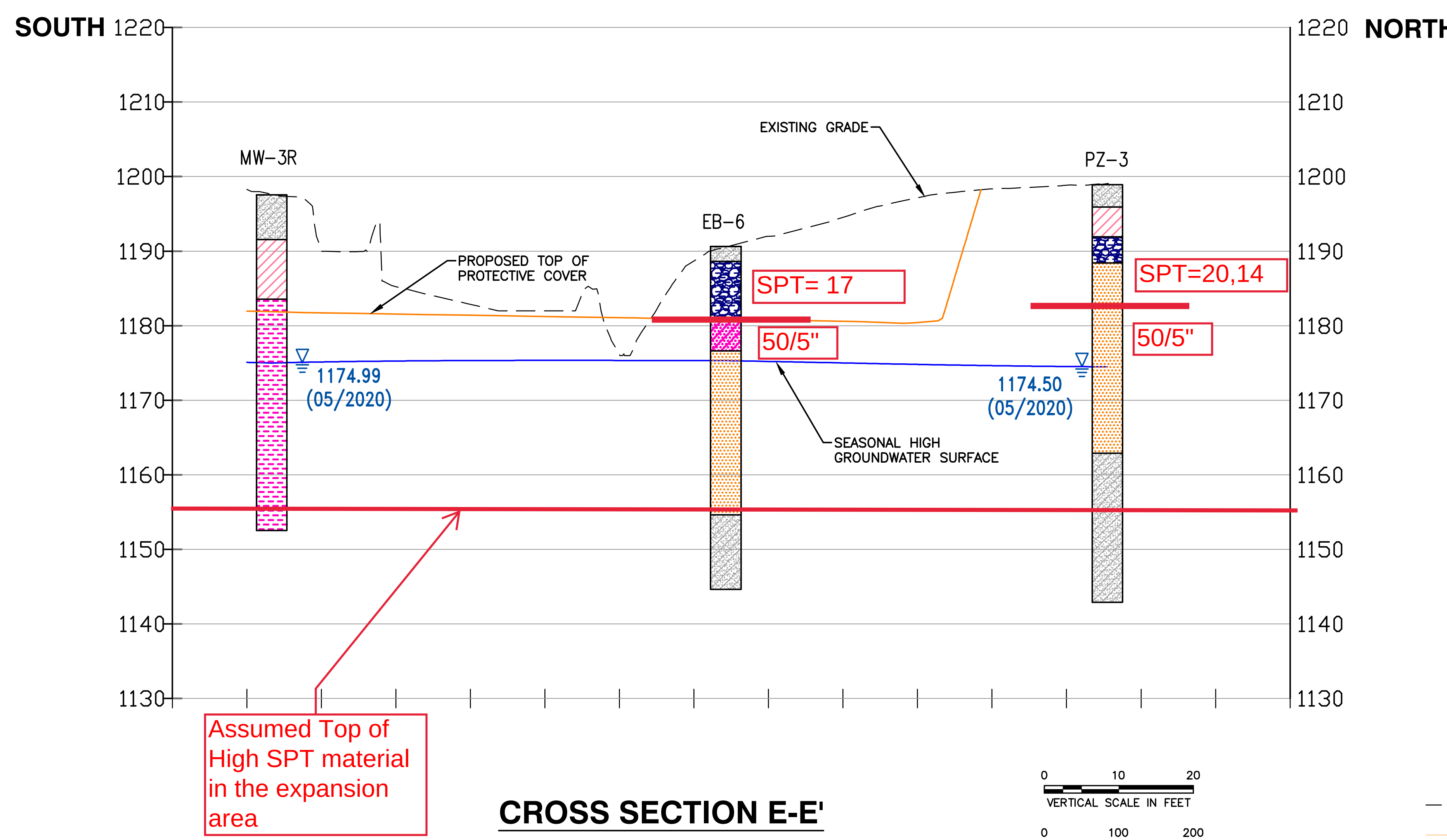
PROJ. NO. 16219107.00 | DSN. BY: RF | DWN. BY: JLJ | CHK. BY: RRK | Q/A RVW BY: RF | APP. BY: RRK

CADD FILE: 3.3 - 3.8 CROSS SECTION (5-2-23)

DATE: 07/2023

SCALE: AS SHOWN

FIGURE NO. 3.6



CROSS SECTION E-E'

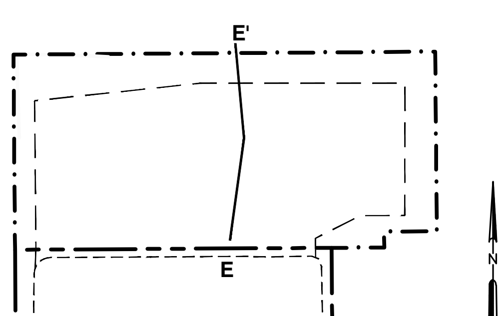
0 10 20
VERTICAL SCALE IN FEET

0 100 200
HORIZONTAL SCALE IN FEET

LEGEND:

- EXISTING GRADE
- PROPOSED TOP OF PROTECTIVE COVER
- SEASONAL HIGH GROUNDWATER SURFACE
- SILTY CLAY
- SANDY CLAY
- CLAYEY SAND
- SAND
- CLAY
- SILTY SAND
- 1173.32 SEASONAL HIGH GROUNDWATER LEVEL IN PIEZOMETER

GROUNDWATER OBSERVED		
BORING ID	DURING DRILLING	AFTER 24 HOURS
MW–3R	1162.30	NA
EB–6	1170.12	1177.23
PZ–3	1168.41	1173.33



KEY MAP
1"=4,000'

REV | DATE | DESCRIPTION | BY

DRAWING TITLE: CROSS SECTION E-E'

PROJECT TITLE: NORTHEAST LANDFILL TIER III PERMIT MODIFICATION APPLICATION

CLIENT: N.E. LAND FILL, LLC 2601 NORTH MIDWEST BLVD. SPENCER, OK 73084

SCS ENGINEERS
STEARNS, CONRAD AND SCHMIDT CONSULTING ENGINEERS, INC.
1901 CENTRAL DRIVE, SUITE 550, BEDFORD, TX 76021
PH (817) 571-2288 FAX NO. (817) 571-2188

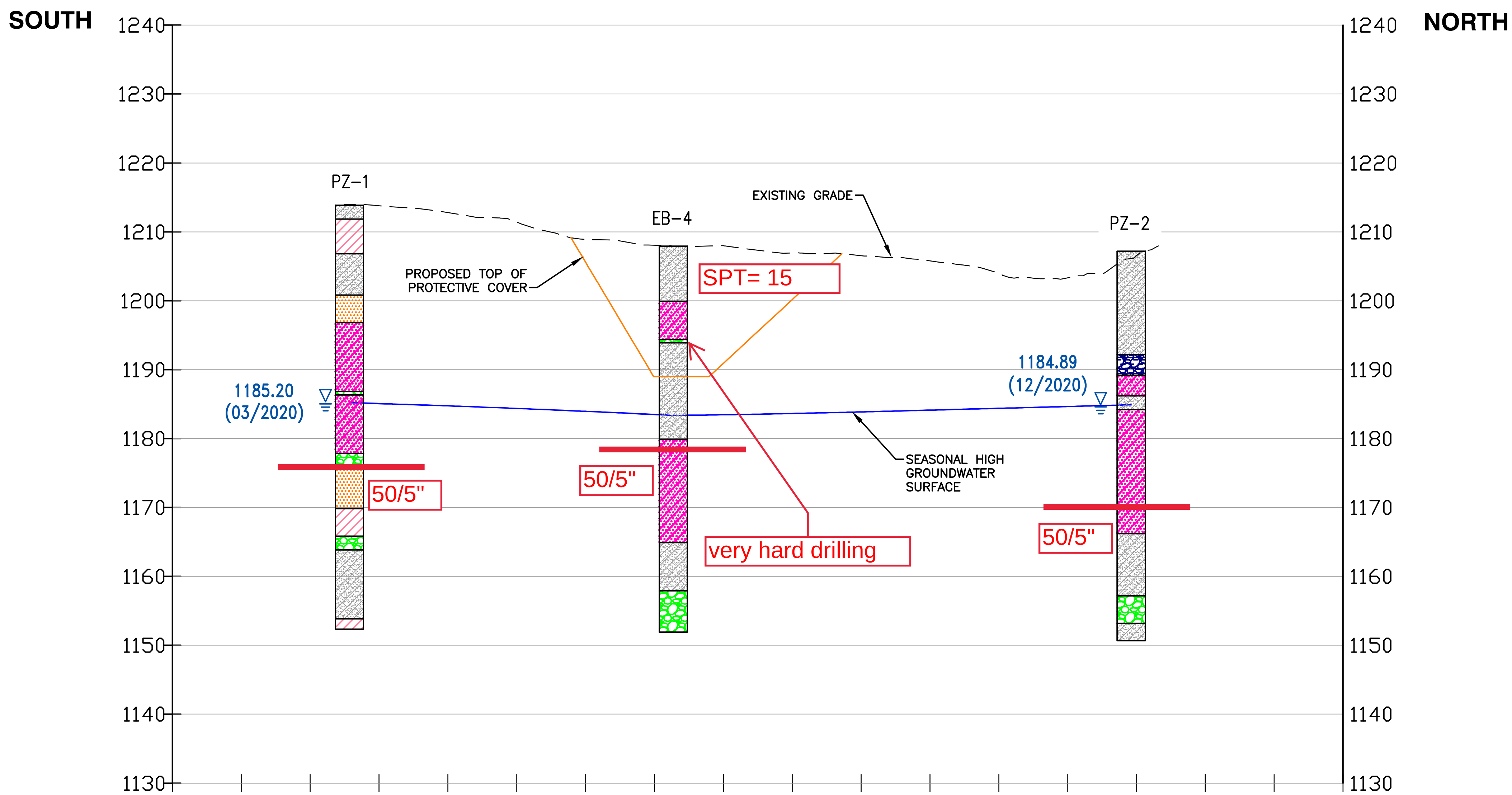
PROJ. NO. 16219107.00 | DSN. BY: RF | DWN. BY: JLJ | CHK. BY: RRK | Q/A RVW BY: RF | APP. BY: RRK

CADD FILE: 3.3 – 3.8 CROSS SECTION (5–2–23)

DATE: 07/2023

SCALE: AS SHOWN

FIGURE NO. 3.7

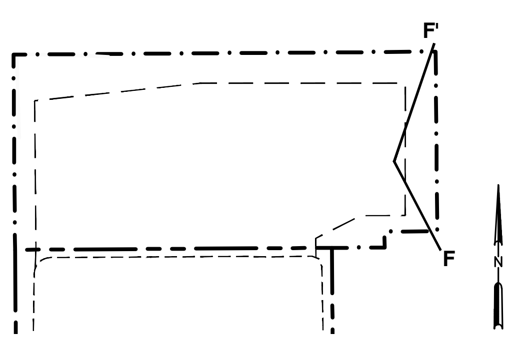


CROSS SECTION F-F'

0 10 20
VERTICAL SCALE IN FEET

0 100 200
HORIZONTAL SCALE IN FEET

GROUNDWATER OBSERVED		
BORING ID	DURING DRILLING	AFTER 24 HOURS
PZ-1	1179.84	1185.95
EB-4	1177.91	1183.50
PZ-2	1183.19	1183.70



KEY MAP
1"=4,000'

LEGEND:

- EXISTING GRADE
- PROPOSED TOP OF PROTECTIVE COVER
- SEASONAL HIGH GROUNDWATER SURFACE
- SILTY CLAY
- SANDY CLAY
- CLAYEY SAND
- SAND
- CLAY
- SILTY SAND
- SANDSTONE
- CLAYEY SILT
- 1183.81 SEASONAL HIGH GROUNDWATER LEVEL IN PIEZOMETER

REV | DATE | DESCRIPTION | BY

DRAWING TITLE: CROSS SECTION F-F'

PROJECT TITLE: NORTHEAST LANDFILL TIER III PERMIT MODIFICATION APPLICATION

CLIENT: N.E. LAND FILL, LLC 2601 NORTH MIDWEST BLVD. SPENCER, OK 73084

SCS ENGINEERS
STEARNS, CONRAD AND SCHMIDT CONSULTING ENGINEERS
1901 CENTRAL DRIVE, SUITE 550, BEDFORD, TX 76021
PH (817) 571-2288 FAX NO. (817) 571-2188

PROJ. NO. 16219107.00 | DSN. BY: RF | DWN. BY: JLJ | CHK. BY: RRK | Q/A RVW BY: RF | APP. BY: RRK

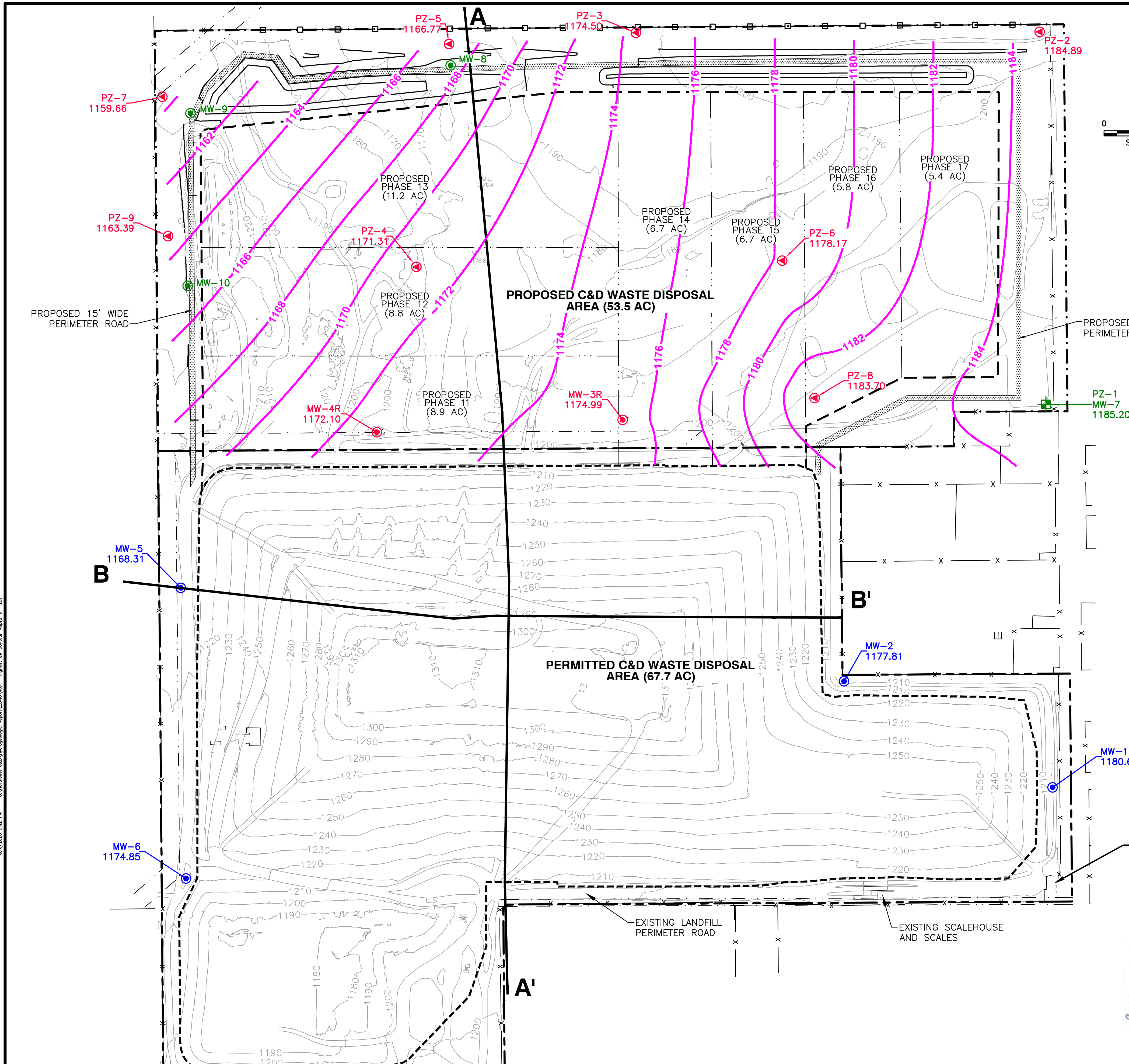
CADD FILE: 3.3 - 3.8 CROSS SECTION (5-2-23)

DATE: 07/2023

SCALE: AS SHOWN

FIGURE NO. 3.8

5/3/2023 5:37 PM
G:\Northeast CAD\Hydrogeologic Report_DWG\3.3 - 3.8 CROSS SECTION (5-2-23) sprd_ sandeep



SCALE IN FEET 0 150 300

LEGEND

- EXISTING C&D LANDFILL PERMIT BOUNDARY (SEE NOTE 1)
- EXISTING C&D LANDFILL LIMITS OF WASTE
- PROPOSED C&D LANDFILL EXPANSION PERMIT BOUNDARY (SEE NOTE 1)
- PROPOSED C&D EXPANSION AREA LIMITS OF WASTE (SEE NOTE 2)
- PROPOSED C&D EXPANSION DISPOSAL AREA PHASE BOUNDARY
- PROPOSED PERIMETER ROAD
- PROPOSED FENCE
- MW-10 PROPOSED MONITORING WELL
- EXISTING FENCE
- 1210 EXISTING 10' CONTOUR (SEE NOTE 3)
- 1182 HIGHEST GROUNDWATER ELEVATION CONTOURS
- EXISTING ROADS
- EXISTING EASEMENT (APPROX., SEE NOTE 4)
- GAS EXISTING GAS LINE (APPROX., SEE NOTE 4)
- MW-1 EXISTING MONITORING WELL (TO REMAIN)
- PZ-1 MW-7 EXISTING PIEZOMETER TO BE CONVERTED INTO MONITORING WELL
- PZ-24 EXISTING PIEZOMETER (TO BE ABANDONED/DECOMMISSIONED)
- MW-4R EXISTING MONITORING WELL (TO BE ABANDONED/DECOMMISSIONED)
- A — A' LANDFILL CROSS-SECTION LOCATION

NOTES:

1. EXISTING AND PROPOSED C&D LANDFILL PERMIT BOUNDARY AREA:
   A. EXISTING C&D LANDFILL PERMIT BOUNDARY AREA = 90.1 AC.
   B. PROPOSED C&D LANDFILL PERMIT BOUNDARY AREA = 73.2 AC.
   C. TOTAL C&D LANDFILL PERMIT BOUNDARY (EXISTING AND EXPANSION) = 163.3 AC.
2. EXISTING AND PROPOSED C&D WASTE DISPOSAL BOUNDARY AREA:
   A. EXISTING C&D LANDFILL DISPOSAL AREA = 67.7 AC.
   B. PROPOSED C&D EXPANSION LANDFILL WASTE DISPOSAL AREA = 53.5 AC.
   C. TOTAL C&D LANDFILL DISPOSAL AREA (EXISTING AND EXPANSION) = 121.2 AC.
3. EXISTING CONTOURS ARE FROM AERIAL PHOTOGRAPHY PERFORMED BY COOPER AERIAL SURVEYS CO. ON 01/23/2023.

HIGHEST GROUNDWATER RECORDED

PIEZOMETER NAME	ELEVATION	DATE RECORDED
MW-1	1180.67	APRIL 2020
MW-2	1177.81	MAY 2020
MW-3R	1174.99	MAY 2020
MW-4R	1172.10	APRIL 2020
MW-5	1168.31	MAY 2020
MW-6	1174.85	SEPTEMBER 2020
PZ-1	1185.20	MARCH 2020
PZ-2	1184.89	DECEMBER 2020
PZ-3	1174.50	MAY 2020
PZ-4	1171.31	MARCH 2020
PZ-5	1166.77	MARCH 2020
PZ-6	1178.17	MAY 2020
PZ-7	1159.66	MAY 2020
PZ-8	1183.70	MARCH 2020
PZ-9	1163.39	JUNE 2020

LICENSED PROFESSIONAL ENGINEER SANDEEP D. SARAF 32896 OKLAHOMA 8-18-23

FOR PERMITTING PURPOSES ONLY

REV | DATE | DESCRIPTION | BY

DRAWING TITLE: HIGHEST GROUNDWATER CONTOUR MAP

PROJECT TITLE: NORTHEAST LANDFILL TIER III PERMIT MODIFICATION APPLICATION

CLIENT: N.E. LAND FILL, LLC NORTHEAST LANDFILL 2601 NORTH MIDWEST BLVD. SPENCER, OK 73084

SCS ENGINEERS
STEARNS, CONRAD AND SCHMIDT CONSULTING ENGINEERS
1901 CENTRAL DRIVE, SUITE 550, BEDFORD, TX 76021
PH (817) 571-2288 FAX NO. (817) 571-2188

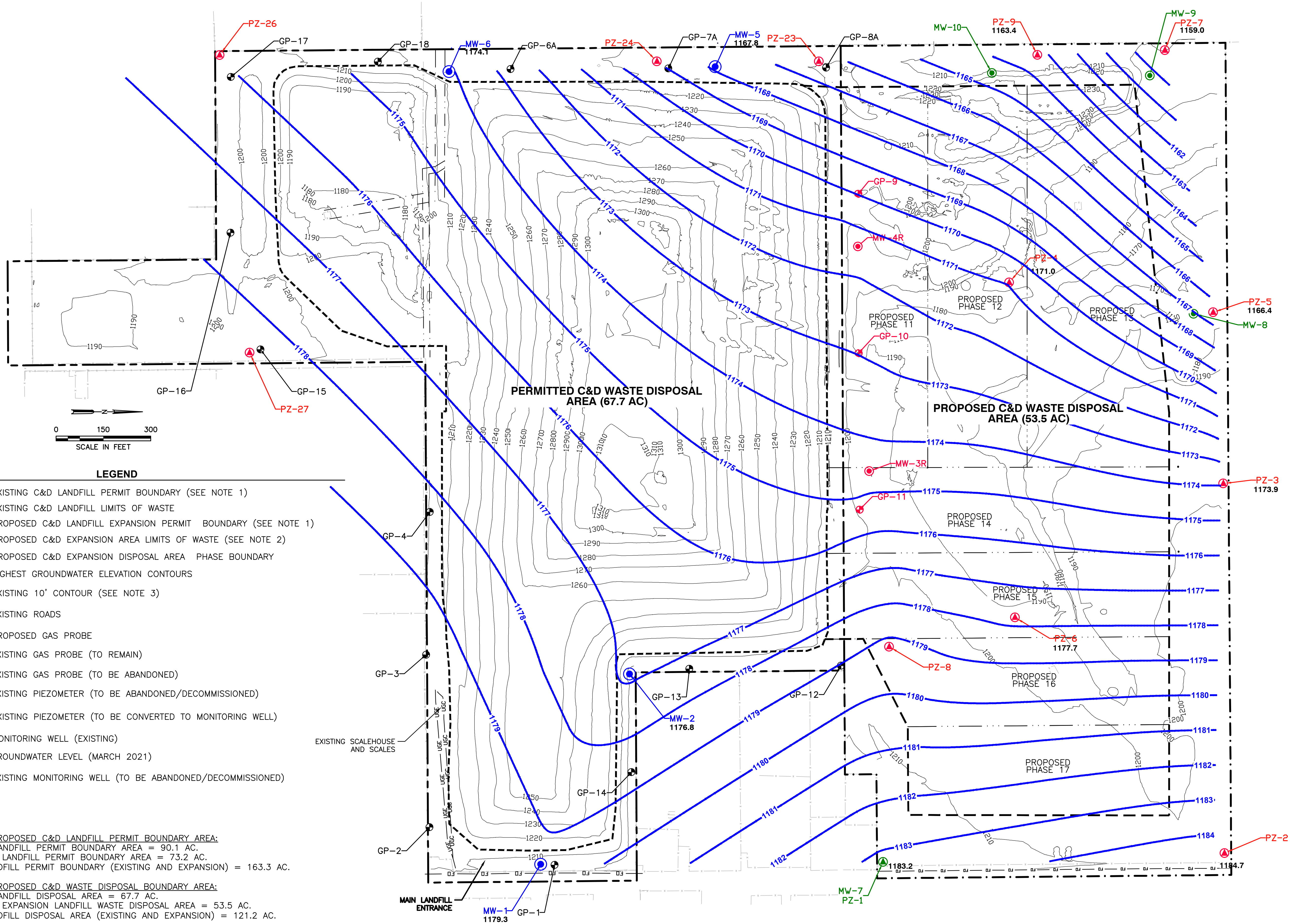
PROJ. NO. 16219107.00 | DSN. BY: SS | DWN. BY: DS | CHK. BY: SDS | Q/A RVW BY: SS | APP. BY: RRK

CADD FILE: 4.6 – HIGHEST GW CONTOUR MAP(8-6-23)

DATE: 08/2023

SCALE: AS SHOWN

DRAWING NO. 4.6



LICENSED PROFESSIONAL ENGINEER
SANDEEP D. SARAF
32896
OKLAHOMA
8-18-23

LEGEND

— — —	EXISTING C&D LANDFILL PERMIT BOUNDARY (SEE NOTE 1)
- - - -	EXISTING C&D LANDFILL LIMITS OF WASTE
— · — ·	PROPOSED C&D LANDFILL EXPANSION PERMIT BOUNDARY (SEE NOTE 1)
— —	PROPOSED C&D EXPANSION AREA LIMITS OF WASTE (SEE NOTE 2)
— · · —	PROPOSED C&D EXPANSION DISPOSAL AREA PHASE BOUNDARY
—1182—	HIGHEST GROUNDWATER ELEVATION CONTOURS
—1210—	EXISTING 10' CONTOUR (SEE NOTE 3)
═══	EXISTING ROADS
GP-14	PROPOSED GAS PROBE
GP-14	EXISTING GAS PROBE (TO REMAIN)
GP-10	EXISTING GAS PROBE (TO BE ABANDONED)
PZ-24	EXISTING PIEZOMETER (TO BE ABANDONED/DECOMMISSIONED)
PZ-1 MW-7	EXISTING PIEZOMETER (TO BE CONVERTED TO MONITORING WELL)
MW-2	MONITORING WELL (EXISTING)
1179.3	GROUNDWATER LEVEL (MARCH 2021)
MW-4R	EXISTING MONITORING WELL (TO BE ABANDONED/DECOMMISSIONED)

NOTES:

1. EXISTING AND PROPOSED C&D LANDFILL PERMIT BOUNDARY AREA:
   A. EXISTING C&D LANDFILL PERMIT BOUNDARY AREA = 90.1 AC.
   B. PROPOSED C&D LANDFILL PERMIT BOUNDARY AREA = 73.2 AC.
   C. TOTAL C&D LANDFILL PERMIT BOUNDARY (EXISTING AND EXPANSION) = 163.3 AC.
2. EXISTING AND PROPOSED C&D WASTE DISPOSAL BOUNDARY AREA:
   A. EXISTING C&D LANDFILL DISPOSAL AREA = 67.7 AC.
   B. PROPOSED C&D EXPANSION LANDFILL WASTE DISPOSAL AREA = 53.5 AC.
   C. TOTAL C&D LANDFILL DISPOSAL AREA (EXISTING AND EXPANSION) = 121.2 AC.
3. EXISTING CONTOURS ARE FROM AERIAL PHOTOGRAPHY PERFORMED BY COOPER AERIAL SURVEYS CO. ON 01/23/2023.

REV	DATE	DESCRIPTION	BY

DRAWING TITLE: POTENTIOMETRIC MAP MARCH 2021

PROJECT TITLE: NORTHEAST LANDFILL TIER III PERMIT MODIFICATION APPLICATION

CLIENT: N.E. LAND FILL, LLC
2601 NORTH MIDWEST BLVD.
SPENCER, OK 73084

SCS ENGINEERS
STEARNS, CONRAD AND SCHMIDT CONSULTING ENGINEERS
1901 CENTRAL DRIVE, SUITE 550, BEDFORD, TX 76021
PH (817) 571-2288 FAX NO. (817) 571-2188

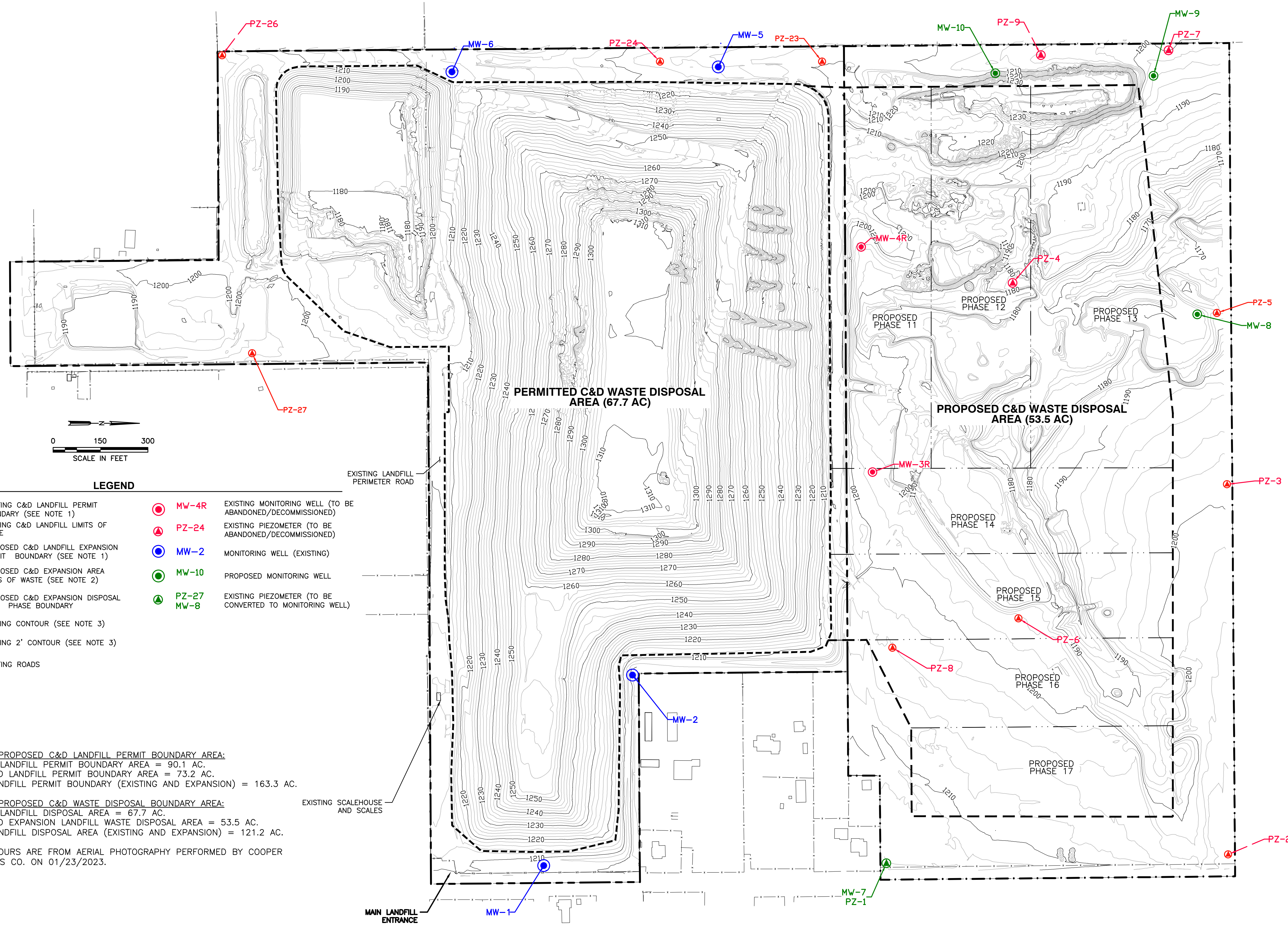
PROJ. NO. 16219107.00 | DSN. BY: RF | DWN. BY: JLJ | CHK. BY: RRK | Q/A RVW BY: RF | APP. BY: RRK

CADD FILE: 4.7 - POT CONTOUR MAP (MARCH 2021)8-6-23

DATE: 07/2023

SCALE: AS SHOWN

FIGURE NO. 4.7



LEGEND

	EXISTING C&D LANDFILL PERMIT BOUNDARY (SEE NOTE 1)	MW-4R	EXISTING MONITORING WELL (TO BE ABANDONED/DECOMMISSIONED)
	EXISTING C&D LANDFILL LIMITS OF WASTE	PZ-24	EXISTING PIEZOMETER (TO BE ABANDONED/DECOMMISSIONED)
	PROPOSED C&D LANDFILL EXPANSION PERMIT BOUNDARY (SEE NOTE 1)	MW-2	MONITORING WELL (EXISTING)
	PROPOSED C&D EXPANSION AREA LIMITS OF WASTE (SEE NOTE 2)	MW-10	PROPOSED MONITORING WELL
	PROPOSED C&D EXPANSION DISPOSAL AREA PHASE BOUNDARY	PZ-27 MW-8	EXISTING PIEZOMETER (TO BE CONVERTED TO MONITORING WELL)
1210	EXISTING CONTOUR (SEE NOTE 3)		
	EXISTING 2' CONTOUR (SEE NOTE 3)		
	EXISTING ROADS		

NOTES:

1. EXISTING AND PROPOSED C&D LANDFILL PERMIT BOUNDARY AREA:
   A. EXISTING C&D LANDFILL PERMIT BOUNDARY AREA = 90.1 AC.
   B. PROPOSED C&D LANDFILL PERMIT BOUNDARY AREA = 73.2 AC.
   C. TOTAL C&D LANDFILL PERMIT BOUNDARY (EXISTING AND EXPANSION) = 163.3 AC.

2. EXISTING AND PROPOSED C&D WASTE DISPOSAL BOUNDARY AREA:
   A. EXISTING C&D LANDFILL DISPOSAL AREA = 67.7 AC.
   B. PROPOSED C&D EXPANSION LANDFILL WASTE DISPOSAL AREA = 53.5 AC.
   C. TOTAL C&D LANDFILL DISPOSAL AREA (EXISTING AND EXPANSION) = 121.2 AC.

3. EXISTING CONTOURS ARE FROM AERIAL PHOTOGRAPHY PERFORMED BY COOPER AERIAL SURVEYS CO. ON 01/23/2023.

REV	DATE	DESCRIPTION	BY

DRAWING TITLE: PROPOSED GROUNDWATER MONITORING NETWORK

PROJECT TITLE: NORTHEAST LANDFILL TIER III PERMIT MODIFICATION APPLICATION

CLIENT: N.E. LAND FILL, LLC
2601 NORTH MIDWEST BLVD.
SPENCER, OK 73084

SCS ENGINEERS
STEARNS, CONRAD AND SCHMIDT
CONSULTING ENGINEERS
1901 CENTRAL DRIVE, SUITE 550, BEDFORD, TX 76021
PH (817) 571-2288 FAX NO. (817) 571-2188

PROJ. NO. 16219107.00 | DWN. BY: JLJ | Q/A RVW BY: RF
DSN. BY: RF | CHK. BY: RRK | APP. BY: RRK

CADD FILE: 5.2 PROP GW MONITOR(8-6-23)

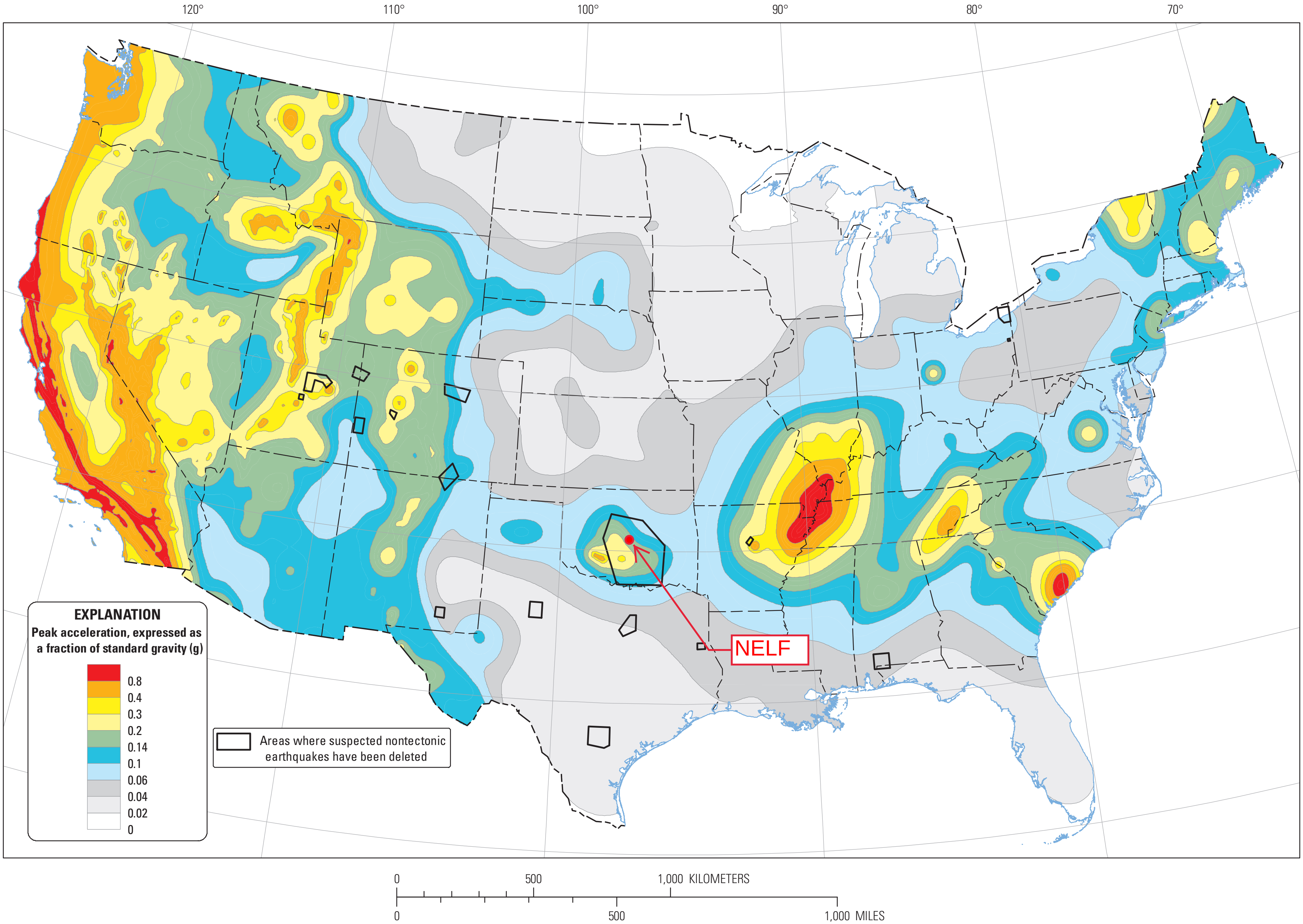
DATE: 07/2023

SCALE: AS SHOWN

FIGURE NO. 5.2

Attachment C-3

Seismic Analysis Supporting Information



Two-percent probability of exceedance in 50 years map of peak ground acceleration

U.S. Geological Survey - Earthquake Hazards Program

Unified Hazard Tool

Please do not use this tool to obtain ground motion parameter values for the design code reference documents covered by the U.S. Seismic Design Maps web tools (e.g., the International Building Code and the ASCE 7 or 41 Standard). The values returned by the two applications are not identical.

Input

Edition

Conterminous U.S. 2014 (v4.0.x)

Spectral Period

Peak Ground Acceleration

Latitude

Decimal degrees

35.501

Time Horizon

Return period in years

2475

2% in 50 years
(2475 years)

Longitude

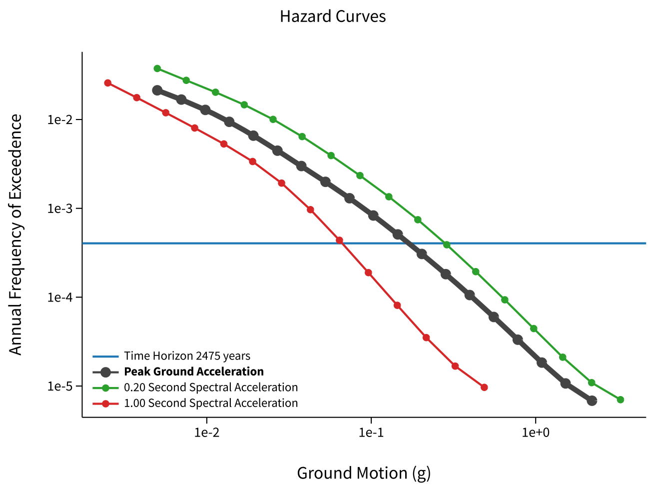
Decimal degrees, negative values for western longitudes

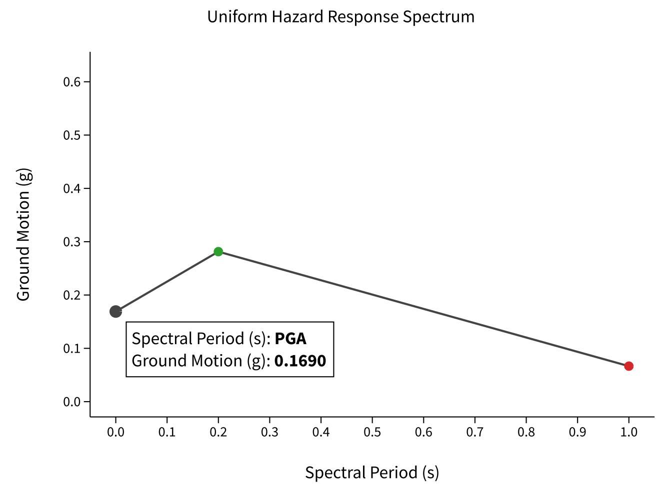
-97.392

Site Class

760 m/s (B/C boundary)

Hazard Curve





[View Raw Data]

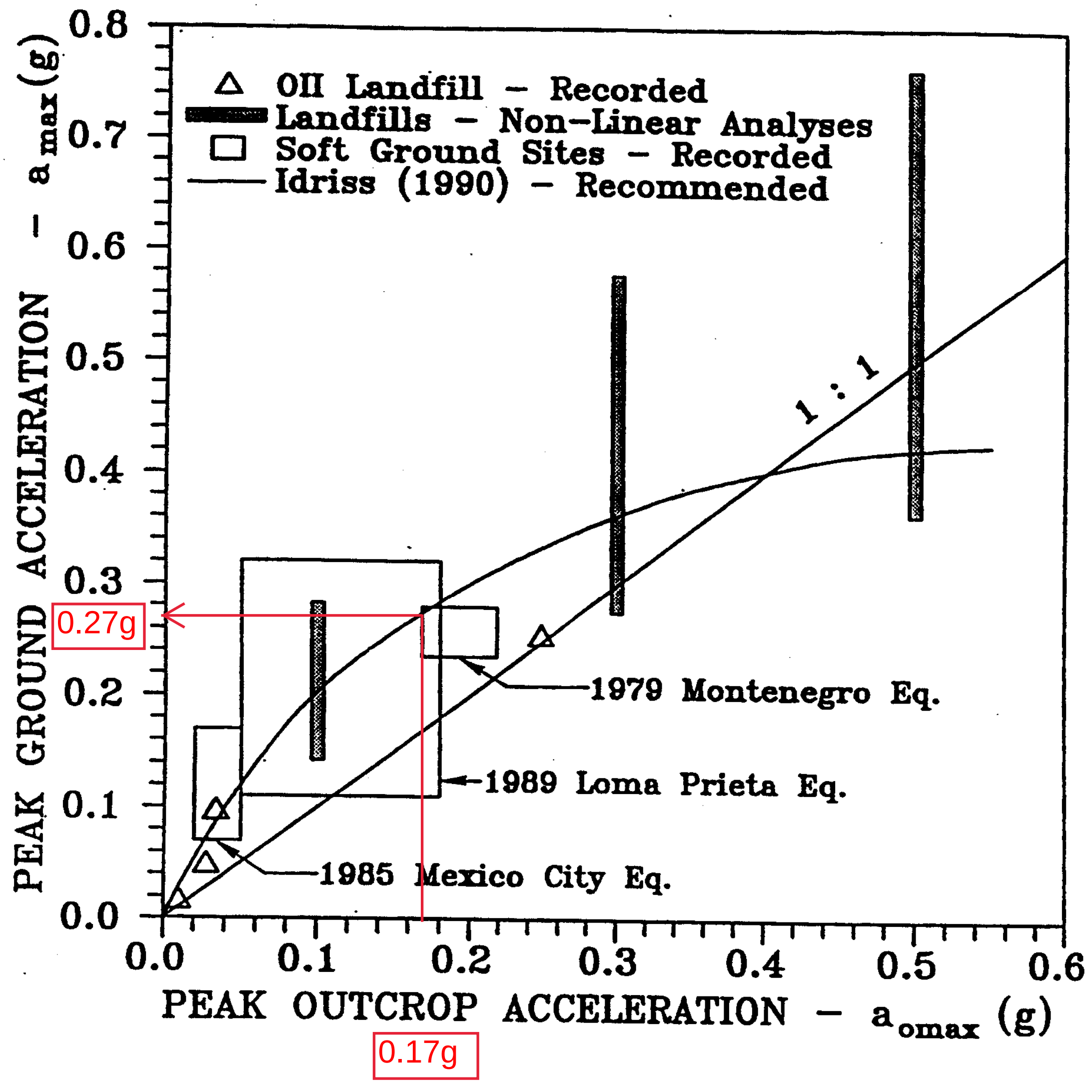


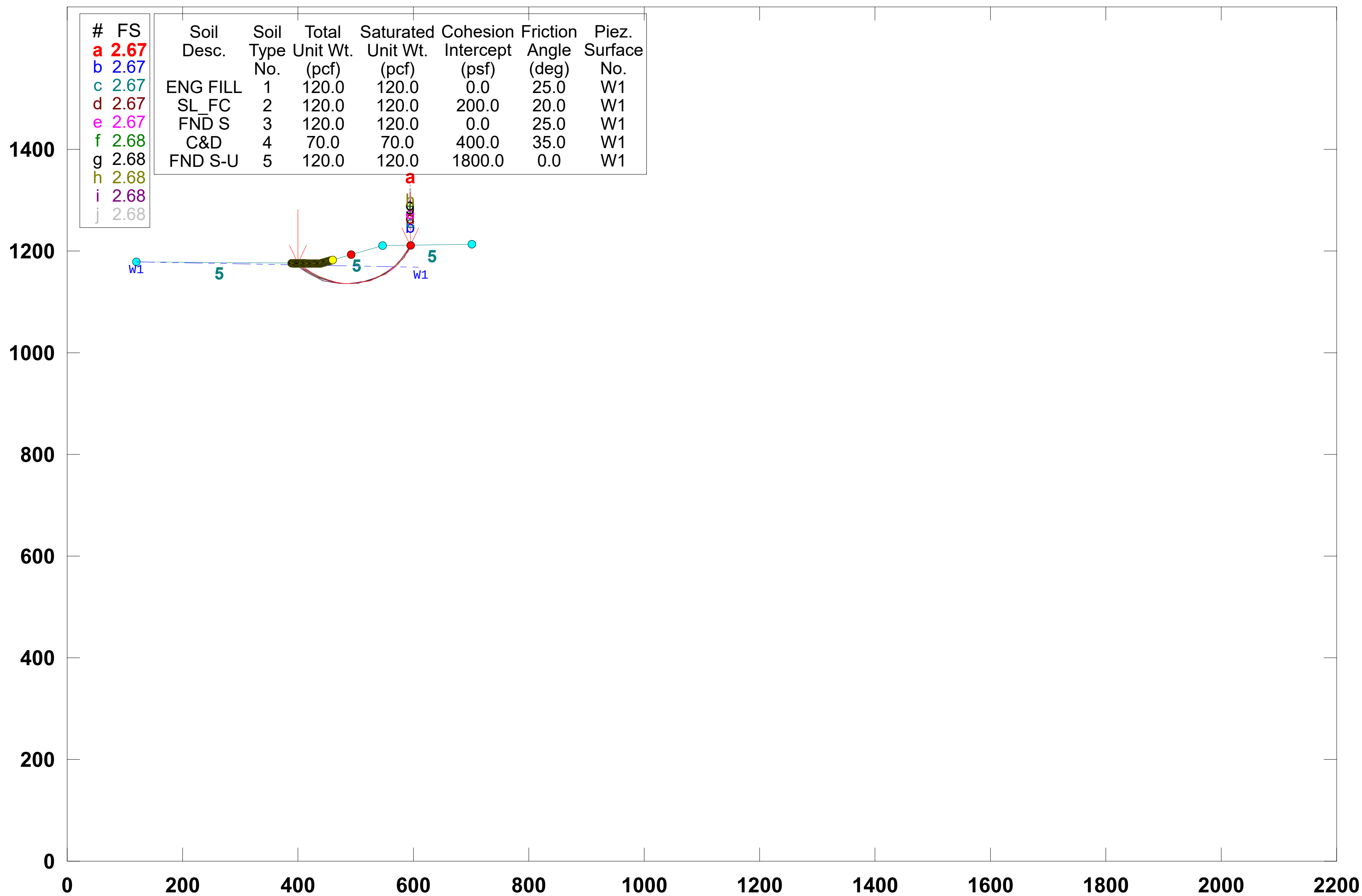
Figure C3.2. **Observed Variations of Peak Horizontal Accelerations on Soft Soil and MSW Sites in Comparison to Rock Sites (Kavazanjian and Matasović, 1994).**

Attachment C-4

PCSTABL5M Slope Stability Analyses Results

Northeast Landfill Cross Section A, Circular (Excavation)

m:\projects\16219107.00\task 3 - tier iii modification app\permit application\app c - liner and final cover system stability analysis\stabl files\nelf\2023.4.13 nelf_xs_a_circ (excavation).pl2 Run By: Username 4/19/2023 08



Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Piez. Surface No.
ENG FILL	1	120.0	120.0	0.0	25.0	W1
SL_FC	2	120.0	120.0	200.0	20.0	W1
FND S	3	120.0	120.0	0.0	25.0	W1
C&D	4	70.0	70.0	400.0	35.0	W1
FND S-U	5	120.0	120.0	1800.0	0.0	W1

PCSTABL5M3 FSmin=2.67
Safety Factors Are Calculated By The Modified Bishop Method

**** PCSTABL5M3 ****
by Purdue University 1985
rev. for SCS Engineers HVA 2008
--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer`s Method of Slices

Run Date: 4/13/2023
Time of Run: 07:03PM
Run By: Username
Input Data Filename: M:2023.4.13 nelf_xs_a_circ (Excavation).in
Output Filename: M:2023.4.13 nelf_xs_a_circ (Excavation).OUT
Unit: ENGLISH
Plotted Output Filename: M:2023.4.13 nelf_xs_a_circ (Excavation).PLT
PROBLEM DESCRIPTION Northeast Landfill
Cross Section A, Circular (Excavation)

BOUNDARY COORDINATES
Note: User origin value specified.
Add 0.00 to X-values and 0.00 to Y-values listed.

3 Top Boundaries
3 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	121.00	1178.30	438.90	1175.40	5
2	438.90	1175.40	545.30	1210.50	5
3	545.30	1210.50	700.00	1212.00	5

ISOTROPIC SOIL PARAMETERS
5 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	120.0	120.0	0.0	25.0	0.00	0.0	1
2	120.0	120.0	200.0	20.0	0.00	0.0	1
3	120.0	120.0	0.0	25.0	0.00	0.0	1
4	70.0	70.0	400.0	35.0	0.00	0.0	1
5	120.0	120.0	1800.0	0.0	0.00	0.0	1

1 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED
Unit Weight of Water = 62.40
Piezometric Surface No. 1 Specified by 2 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	121.00	1177.60
2	612.00	1168.30

A Critical Failure Surface Searching Method, Using A Random Technique For Generating Circular Surfaces, Has Been Specified.
10000 Trial Surfaces Have Been Generated.
100 Surfaces Initiate From Each Of100 Points Equally Spaced
Along The Ground Surface Between X = 388.90 ft.
and X = 460.00 ft.
Each Surface Terminates Between X = 492.30 ft.
and X = 595.30 ft.
Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y = 0.00 ft.
15.00 ft. Line Segments Define Each Trial Failure Surface.
Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Examined. They Are Ordered - Most Critical
First.
* * Safety Factors Are Calculated By The Modified Bishop Method * *
Failure Surface Specified By 17 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	401.11	1175.74
2	411.72	1165.14
3	423.62	1156.00
4	436.60	1148.49
5	450.45	1142.74
6	464.93	1138.83
7	479.80	1136.84
8	494.80	1136.80
9	509.68	1138.71

10	524.18	1142.53
11	538.06	1148.22
12	551.09	1155.65
13	563.04	1164.72
14	573.70	1175.27
15	582.91	1187.11
16	590.49	1200.05
17	595.11	1210.98

Circle Center At X = 487.6 ; Y = 1251.7 and Radius, 115.1

*** 2.671 ***

Individual data on the 20 slices

Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Tie Force Norm (lbs)	Tie Force Tan (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Surcharge Load (lbs)
1	3.5	735.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	7.1	5952.7	0.0	2174.6	0.0	0.0	0.0	0.0	0.0
3	11.9	21445.7	0.0	10676.2	0.0	0.0	0.0	0.0	0.0
4	13.0	36196.0	0.0	18244.4	0.0	0.0	0.0	0.0	0.0
5	2.3	7562.1	0.0	3665.6	0.0	0.0	0.0	0.0	0.0
6	11.6	44586.1	0.0	20549.6	0.0	0.0	0.0	0.0	0.0
7	14.5	70932.4	0.0	28487.0	0.0	0.0	0.0	0.0	0.0
8	14.9	86718.5	0.0	30987.3	0.0	0.0	0.0	0.0	0.0
9	15.0	98189.7	0.0	31673.9	0.0	0.0	0.0	0.0	0.0
10	14.9	104521.7	0.0	30534.8	0.0	0.0	0.0	0.0	0.0
11	14.5	105330.9	0.0	27589.6	0.0	0.0	0.0	0.0	0.0
12	13.9	100699.0	0.0	22888.0	0.0	0.0	0.0	0.0	0.0
13	7.2	51259.6	0.0	10061.1	0.0	0.0	0.0	0.0	0.0
14	5.8	39264.3	0.0	6449.1	0.0	0.0	0.0	0.0	0.0
15	11.9	72294.5	0.0	8564.4	0.0	0.0	0.0	0.0	0.0
16	4.5	23470.3	0.0	883.1	0.0	0.0	0.0	0.0	0.0
17	6.2	28659.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0
18	9.2	32725.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0
19	7.6	15764.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0
20	4.6	3016.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Failure Surface Specified By 18 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	394.65	1175.80
2	405.25	1165.20
3	417.11	1156.01
4	430.02	1148.37
5	443.79	1142.42
6	458.20	1138.25
7	473.01	1135.91
8	488.01	1135.45
9	502.94	1136.88
10	517.57	1140.16
11	531.68	1145.26
12	545.04	1152.09
13	557.43	1160.54
14	568.67	1170.47
15	578.57	1181.74
16	586.98	1194.16
17	593.76	1207.54
18	594.99	1210.98

Circle Center At X = 484.1 ; Y = 1254.5 and Radius, 119.1

*** 2.672 ***

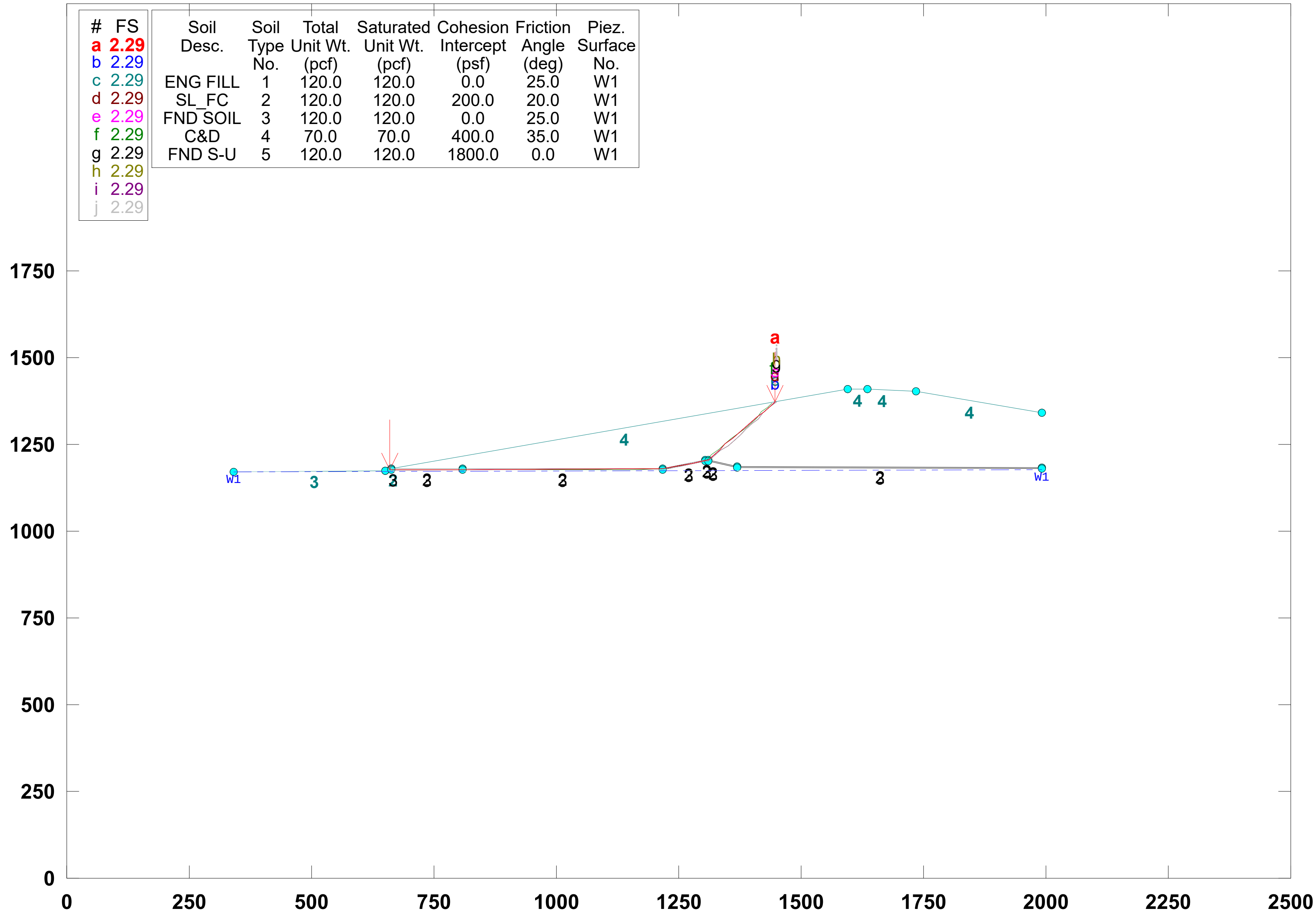
Failure Surface Specified By 17 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	401.11	1175.74
2	411.73	1165.15
3	423.63	1156.02
4	436.62	1148.52
5	450.48	1142.78
6	464.97	1138.89
7	479.84	1136.92
8	494.84	1136.90
9	509.71	1138.83

```
   10        524.21     1142.68
   11        538.08     1148.39
   12        551.09     1155.85
   13        563.02     1164.95
   14        573.66     1175.52
   15        582.84     1187.38
   16        590.40     1200.34
   17        594.86     1210.98
Circle Center At X =  487.5 ; Y = 1251.7  and Radius,  115.0
      ***     2.673   ***
Failure Surface Specified By 17 Coordinate Points
  Point      X-Surf      Y-Surf
   No.        (ft)        (ft)
    1        401.83     1175.74
    2        412.43     1165.13
    3        424.34     1156.00
    4        437.33     1148.51
    5        451.20     1142.79
    6        465.69     1138.92
    7        480.57     1136.99
    8        495.57     1137.02
    9        510.43     1139.01
   10        524.91     1142.93
   11        538.75     1148.71
   12        551.72     1156.25
   13        563.59     1165.42
   14        574.15     1176.07
   15        583.23     1188.01
   16        590.68     1201.03
   17        594.74     1210.98
Circle Center At X =  487.8 ; Y = 1251.2  and Radius,  114.4
      ***     2.673   ***
Failure Surface Specified By 17 Coordinate Points
  Point      X-Surf      Y-Surf
   No.        (ft)        (ft)
    1        398.95     1175.76
    2        409.60     1165.20
    3        421.52     1156.09
    4        434.50     1148.58
    5        448.34     1142.79
    6        462.81     1138.83
    7        477.66     1136.75
    8        492.66     1136.60
    9        507.56     1138.36
   10        522.10     1142.03
   11        536.06     1147.52
   12        549.20     1154.76
   13        561.30     1163.62
   14        572.16     1173.97
   15        581.62     1185.62
   16        589.49     1198.38
   17        595.19     1210.98
Circle Center At X =  486.4 ; Y = 1253.2  and Radius,  116.8
      ***     2.674   ***
Failure Surface Specified By 17 Coordinate Points
  Point      X-Surf      Y-Surf
   No.        (ft)        (ft)
    1        398.95     1175.76
    2        409.61     1165.20
    3        421.53     1156.10
    4        434.52     1148.60
    5        448.36     1142.83
    6        462.83     1138.88
    7        477.69     1136.82
    8        492.69     1136.69
    9        507.58     1138.49
   10        522.12     1142.18
   11        536.07     1147.71
   12        549.19     1154.98
   13        561.26     1163.88
```

Northeast Landfill Cross Section B-B', PH12 WB

m:\projects\16219107.00\task 3 - tier iii modification app\permit application\app c - liner and final cover system stability analysis\stabl files\nelf\2023.4.13 nelf_xs_b_ph12 wb.pl2 Run By: Username 5/11/2023



Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Piez. Surface No.
ENG FILL	1	120.0	120.0	0.0	25.0	W1
SL_FC	2	120.0	120.0	200.0	20.0	W1
FND SOIL	3	120.0	120.0	0.0	25.0	W1
C&D	4	70.0	70.0	400.0	35.0	W1
FND S-U	5	120.0	120.0	1800.0	0.0	W1

PCSTABL5M3 FSmin=2.29
Safety Factors Are Calculated By The Modified Janbu Method

**** PCSTABL5M3 ****
by Purdue University 1985
rev. for SCS Engineers HVA 2008
--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer`s Method of Slices

Run Date: 5/11/2023
Time of Run: 05:17PM
Run By: Username
Input Data Filename: M:2023.4.13 nelf_xs_b_ph12 wb.in
Output Filename: M:2023.4.13 nelf_xs_b_ph12 wb.OUT
Unit: ENGLISH
Plotted Output Filename: M:2023.4.13 nelf_xs_b_ph12 wb.PLT
PROBLEM DESCRIPTION Northeast Landfill
Cross Section B-B', PH12 WB

BOUNDARY COORDINATES
Note: User origin value specified.
Add 0.00 to X-values and 0.00 to Y-values listed.

6 Top Boundaries
19 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	341.50	1171.90	651.40	1174.70	3
2	651.40	1174.70	663.40	1178.70	2
3	663.40	1178.70	1596.50	1408.00	4
4	1596.50	1408.00	1635.60	1408.00	4
5	1635.60	1408.00	1735.70	1404.00	4
6	1735.70	1404.00	1991.20	1340.20	4
7	663.40	1178.70	807.10	1180.00	2
8	807.10	1180.00	1218.60	1181.00	2
9	1218.60	1181.00	1305.60	1206.00	2
10	1305.60	1206.00	1310.60	1206.00	2
11	1310.60	1206.00	1369.90	1186.00	2
12	1369.90	1186.00	1991.20	1184.40	2
13	651.40	1174.70	663.40	1178.40	3
14	663.40	1178.40	807.10	1176.00	3
15	807.10	1176.00	1218.60	1177.00	3
16	1218.60	1177.00	1305.60	1202.00	3
17	1305.60	1202.00	1310.60	1202.00	3
18	1310.60	1202.00	1369.90	1182.00	3
19	1369.90	1182.00	1991.20	1180.40	3

ISOTROPIC SOIL PARAMETERS
5 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	120.0	120.0	0.0	25.0	0.00	0.0	1
2	120.0	120.0	200.0	20.0	0.00	0.0	1
3	120.0	120.0	0.0	25.0	0.00	0.0	1
4	70.0	70.0	400.0	35.0	0.00	0.0	1
5	120.0	120.0	1800.0	0.0	0.00	0.0	1

1 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED
Unit Weight of Water = 62.40
Piezometric Surface No. 1 Specified by 2 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	340.80	1170.40
2	1991.20	1176.50

A Critical Failure Surface Searching Method, Using A Random Technique For Generating Sliding Block Surfaces, Has Been Specified.
1000 Trial Surfaces Have Been Generated.
8 Boxes Specified For Generation Of Central Block Base
Length Of Line Segments For Active And Passive Portions Of Sliding Block Is 20.0

Box No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Height (ft)
1	663.40	1176.70	663.50	1176.70	4.00
2	664.00	1176.70	806.50	1178.00	4.00

3	807.00	1178.00	807.10	1178.00	4.00
4	807.60	1178.00	1218.10	1179.00	4.00
5	1218.60	1179.00	1218.70	1179.00	4.00
6	1219.20	1179.00	1305.10	1204.00	4.00
7	1305.60	1204.00	1305.70	1204.00	4.00
8	1306.10	1204.00	1310.10	1204.00	4.00

Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Examined. They Are Ordered - Most Critical
First.
* * Safety Factors Are Calculated By The Modified Janbu Method * *
Failure Surface Specified By 20 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	658.70	1177.13
2	663.42	1176.33
3	678.36	1177.16
4	807.03	1177.38
5	1215.77	1179.16
6	1218.62	1180.06
7	1278.02	1195.56
8	1305.68	1203.68
9	1309.79	1205.16
10	1323.89	1219.34
11	1335.54	1235.60
12	1345.54	1252.92
13	1359.57	1267.17
14	1371.47	1283.25
15	1385.59	1297.41
16	1397.02	1313.82
17	1410.53	1328.57
18	1423.69	1343.63
19	1435.79	1359.55
20	1446.42	1371.12

*** 2.290 ***

Individual data on the 27 slices

Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Tie Force Norm (lbs)	Tie Force Tan (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Surcharge Load (lbs)
1	0.4	4.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	4.3	661.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	0.0	7.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	14.9	5479.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	53.9	49572.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6	74.8	152657.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7	0.1	195.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8	408.7	2504456.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
9	2.8	26976.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10	0.0	213.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0
11	59.4	564889.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
12	27.6	261108.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0
13	0.1	795.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0
14	4.1	38420.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15	0.8	7522.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0
16	0.0	175.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0
17	13.3	117707.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0
18	11.7	93774.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0
19	10.0	70565.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
20	14.0	86432.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
21	11.9	63318.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
22	14.1	63395.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
23	11.4	41565.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0
24	13.5	37304.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0
25	13.2	25622.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
26	12.1	13073.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
27	10.6	3332.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Failure Surface Specified By 20 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	658.70	1177.13

2	663.42	1176.33
3	678.36	1177.16
4	807.03	1177.38
5	1215.77	1179.16
6	1218.62	1180.06
7	1278.02	1195.56
8	1305.68	1203.68
9	1309.79	1205.16
10	1323.89	1219.34
11	1335.54	1235.60
12	1345.54	1252.92
13	1359.57	1267.17
14	1371.47	1283.25
15	1385.59	1297.41
16	1397.02	1313.82
17	1410.53	1328.57
18	1423.69	1343.63
19	1435.79	1359.55
20	1446.42	1371.12

*** 2.290 ***

Failure Surface Specified By 20 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	658.70	1177.13
2	663.42	1176.33
3	678.36	1177.16
4	807.03	1177.38
5	1215.77	1179.16
6	1218.62	1180.06
7	1278.02	1195.56
8	1305.68	1203.68
9	1309.79	1205.16
10	1323.89	1219.34
11	1335.54	1235.60
12	1345.54	1252.92
13	1359.57	1267.17
14	1371.47	1283.25
15	1385.59	1297.41
16	1397.02	1313.82
17	1410.53	1328.57
18	1423.69	1343.63
19	1435.79	1359.55
20	1446.42	1371.12

*** 2.290 ***

Failure Surface Specified By 20 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	658.70	1177.13
2	663.42	1176.33
3	678.36	1177.16
4	807.03	1177.38
5	1215.77	1179.16
6	1218.62	1180.06
7	1278.02	1195.56
8	1305.68	1203.68
9	1309.79	1205.16
10	1323.89	1219.34
11	1335.54	1235.60
12	1345.54	1252.92
13	1359.57	1267.17
14	1371.47	1283.25
15	1385.59	1297.41
16	1397.02	1313.82
17	1410.53	1328.57
18	1423.69	1343.63
19	1435.79	1359.55
20	1446.42	1371.12

*** 2.290 ***

Failure Surface Specified By 20 Coordinate Points

Point	X-Surf	Y-Surf

No.	(ft)	(ft)
1	658.70	1177.13
2	663.42	1176.33
3	678.36	1177.16
4	807.03	1177.38
5	1215.77	1179.16
6	1218.62	1180.06
7	1278.02	1195.56
8	1305.68	1203.68
9	1309.79	1205.16
10	1323.89	1219.34
11	1335.54	1235.60
12	1345.54	1252.92
13	1359.57	1267.17
14	1371.47	1283.25
15	1385.59	1297.41
16	1397.02	1313.82
17	1410.53	1328.57
18	1423.69	1343.63
19	1435.79	1359.55
20	1446.42	1371.12

*** 2.290 ***

Failure Surface Specified By 20 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	662.10	1178.27
2	663.50	1176.87
3	695.96	1178.05
4	807.07	1177.44
5	1154.23	1178.53
6	1218.69	1180.16
7	1295.34	1199.40
8	1305.65	1204.31
9	1306.50	1203.74
10	1317.93	1220.15
11	1331.44	1234.90
12	1344.60	1249.96
13	1356.70	1265.88
14	1370.23	1280.61
15	1384.35	1294.77
16	1396.75	1310.47
17	1409.55	1325.83
18	1419.22	1343.34
19	1432.51	1358.29
20	1440.60	1369.69

*** 2.292 ***

Failure Surface Specified By 20 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	655.33	1176.01
2	663.47	1175.96
3	720.49	1177.51
4	807.09	1177.62
5	867.31	1176.26
6	1218.61	1178.66
7	1251.74	1187.60
8	1305.63	1202.39
9	1309.49	1202.33
10	1323.16	1216.92
11	1336.28	1232.02
12	1350.06	1246.51
13	1364.10	1260.76
14	1375.48	1277.21
15	1386.78	1293.71
16	1399.72	1308.96
17	1412.77	1324.11
18	1421.02	1342.33
19	1434.89	1356.74
20	1448.17	1371.55

*** 2.293 ***

Failure Surface Specified By 20 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	655.33	1176.01
2	663.47	1175.96
3	720.49	1177.51
4	807.09	1177.62
5	867.31	1176.26
6	1218.61	1178.66
7	1251.74	1187.60
8	1305.63	1202.39
9	1309.49	1202.33
10	1323.16	1216.92
11	1336.28	1232.02
12	1350.06	1246.51
13	1364.10	1260.76
14	1375.48	1277.21
15	1386.78	1293.71
16	1399.72	1308.96
17	1412.77	1324.11
18	1421.02	1342.33
19	1434.89	1356.74
20	1448.17	1371.55

*** 2.293 ***

Failure Surface Specified By 20 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	655.33	1176.01
2	663.47	1175.96
3	720.49	1177.51
4	807.09	1177.62
5	867.31	1176.26
6	1218.61	1178.66
7	1251.74	1187.60
8	1305.63	1202.39
9	1309.49	1202.33
10	1323.16	1216.92
11	1336.28	1232.02
12	1350.06	1246.51
13	1364.10	1260.76
14	1375.48	1277.21
15	1386.78	1293.71
16	1399.72	1308.96
17	1412.77	1324.11
18	1421.02	1342.33
19	1434.89	1356.74
20	1448.17	1371.55

*** 2.293 ***

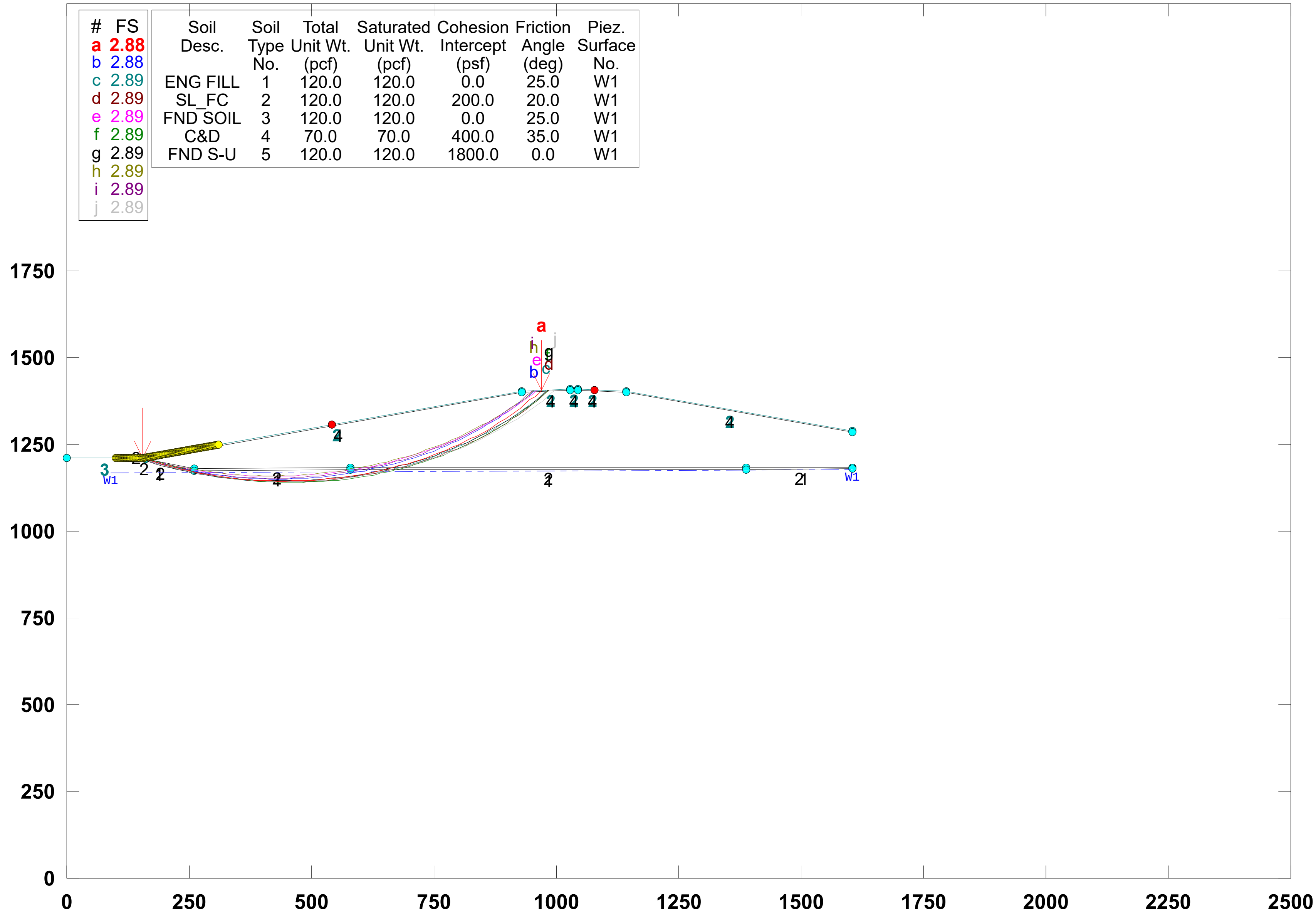
Failure Surface Specified By 20 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	655.33	1176.01
2	663.47	1175.96
3	720.49	1177.51
4	807.09	1177.62
5	867.31	1176.26
6	1218.61	1178.66
7	1251.74	1187.60
8	1305.63	1202.39
9	1309.49	1202.33
10	1323.16	1216.92
11	1336.28	1232.02
12	1350.06	1246.51
13	1364.10	1260.76
14	1375.48	1277.21
15	1386.78	1293.71
16	1399.72	1308.96
17	1412.77	1324.11
18	1421.02	1342.33
19	1434.89	1356.74

```
20        1448.17     1371.55
   ***      2.293   ***
```

Northeast Landfill Cross Section A, Circular

m:\projects\16219107.00\task 3 - tier iii modification app\permit application\app c - liner and final cover system stability analysis\stabl files\nelf\2023.4.13 nelf_xs_a_circ.pl2 Run By: Username 5/11/2023



#	FS
a	2.88
b	2.88
c	2.89
d	2.89
e	2.89
f	2.89
g	2.89
h	2.89
i	2.89
j	2.89

Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Piez. Surface No.
ENG FILL	1	120.0	120.0	0.0	25.0	W1
SL_FC	2	120.0	120.0	200.0	20.0	W1
FND SOIL	3	120.0	120.0	0.0	25.0	W1
C&D	4	70.0	70.0	400.0	35.0	W1
FND S-U	5	120.0	120.0	1800.0	0.0	W1

PCSTABL5M3 FSmin=2.88

Safety Factors Are Calculated By The Modified Bishop Method

**** PCSTABL5M3 ****

by Purdue University 1985
rev. for SCS Engineers HVA 2008
--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer`s Method of Slices

Run Date: 5/11/2023
Time of Run: 05:29PM
Run By: Username
Input Data Filename: M:2023.4.13 nelf_xs_a_circ.in
Output Filename: M:2023.4.13 nelf_xs_a_circ.OUT
Unit: ENGLISH
Plotted Output Filename: M:2023.4.13 nelf_xs_a_circ.PLT
PROBLEM DESCRIPTION Northeast Landfill
Cross Section A, Circular

BOUNDARY COORDINATES
Note: User origin value specified.
Add 0.00 to X-values and 0.00 to Y-values listed.

6 Top Boundaries
21 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	0.00	1212.00	154.70	1210.50	3
2	154.70	1210.50	928.90	1404.00	2
3	928.90	1404.00	1029.10	1408.00	2
4	1029.10	1408.00	1043.80	1408.00	2
5	1043.80	1408.00	1144.10	1404.00	2
6	1144.10	1404.00	1603.40	1289.90	2
7	154.70	1210.50	160.70	1210.50	2
8	160.70	1210.50	162.30	1209.40	2
9	162.30	1209.40	928.90	1401.00	4
10	928.90	1401.00	1029.10	1405.00	4
11	1029.10	1405.00	1043.80	1405.00	4
12	1043.80	1405.00	1144.10	1401.00	4
13	1144.10	1401.00	1603.40	1286.90	4
14	162.30	1209.40	261.10	1179.40	2
15	261.10	1179.40	579.00	1182.30	2
16	579.00	1182.30	1386.40	1182.10	2
17	1386.40	1182.10	1603.40	1184.20	2
18	154.70	1210.50	261.10	1175.40	1
19	261.10	1175.40	579.00	1178.30	1
20	579.00	1178.30	1386.40	1178.10	1
21	1386.40	1178.10	1603.40	1180.20	1

ISOTROPIC SOIL PARAMETERS
5 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	120.0	120.0	0.0	25.0	0.00	0.0	1
2	120.0	120.0	200.0	20.0	0.00	0.0	1
3	120.0	120.0	0.0	25.0	0.00	0.0	1
4	70.0	70.0	400.0	35.0	0.00	0.0	1
5	120.0	120.0	1800.0	0.0	0.00	0.0	1

1 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED
Unit Weight of Water = 62.40
Piezometric Surface No. 1 Specified by 2 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	88.50	1168.30
2	1603.40	1177.60

A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Circular Surfaces, Has Been Specified.
10000 Trial Surfaces Have Been Generated.
100 Surfaces Initiate From Each Of100 Points Equally Spaced
Along The Ground Surface Between X = 100.00 ft.
and X = 310.00 ft.
Each Surface Terminates Between X = 541.50 ft.
and X =1078.00 ft.
Unless Further Limitations Were Imposed, The Minimum Elevation

At Which A Surface Extends Is Y = 0.00 ft.
15.00 ft. Line Segments Define Each Trial Failure Surface.
Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Examined. They Are Ordered - Most Critical
First.
* * Safety Factors Are Calculated By The Modified Bishop Method * *
Failure Surface Specified By 62 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	155.15	1210.61
2	168.72	1204.22
3	182.43	1198.14
4	196.28	1192.37
5	210.25	1186.91
6	224.34	1181.78
7	238.55	1176.96
8	252.86	1172.47
9	267.27	1168.31
10	281.78	1164.47
11	296.36	1160.97
12	311.02	1157.80
13	325.75	1154.96
14	340.54	1152.45
15	355.38	1150.29
16	370.27	1148.46
17	385.20	1146.97
18	400.15	1145.82
19	415.13	1145.01
20	430.12	1144.54
21	445.12	1144.41
22	460.12	1144.62
23	475.11	1145.17
24	490.08	1146.06
25	505.03	1147.30
26	519.95	1148.87
27	534.83	1150.78
28	549.66	1153.03
29	564.44	1155.61
30	579.15	1158.53
31	593.79	1161.78
32	608.36	1165.37
33	622.84	1169.28
34	637.22	1173.52
35	651.51	1178.09
36	665.69	1182.98
37	679.76	1188.19
38	693.70	1193.73
39	707.51	1199.57
40	721.19	1205.73
41	734.73	1212.20
42	748.11	1218.97
43	761.34	1226.05
44	774.40	1233.42
45	787.29	1241.09
46	800.00	1249.05
47	812.53	1257.30
48	824.87	1265.82
49	837.01	1274.63
50	848.95	1283.71
51	860.68	1293.06
52	872.20	1302.68
53	883.49	1312.55
54	894.56	1322.68
55	905.39	1333.05
56	915.98	1343.67
57	926.33	1354.53
58	936.43	1365.62
59	946.28	1376.93
60	955.87	1388.47
61	965.19	1400.22

62 969.27 1405.61
Circle Center At X = 443.3 ; Y = 1804.5 and Radius, 660.1
*** 2.882 ***
Individual data on the 73 slices

Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Tie Force Norm (lbs)	Tie Force Tan (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Surcharge Load (lbs)
1	0.2	2.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	1.6	146.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	3.7	1182.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	1.6	878.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	6.4	5185.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6	13.7	18884.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7	13.8	29358.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8	14.0	39488.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0
9	14.1	49241.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10	14.2	58581.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
11	14.3	67479.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0
12	8.2	42442.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
13	2.5	13343.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
14	3.7	20415.8	0.0	130.4	0.0	0.0	0.0	0.0	0.0
15	14.5	86871.5	0.0	2855.5	0.0	0.0	0.0	0.0	0.0
16	14.6	97602.0	0.0	6374.2	0.0	0.0	0.0	0.0	0.0
17	14.7	107831.6	0.0	9583.0	0.0	0.0	0.0	0.0	0.0
18	14.7	117531.7	0.0	12480.6	0.0	0.0	0.0	0.0	0.0
19	14.8	126674.5	0.0	15065.3	0.0	0.0	0.0	0.0	0.0
20	14.8	135236.0	0.0	17336.0	0.0	0.0	0.0	0.0	0.0
21	14.9	143191.4	0.0	19291.3	0.0	0.0	0.0	0.0	0.0
22	14.9	150520.8	0.0	20930.2	0.0	0.0	0.0	0.0	0.0
23	15.0	157204.2	0.0	22251.8	0.0	0.0	0.0	0.0	0.0
24	15.0	163225.4	0.0	23255.8	0.0	0.0	0.0	0.0	0.0
25	15.0	168569.3	0.0	23941.3	0.0	0.0	0.0	0.0	0.0
26	15.0	173223.2	0.0	24308.0	0.0	0.0	0.0	0.0	0.0
27	15.0	177176.9	0.0	24355.8	0.0	0.0	0.0	0.0	0.0
28	15.0	180422.4	0.0	24084.5	0.0	0.0	0.0	0.0	0.0
29	15.0	182954.2	0.0	23494.5	0.0	0.0	0.0	0.0	0.0
30	14.9	184768.3	0.0	22586.1	0.0	0.0	0.0	0.0	0.0
31	14.9	185863.8	0.0	21359.6	0.0	0.0	0.0	0.0	0.0
32	14.9	186241.7	0.0	19815.8	0.0	0.0	0.0	0.0	0.0
33	14.8	185905.5	0.0	17955.4	0.0	0.0	0.0	0.0	0.0
34	14.8	184860.3	0.0	15779.1	0.0	0.0	0.0	0.0	0.0
35	14.6	181274.5	0.0	13167.7	0.0	0.0	0.0	0.0	0.0
36	0.1	1840.3	0.0	120.8	0.0	0.0	0.0	0.0	0.0
37	14.6	180626.7	0.0	10484.4	0.0	0.0	0.0	0.0	0.0
38	14.6	177412.3	0.0	7368.8	0.0	0.0	0.0	0.0	0.0
39	14.5	173536.2	0.0	3942.9	0.0	0.0	0.0	0.0	0.0
40	8.0	94031.2	0.0	595.9	0.0	0.0	0.0	0.0	0.0
41	6.4	74984.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
42	14.3	163868.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
43	0.6	6264.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0
44	11.6	129412.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
45	2.0	22475.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
46	14.1	154111.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
47	13.9	150947.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
48	13.8	147402.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
49	13.7	143489.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0
50	13.5	139225.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0
51	13.4	134627.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0
52	13.2	129713.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
53	13.1	124501.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
54	12.9	119011.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0
55	12.7	113265.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0
56	12.5	107284.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
57	12.3	101092.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
58	12.1	94711.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0
59	11.9	88166.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0
60	11.7	81482.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0
61	11.5	74685.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
62	11.3	67800.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0

63	11.1	60854.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0
64	10.8	53875.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
65	10.6	46889.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0
66	10.4	39926.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
67	2.6	8966.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0
68	7.5	23629.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
69	9.8	24374.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0
70	9.6	16324.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
71	9.3	8522.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
72	1.7	761.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
73	2.3	421.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Failure Surface Specified By 61 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	155.15	1210.61
2	168.87	1204.54
3	182.71	1198.77
4	196.69	1193.32
5	210.78	1188.18
6	224.99	1183.37
7	239.30	1178.87
8	253.71	1174.70
9	268.20	1170.86
10	282.79	1167.34
11	297.44	1164.15
12	312.17	1161.29
13	326.96	1158.77
14	341.80	1156.58
15	356.68	1154.73
16	371.60	1153.21
17	386.56	1152.03
18	401.53	1151.18
19	416.52	1150.68
20	431.52	1150.51
21	446.52	1150.68
22	461.51	1151.19
23	476.49	1152.04
24	491.44	1153.22
25	506.37	1154.74
26	521.25	1156.60
27	536.09	1158.79
28	550.87	1161.32
29	565.60	1164.18
30	580.26	1167.37
31	594.84	1170.89
32	609.34	1174.74
33	623.74	1178.91
34	638.05	1183.41
35	652.26	1188.23
36	666.35	1193.37
37	680.32	1198.82
38	694.17	1204.59
39	707.88	1210.67
40	721.46	1217.06
41	734.88	1223.75
42	748.15	1230.74
43	761.26	1238.03
44	774.20	1245.61
45	786.97	1253.49
46	799.56	1261.65
47	811.96	1270.09
48	824.16	1278.80
49	836.17	1287.80
50	847.97	1297.06
51	859.56	1306.58
52	870.93	1316.36
53	882.08	1326.40
54	892.99	1336.68
55	903.68	1347.21
56	914.12	1357.98

57	924.32	1368.98
58	934.27	1380.21
59	943.96	1391.66
60	953.39	1403.32
61	954.71	1405.03

Circle Center At X = 431.5 ; Y = 1815.7 and Radius, 665.2

*** 2.884 ***

Failure Surface Specified By 63 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	150.91	1210.54
2	164.46	1204.10
3	178.15	1197.96
4	191.97	1192.13
5	205.91	1186.62
6	219.98	1181.41
7	234.16	1176.52
8	248.45	1171.95
9	262.83	1167.70
10	277.31	1163.76
11	291.87	1160.16
12	306.51	1156.88
13	321.21	1153.92
14	335.98	1151.30
15	350.80	1149.01
16	365.68	1147.04
17	380.59	1145.41
18	395.53	1144.12
19	410.50	1143.15
20	425.49	1142.52
21	440.48	1142.23
22	455.48	1142.27
23	470.48	1142.64
24	485.46	1143.35
25	500.43	1144.40
26	515.36	1145.78
27	530.26	1147.49
28	545.12	1149.53
29	559.94	1151.90
30	574.69	1154.61
31	589.38	1157.64
32	604.00	1161.00
33	618.54	1164.68
34	632.99	1168.69
35	647.36	1173.02
36	661.62	1177.67
37	675.77	1182.64
38	689.81	1187.92
39	703.73	1193.51
40	717.52	1199.42
41	731.17	1205.63
42	744.69	1212.14
43	758.05	1218.95
44	771.26	1226.06
45	784.30	1233.46
46	797.18	1241.15
47	809.89	1249.13
48	822.41	1257.39
49	834.74	1265.92
50	846.89	1274.73
51	858.83	1283.81
52	870.56	1293.15
53	882.09	1302.75
54	893.40	1312.60
55	904.48	1322.71
56	915.34	1333.06
57	925.96	1343.65
58	936.34	1354.48
59	946.48	1365.53
60	956.37	1376.81

61	966.01	1388.30
62	975.39	1400.01
63	980.00	1406.04

Circle Center At X = 446.2 ; Y = 1814.3 and Radius, 672.1

*** 2.885 ***

Failure Surface Specified By 63 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	155.15	1210.61
2	168.70	1204.17
3	182.38	1198.02
4	196.20	1192.19
5	210.14	1186.66
6	224.21	1181.45
7	238.39	1176.55
8	252.67	1171.97
9	267.05	1167.70
10	281.52	1163.76
11	296.08	1160.14
12	310.71	1156.85
13	325.42	1153.89
14	340.19	1151.25
15	355.01	1148.94
16	369.88	1146.97
17	384.79	1145.32
18	399.73	1144.01
19	414.70	1143.03
20	429.68	1142.39
21	444.68	1142.08
22	459.68	1142.10
23	474.67	1142.46
24	489.66	1143.15
25	504.62	1144.18
26	519.56	1145.54
27	534.47	1147.23
28	549.33	1149.26
29	564.14	1151.61
30	578.90	1154.30
31	593.59	1157.31
32	608.22	1160.65
33	622.76	1164.31
34	637.22	1168.30
35	651.59	1172.61
36	665.86	1177.24
37	680.02	1182.19
38	694.07	1187.45
39	707.99	1193.02
40	721.79	1198.90
41	735.46	1205.09
42	748.98	1211.58
43	762.36	1218.37
44	775.58	1225.45
45	788.64	1232.83
46	801.53	1240.50
47	814.25	1248.45
48	826.78	1256.69
49	839.13	1265.20
50	851.29	1273.99
51	863.25	1283.04
52	875.01	1292.36
53	886.55	1301.94
54	897.88	1311.77
55	908.98	1321.86
56	919.86	1332.18
57	930.50	1342.75
58	940.91	1353.56
59	951.07	1364.59
60	960.99	1375.84
61	970.65	1387.32
62	980.05	1399.01

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   63        985.63     1406.26
Circle Center At X =  451.1 ; Y = 1815.0  and Radius,  672.9
      ***      2.885   ***
Failure Surface Specified By 60 Coordinate Points
  Point      X-Surf      Y-Surf
   No.        (ft)        (ft)
    1        155.15     1210.61
    2        169.10     1205.09
    3        183.16     1199.87
    4        197.33     1194.94
    5        211.60     1190.32
    6        225.96     1186.00
    7        240.42     1181.99
    8        254.95     1178.28
    9        269.56     1174.88
   10        284.24     1171.80
   11        298.98     1169.02
   12        313.78     1166.56
   13        328.62     1164.41
   14        343.51     1162.58
   15        358.43     1161.06
   16        373.39     1159.86
   17        388.36     1158.98
   18        403.35     1158.41
   19        418.35     1158.17
   20        433.35     1158.24
   21        448.34     1158.63
   22        463.32     1159.33
   23        478.29     1160.36
   24        493.23     1161.70
   25        508.14     1163.36
   26        523.01     1165.33
   27        537.83     1167.62
   28        552.60     1170.22
   29        567.32     1173.13
   30        581.97     1176.36
   31        596.55     1179.90
   32        611.04     1183.74
   33        625.46     1187.89
   34        639.78     1192.35
   35        654.01     1197.10
   36        668.13     1202.16
   37        682.14     1207.52
   38        696.03     1213.17
   39        709.80     1219.12
   40        723.45     1225.35
   41        736.95     1231.88
   42        750.32     1238.69
   43        763.54     1245.78
   44        776.60     1253.15
   45        789.51     1260.79
   46        802.25     1268.71
   47        814.82     1276.90
   48        827.21     1285.35
   49        839.42     1294.06
   50        851.45     1303.02
   51        863.28     1312.24
   52        874.91     1321.71
   53        886.34     1331.43
   54        897.56     1341.38
   55        908.57     1351.57
   56        919.36     1361.99
   57        929.93     1372.64
   58        940.26     1383.51
   59        950.37     1394.59
   60        959.66     1405.23
Circle Center At X =  422.5 ; Y = 1865.6  and Radius,  707.5
      ***      2.887   ***
Failure Surface Specified By 63 Coordinate Points
  Point      X-Surf      Y-Surf
```

No.	(ft)	(ft)
1	161.52	1212.20
2	174.94	1205.51
3	188.51	1199.12
4	202.23	1193.05
5	216.08	1187.30
6	230.06	1181.87
7	244.17	1176.76
8	258.39	1171.98
9	272.71	1167.53
10	287.13	1163.41
11	301.65	1159.63
12	316.25	1156.18
13	330.92	1153.06
14	345.66	1150.29
15	360.46	1147.86
16	375.32	1145.77
17	390.21	1144.02
18	405.15	1142.62
19	420.11	1141.57
20	435.09	1140.85
21	450.09	1140.49
22	465.09	1140.47
23	480.09	1140.79
24	495.07	1141.47
25	510.04	1142.48
26	524.97	1143.85
27	539.88	1145.55
28	554.74	1147.60
29	569.54	1150.00
30	584.29	1152.73
31	598.98	1155.80
32	613.58	1159.21
33	628.11	1162.96
34	642.54	1167.04
35	656.88	1171.45
36	671.11	1176.20
37	685.22	1181.27
38	699.22	1186.66
39	713.09	1192.38
40	726.82	1198.41
41	740.41	1204.76
42	753.85	1211.42
43	767.14	1218.39
44	780.25	1225.66
45	793.20	1233.24
46	805.97	1241.11
47	818.55	1249.27
48	830.95	1257.72
49	843.14	1266.46
50	855.13	1275.47
51	866.91	1284.76
52	878.47	1294.32
53	889.80	1304.14
54	900.91	1314.22
55	911.78	1324.56
56	922.41	1335.14
57	932.80	1345.96
58	942.93	1357.03
59	952.80	1368.32
60	962.41	1379.84
61	971.75	1391.57
62	980.82	1403.52
63	982.72	1406.15

Circle Center At X = 458.5 ; Y = 1790.6 and Radius, 650.1

*** 2.889 ***

Failure Surface Specified By 64 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	142.42	1210.62

2	156.08	1204.40
3	169.86	1198.48
4	183.76	1192.85
5	197.78	1187.53
6	211.92	1182.50
7	226.16	1177.79
8	240.49	1173.37
9	254.92	1169.27
10	269.43	1165.48
11	284.03	1162.00
12	298.69	1158.84
13	313.42	1155.99
14	328.20	1153.46
15	343.04	1151.24
16	357.92	1149.35
17	372.83	1147.77
18	387.78	1146.52
19	402.75	1145.58
20	417.74	1144.97
21	432.74	1144.69
22	447.74	1144.72
23	462.73	1145.07
24	477.72	1145.75
25	492.68	1146.75
26	507.62	1148.07
27	522.53	1149.71
28	537.41	1151.67
29	552.23	1153.95
30	567.00	1156.55
31	581.72	1159.47
32	596.37	1162.69
33	610.94	1166.24
34	625.44	1170.09
35	639.85	1174.26
36	654.16	1178.74
37	668.38	1183.52
38	682.49	1188.60
39	696.49	1193.99
40	710.37	1199.68
41	724.13	1205.66
42	737.75	1211.94
43	751.24	1218.51
44	764.58	1225.37
45	777.77	1232.51
46	790.80	1239.93
47	803.67	1247.63
48	816.38	1255.61
49	828.90	1263.86
50	841.25	1272.37
51	853.42	1281.15
52	865.39	1290.19
53	877.16	1299.48
54	888.74	1309.03
55	900.10	1318.82
56	911.25	1328.85
57	922.19	1339.12
58	932.90	1349.62
59	943.38	1360.35
60	953.63	1371.30
61	963.64	1382.47
62	973.41	1393.85
63	982.94	1405.44
64	983.52	1406.18

Circle Center At X = 438.7 ; Y = 1843.0 and Radius, 698.3

*** 2.890 ***

Failure Surface Specified By 60 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	153.03	1210.52
2	167.02	1205.11

3	181.12	1199.99
4	195.33	1195.18
5	209.63	1190.66
6	224.03	1186.45
7	238.51	1182.53
8	253.07	1178.93
9	267.70	1175.63
10	282.40	1172.64
11	297.16	1169.96
12	311.97	1167.59
13	326.83	1165.53
14	341.73	1163.79
15	356.66	1162.36
16	371.62	1161.24
17	386.60	1160.44
18	401.59	1159.95
19	416.59	1159.78
20	431.59	1159.93
21	446.58	1160.39
22	461.56	1161.16
23	476.52	1162.25
24	491.45	1163.66
25	506.36	1165.37
26	521.22	1167.41
27	536.03	1169.75
28	550.80	1172.40
29	565.50	1175.37
30	580.14	1178.64
31	594.71	1182.22
32	609.19	1186.10
33	623.60	1190.29
34	637.91	1194.79
35	652.12	1199.58
36	666.23	1204.67
37	680.23	1210.05
38	694.12	1215.73
39	707.88	1221.70
40	721.51	1227.95
41	735.01	1234.50
42	748.37	1241.32
43	761.58	1248.42
44	774.64	1255.80
45	787.54	1263.46
46	800.28	1271.38
47	812.84	1279.57
48	825.23	1288.02
49	837.45	1296.73
50	849.47	1305.70
51	861.31	1314.91
52	872.95	1324.38
53	884.38	1334.08
54	895.61	1344.02
55	906.63	1354.20
56	917.43	1364.61
57	928.02	1375.24
58	938.37	1386.09
59	948.49	1397.16
60	955.42	1405.06

Circle Center At X = 417.2 ; Y = 1872.9 and Radius, 713.1

***   2.890   ***

Failure Surface Specified By 61 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	146.67	1210.58
2	160.46	1204.68
3	174.38	1199.10
4	188.42	1193.81
5	202.57	1188.84
6	216.83	1184.18
7	231.19	1179.84

8	245.64	1175.81
9	260.17	1172.10
10	274.78	1168.71
11	289.46	1165.64
12	304.21	1162.89
13	319.01	1160.47
14	333.87	1158.37
15	348.76	1156.60
16	363.69	1155.16
17	378.65	1154.05
18	393.63	1153.26
19	408.62	1152.81
20	423.62	1152.68
21	438.62	1152.88
22	453.61	1153.41
23	468.59	1154.28
24	483.54	1155.47
25	498.46	1156.98
26	513.35	1158.83
27	528.19	1161.00
28	542.98	1163.50
29	557.71	1166.32
30	572.38	1169.46
31	586.97	1172.93
32	601.49	1176.71
33	615.92	1180.82
34	630.25	1185.24
35	644.49	1189.97
36	658.61	1195.01
37	672.62	1200.37
38	686.52	1206.03
39	700.28	1211.99
40	713.91	1218.25
41	727.40	1224.82
42	740.74	1231.67
43	753.93	1238.82
44	766.95	1246.26
45	779.81	1253.98
46	792.50	1261.98
47	805.01	1270.25
48	817.34	1278.80
49	829.47	1287.62
50	841.41	1296.70
51	853.14	1306.05
52	864.67	1315.65
53	875.98	1325.49
54	887.08	1335.59
55	897.95	1345.93
56	908.59	1356.50
57	918.99	1367.30
58	929.16	1378.33
59	939.08	1389.58
60	948.75	1401.05
61	951.88	1404.92

Circle Center At X = 421.9 ; Y = 1835.7 and Radius, 683.0

*** 2.891 ***

Failure Surface Specified By 64 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	148.79	1210.56
2	162.42	1204.29
3	176.18	1198.32
4	190.06	1192.65
5	204.06	1187.27
6	218.18	1182.19
7	232.40	1177.41
8	246.72	1172.94
9	261.12	1168.77
10	275.62	1164.91
11	290.19	1161.36

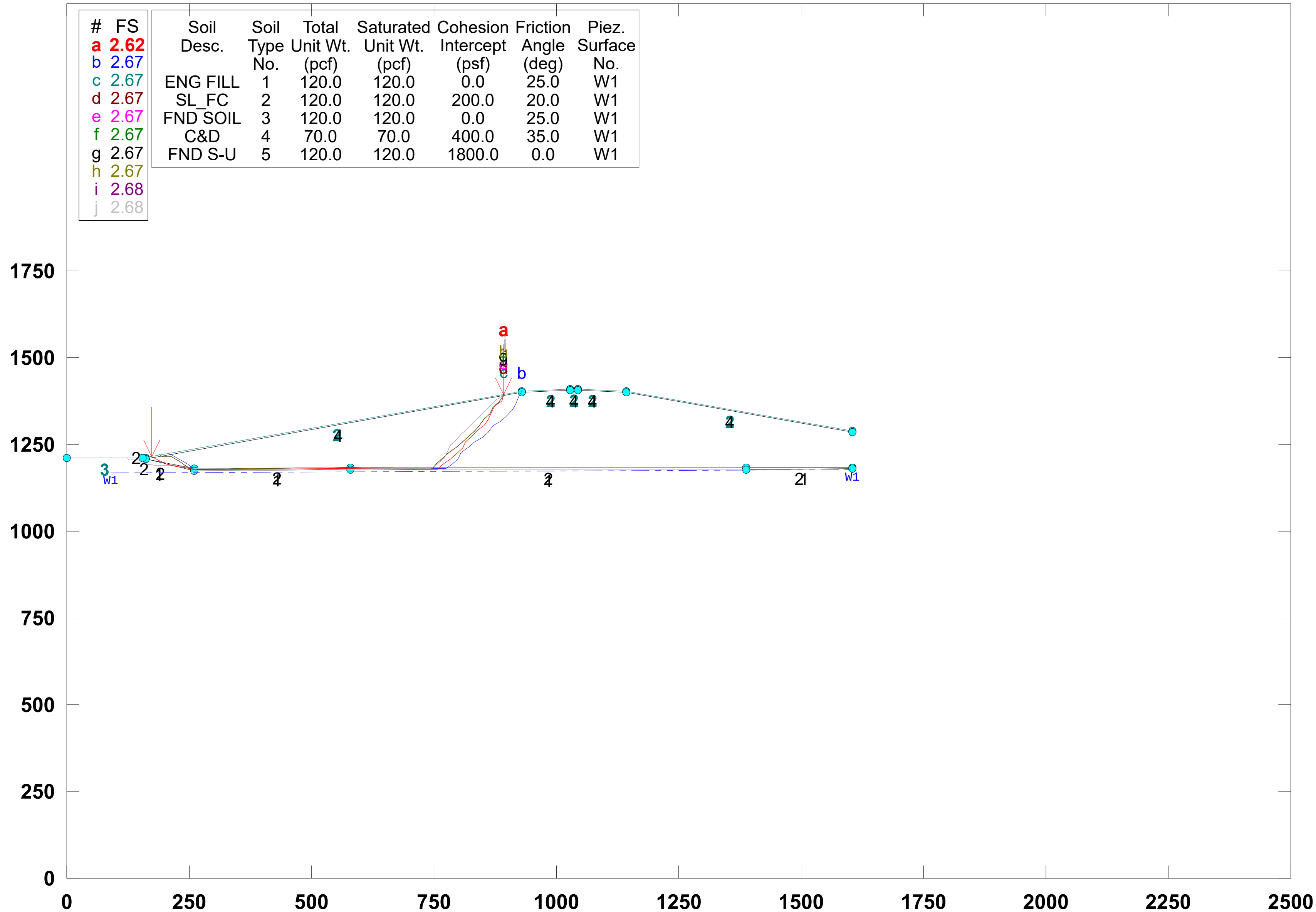
12	304.84	1158.13
13	319.55	1155.20
14	334.33	1152.60
15	349.15	1150.30
16	364.02	1148.33
17	378.93	1146.67
18	393.87	1145.33
19	408.83	1144.30
20	423.81	1143.60
21	438.81	1143.22
22	453.81	1143.16
23	468.81	1143.41
24	483.80	1143.99
25	498.77	1144.89
26	513.72	1146.10
27	528.64	1147.64
28	543.53	1149.49
29	558.37	1151.66
30	573.16	1154.15
31	587.90	1156.95
32	602.57	1160.06
33	617.17	1163.49
34	631.70	1167.22
35	646.15	1171.27
36	660.50	1175.62
37	674.76	1180.28
38	688.91	1185.24
39	702.96	1190.51
40	716.89	1196.07
41	730.70	1201.92
42	744.38	1208.07
43	757.93	1214.51
44	771.34	1221.24
45	784.60	1228.25
46	797.70	1235.55
47	810.65	1243.12
48	823.44	1250.96
49	836.05	1259.08
50	848.49	1267.46
51	860.75	1276.11
52	872.82	1285.02
53	884.69	1294.18
54	896.37	1303.59
55	907.85	1313.25
56	919.11	1323.16
57	930.17	1333.30
58	941.00	1343.67
59	951.61	1354.27
60	961.99	1365.10
61	972.14	1376.15
62	982.05	1387.41
63	991.72	1398.87
64	998.09	1406.76

Circle Center At X = 449.2 ; Y = 1846.3 and Radius, 703.2

*** 2.892 ***

Northeast Landfill Cross Section A-A', WB

m:\projects\16219107.00\task 3 - tier iii modification app\permit application\app c - liner and final cover system stability analysis\stabl files\nelf\2023.4.13 nelf_xs_a_wb.pl2 Run By: Username 5/11/2023 0



PCSTABL5M3 FSmin=2.62
Safety Factors Are Calculated By The Modified Janbu Method

**** PCSTABL5M3 ****

by Purdue University 1985
rev. for SCS Engineers HVA 2008
--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer`s Method of Slices

Run Date: 5/11/2023
Time of Run: 05:33PM
Run By: Username
Input Data Filename: M:2023.4.13 nelf_xs_a_wb.in
Output Filename: M:2023.4.13 nelf_xs_a_wb.OUT
Unit: ENGLISH
Plotted Output Filename: M:2023.4.13 nelf_xs_a_wb.PLT
PROBLEM DESCRIPTION Northeast Landfill
Cross Section A-A', WB

BOUNDARY COORDINATES
Note: User origin value specified.
Add 0.00 to X-values and 0.00 to Y-values listed.

6 Top Boundaries
21 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	0.00	1212.00	154.70	1210.50	3
2	154.70	1210.50	928.90	1404.00	2
3	928.90	1404.00	1029.10	1408.00	2
4	1029.10	1408.00	1043.80	1408.00	2
5	1043.80	1408.00	1144.10	1404.00	2
6	1144.10	1404.00	1603.40	1289.90	2
7	154.70	1210.50	160.70	1210.50	2
8	160.70	1210.50	162.30	1209.40	2
9	162.30	1209.40	928.90	1401.00	4
10	928.90	1401.00	1029.10	1405.00	4
11	1029.10	1405.00	1043.80	1405.00	4
12	1043.80	1405.00	1144.10	1401.00	4
13	1144.10	1401.00	1603.40	1286.90	4
14	162.30	1209.40	261.10	1179.40	2
15	261.10	1179.40	579.00	1182.30	2
16	579.00	1182.30	1386.40	1182.10	2
17	1386.40	1182.10	1603.40	1184.20	2
18	154.70	1210.50	261.10	1175.40	1
19	261.10	1175.40	579.00	1178.30	1
20	579.00	1178.30	1386.40	1178.10	1
21	1386.40	1178.10	1603.40	1180.20	1

ISOTROPIC SOIL PARAMETERS
5 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	120.0	120.0	0.0	25.0	0.00	0.0	1
2	120.0	120.0	200.0	20.0	0.00	0.0	1
3	120.0	120.0	0.0	25.0	0.00	0.0	1
4	70.0	70.0	400.0	35.0	0.00	0.0	1
5	120.0	120.0	1800.0	0.0	0.00	0.0	1

1 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED
Unit Weight of Water = 62.40
Piezometric Surface No. 1 Specified by 2 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	88.50	1168.30
2	1603.40	1177.60

A Critical Failure Surface Searching Method, Using A Random Technique For Generating Sliding Block Surfaces, Has Been Specified.
1000 Trial Surfaces Have Been Generated.
4 Boxes Specified For Generation Of Central Block Base
Length Of Line Segments For Active And Passive Portions Of Sliding Block Is 20.0

Box No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Height (ft)

1	261.10	1177.40	261.20	1177.40	4.00
2	261.70	1177.40	579.00	1180.30	4.00
3	579.50	1180.30	579.60	1180.30	4.00
4	580.10	1180.30	1386.40	1180.10	4.00

Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Examined. They Are Ordered - Most Critical
First.
* * Safety Factors Are Calculated By The Modified Janbu Method * *
Failure Surface Specified By 23 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	174.52	1215.45
2	187.03	1203.80
3	203.14	1191.94
4	221.93	1185.09
5	241.80	1182.84
6	261.14	1177.73
7	535.83	1179.10
8	579.55	1180.60
9	756.23	1178.26
10	768.63	1193.95
11	782.36	1208.50
12	794.99	1224.01
13	807.22	1239.84
14	814.92	1258.29
15	827.94	1273.48
16	838.85	1290.24
17	852.77	1304.60
18	861.84	1322.43
19	866.03	1341.98
20	874.71	1360.00
21	888.51	1374.48
22	890.88	1394.33
23	890.99	1394.53

*** 2.623 ***

Individual data on the 30 slices

Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Tie Force Norm (lbs)	Tie Force Tan (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Surcharge Load (lbs)
1	2.5	457.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	10.0	7706.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	4.4	5903.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	5.3	9264.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	6.3	14347.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6	18.8	56031.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7	14.9	52757.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8	4.9	18252.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
9	19.3	78330.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10	0.0	185.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
11	274.7	1860341.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
12	43.2	408143.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
13	0.5	5340.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
14	176.7	2022270.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15	3.2	40755.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
16	9.2	114458.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
17	13.7	160001.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
18	12.6	136980.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
19	12.2	121739.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
20	7.7	68849.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
21	13.0	103285.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
22	10.9	76737.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
23	13.9	85708.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
24	9.1	47429.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
25	4.2	16921.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
26	8.7	24638.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
27	13.8	26163.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
28	2.0	1888.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
29	0.3	66.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
30	0.1	1.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Failure Surface Specified By 22 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	209.10	1224.10
2	216.28	1217.10
3	231.72	1204.40
4	246.95	1191.43
5	261.18	1177.37
6	475.56	1177.86
7	579.56	1179.46
8	773.16	1179.54
9	787.30	1193.68
10	800.15	1209.01
11	806.65	1227.92
12	819.84	1242.96
13	833.88	1257.20
14	847.95	1271.41
15	861.56	1286.07
16	871.81	1303.24
17	885.83	1317.50
18	898.82	1332.71
19	910.31	1349.08
20	918.25	1367.44
21	924.17	1386.54
22	929.63	1404.03

*** 2.667 ***

Failure Surface Specified By 23 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	190.29	1219.39
2	194.14	1215.72
3	214.13	1214.99
4	228.28	1200.86
5	243.48	1187.86
6	261.11	1178.42
7	358.28	1179.76
8	579.58	1182.22
9	746.00	1178.98
10	756.99	1195.69
11	767.77	1212.53
12	781.91	1226.68
13	795.10	1241.72
14	808.11	1256.90
15	819.94	1273.03
16	834.07	1287.18
17	841.90	1305.58
18	853.32	1322.01
19	864.02	1338.90
20	870.30	1357.89
21	884.17	1372.29
22	890.95	1391.11
23	893.45	1395.14

*** 2.673 ***

Failure Surface Specified By 23 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	190.29	1219.39
2	194.14	1215.72
3	214.13	1214.99
4	228.28	1200.86
5	243.48	1187.86
6	261.11	1178.42
7	358.28	1179.76
8	579.58	1182.22
9	746.00	1178.98
10	756.99	1195.69
11	767.77	1212.53
12	781.91	1226.68
13	795.10	1241.72
14	808.11	1256.90

15	819.94	1273.03
16	834.07	1287.18
17	841.90	1305.58
18	853.32	1322.01
19	864.02	1338.90
20	870.30	1357.89
21	884.17	1372.29
22	890.95	1391.11
23	893.45	1395.14

*** 2.673 ***

Failure Surface Specified By 23 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	190.29	1219.39
2	194.14	1215.72
3	214.13	1214.99
4	228.28	1200.86
5	243.48	1187.86
6	261.11	1178.42
7	358.28	1179.76
8	579.58	1182.22
9	746.00	1178.98
10	756.99	1195.69
11	767.77	1212.53
12	781.91	1226.68
13	795.10	1241.72
14	808.11	1256.90
15	819.94	1273.03
16	834.07	1287.18
17	841.90	1305.58
18	853.32	1322.01
19	864.02	1338.90
20	870.30	1357.89
21	884.17	1372.29
22	890.95	1391.11
23	893.45	1395.14

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9	746.00	1178.98
10	756.99	1195.69
11	767.77	1212.53
12	781.91	1226.68
13	795.10	1241.72
14	808.11	1256.90
15	819.94	1273.03
16	834.07	1287.18
17	841.90	1305.58
18	853.32	1322.01
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22	890.95	1391.11
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Failure Surface Specified By 23 Coordinate Points

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1	190.29	1219.39
2	194.14	1215.72
3	214.13	1214.99

4	228.28	1200.86
5	243.48	1187.86
6	261.11	1178.42
7	358.28	1179.76
8	579.58	1182.22
9	746.00	1178.98
10	756.99	1195.69
11	767.77	1212.53
12	781.91	1226.68
13	795.10	1241.72
14	808.11	1256.90
15	819.94	1273.03
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17	841.90	1305.58
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19	864.02	1338.90
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Failure Surface Specified By 23 Coordinate Points

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15	819.94	1273.03
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19	864.02	1338.90
20	870.30	1357.89
21	884.17	1372.29
22	890.95	1391.11
23	893.45	1395.14

*** 2.673 ***

Failure Surface Specified By 26 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	122.56	1210.81
2	128.16	1205.31
3	148.12	1204.07
4	163.73	1191.56
5	183.65	1189.76
6	203.64	1189.21
7	223.64	1189.07
8	243.09	1184.40
9	261.12	1175.75
10	526.23	1178.57
11	579.57	1180.93
12	744.42	1180.63
13	757.72	1195.57
14	771.86	1209.72
15	776.30	1229.22
16	783.80	1247.76
17	796.06	1263.56
18	806.78	1280.44
19	819.01	1296.27

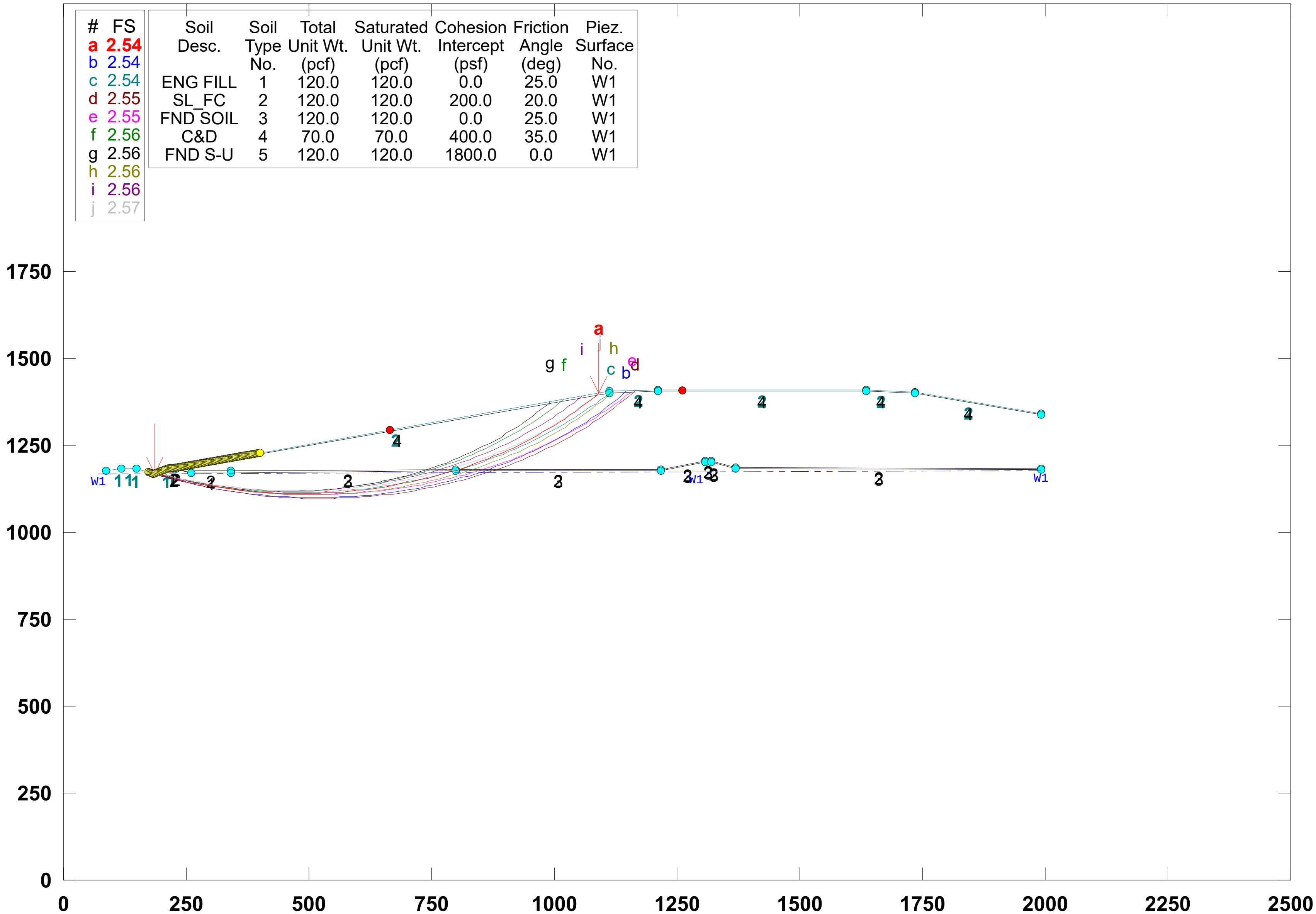
20	829.31	1313.41
21	843.39	1327.61
22	852.25	1345.54
23	864.68	1361.21
24	877.08	1376.90
25	891.20	1391.07
26	895.74	1395.71
***	2.676	***

Failure Surface Specified By 26 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	122.56	1210.81
2	128.16	1205.31
3	148.12	1204.07
4	163.73	1191.56
5	183.65	1189.76
6	203.64	1189.21
7	223.64	1189.07
8	243.09	1184.40
9	261.12	1175.75
10	526.23	1178.57
11	579.57	1180.93
12	744.42	1180.63
13	757.72	1195.57
14	771.86	1209.72
15	776.30	1229.22
16	783.80	1247.76
17	796.06	1263.56
18	806.78	1280.44
19	819.01	1296.27
20	829.31	1313.41
21	843.39	1327.61
22	852.25	1345.54
23	864.68	1361.21
24	877.08	1376.90
25	891.20	1391.07
26	895.74	1395.71
***	2.676	***

Northeast Landfill Cross Section B, Circular

m:\projects\16219107.00\task 3 - tier iii modification app\permit application\app c - liner and final cover system stability analysis\stabl files\nelf\2023.4.13 nelf_xs_b_circ.pl2 Run By: Username 5/11/2023 0



PCSTABL5M3 FSmin=2.54

Safety Factors Are Calculated By The Modified Bishop Method

**** PCSTABL5M3 ****

by Purdue University 1985
rev. for SCS Engineers HVA 2008
--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer`s Method of Slices

Run Date: 5/11/2023
Time of Run: 05:37PM
Run By: Username
Input Data Filename: M:2023.4.13 nelf_xs_b_circ.in
Output Filename: M:2023.4.13 nelf_xs_b_circ.OUT
Unit: ENGLISH
Plotted Output Filename: M:2023.4.13 nelf_xs_b_circ.PLT
PROBLEM DESCRIPTION Northeast Landfill
Cross Section B, Circular

BOUNDARY COORDINATES
Note: User origin value specified.
Add 0.00 to X-values and 0.00 to Y-values listed.

10 Top Boundaries
33 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	87.00	1176.00	118.70	1184.50	1
2	118.70	1184.50	149.60	1184.50	1
3	149.60	1184.50	183.40	1168.50	1
4	183.40	1168.50	215.50	1184.50	1
5	215.50	1184.50	223.10	1184.50	1
6	223.10	1184.50	1110.60	1405.50	2
7	1110.60	1405.50	1211.80	1408.00	2
8	1211.80	1408.00	1635.60	1408.00	2
9	1635.60	1408.00	1735.70	1404.00	2
10	1735.70	1404.00	1991.20	1340.20	2
11	223.10	1184.50	229.10	1184.50	2
12	229.10	1184.50	230.70	1182.90	2
13	230.70	1182.90	1110.60	1401.00	4
14	1110.60	1401.00	1211.80	1405.00	4
15	1211.80	1405.00	1635.60	1405.00	4
16	1635.60	1405.00	1735.70	1401.00	4
17	1735.70	1401.00	1991.20	1337.20	4
18	230.70	1182.90	261.10	1171.80	2
19	261.10	1175.90	341.50	1175.90	2
20	341.50	1175.90	800.00	1179.90	2
21	800.00	1179.90	1218.60	1181.00	2
22	1218.60	1181.00	1305.70	1206.00	2
23	1305.70	1206.00	1320.70	1206.00	2
24	1320.70	1206.00	1369.90	1186.00	2
25	1369.90	1186.00	1991.20	1184.40	2
26	223.10	1184.40	261.10	1171.80	1
27	261.10	1171.80	341.50	1171.90	1
28	341.50	1171.90	800.00	1175.90	3
29	800.00	1175.90	1218.60	1177.00	3
30	1218.60	1177.00	1305.70	1202.00	3
31	1305.70	1202.00	1320.70	1202.00	3
32	1320.70	1202.00	1369.90	1182.00	3
33	1369.90	1182.00	1991.20	1180.40	3

ISOTROPIC SOIL PARAMETERS
5 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	120.0	120.0	0.0	25.0	0.00	0.0	1
2	120.0	120.0	200.0	20.0	0.00	0.0	1
3	120.0	120.0	0.0	25.0	0.00	0.0	1
4	70.0	70.0	400.0	35.0	0.00	0.0	1
5	120.0	120.0	1800.0	0.0	0.00	0.0	1

1 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED
Unit Weight of Water = 62.40
Piezometric Surface No. 1 Specified by 3 Coordinate Points
Point X-Water Y-Water

No.	(ft)	(ft)
1	70.80	1167.90
2	1287.50	1174.20
3	1991.20	1176.50

A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Circular Surfaces, Has Been Specified.
10000 Trial Surfaces Have Been Generated.
100 Surfaces Initiate From Each Of100 Points Equally Spaced
Along The Ground Surface Between X = 173.10 ft.
and X = 400.60 ft.
Each Surface Terminates Between   X = 665.00 ft.
and   X =1260.60 ft.
Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y = 0.00 ft.
15.00 ft. Line Segments Define Each Trial Failure Surface.
Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Examined. They Are Ordered - Most Critical
First.
* * Safety Factors Are Calculated By The Modified Bishop Method * *
Failure Surface Specified By 68 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	184.59	1169.09
2	198.55	1163.61
3	212.62	1158.39
4	226.78	1153.44
5	241.03	1148.76
6	255.36	1144.36
7	269.78	1140.22
8	284.28	1136.36
9	298.84	1132.78
10	313.48	1129.47
11	328.17	1126.44
12	342.91	1123.69
13	357.71	1121.23
14	372.55	1119.04
15	387.43	1117.14
16	402.34	1115.51
17	417.28	1114.18
18	432.24	1113.12
19	447.22	1112.35
20	462.21	1111.87
21	477.21	1111.67
22	492.21	1111.76
23	507.21	1112.13
24	522.19	1112.78
25	537.16	1113.72
26	552.11	1114.94
27	567.04	1116.45
28	581.93	1118.24
29	596.79	1120.32
30	611.60	1122.67
31	626.37	1125.31
32	641.08	1128.22
33	655.74	1131.42
34	670.33	1134.89
35	684.85	1138.64
36	699.30	1142.67
37	713.67	1146.96
38	727.96	1151.54
39	742.16	1156.38
40	756.26	1161.49
41	770.26	1166.86
42	784.16	1172.51
43	797.95	1178.41
44	811.63	1184.58
45	825.18	1191.00
46	838.61	1197.68
47	851.91	1204.62
48	865.08	1211.80

49	878.10	1219.24
50	890.99	1226.92
51	903.72	1234.84
52	916.31	1243.01
53	928.73	1251.41
54	941.00	1260.05
55	953.09	1268.92
56	965.02	1278.01
57	976.77	1287.34
58	988.35	1296.88
59	999.74	1306.64
60	1010.94	1316.62
61	1021.95	1326.80
62	1032.76	1337.20
63	1043.38	1347.79
64	1053.79	1358.59
65	1064.00	1369.59
66	1073.99	1380.77
67	1083.77	1392.14
68	1090.73	1400.55

Circle Center At X = 480.2 ; Y = 1901.2 and Radius, 789.5

*** 2.541 ***

Individual data on the 79 slices

Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Tie Force Norm (lbs)	Tie Force Tan (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Surcharge Load (lbs)
1	1.5	123.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	12.4	10300.0	0.0	2065.4	0.0	0.0	0.0	0.0	0.0
3	14.1	31315.5	0.0	7110.4	0.0	0.0	0.0	0.0	0.0
4	2.9	8962.2	0.0	2050.3	0.0	0.0	0.0	0.0	0.0
5	7.6	25940.7	0.0	6336.2	0.0	0.0	0.0	0.0	0.0
6	3.7	13616.6	0.0	3550.2	0.0	0.0	0.0	0.0	0.0
7	2.3	9105.2	0.0	2389.4	0.0	0.0	0.0	0.0	0.0
8	1.6	6484.9	0.0	1713.5	0.0	0.0	0.0	0.0	0.0
9	10.3	44488.8	0.0	12408.7	0.0	0.0	0.0	0.0	0.0
10	14.3	68340.3	0.0	20833.7	0.0	0.0	0.0	0.0	0.0
11	5.7	29375.2	0.0	9432.7	0.0	0.0	0.0	0.0	0.0
12	8.7	49051.2	0.0	15468.4	0.0	0.0	0.0	0.0	0.0
13	14.5	90337.0	0.0	28712.6	0.0	0.0	0.0	0.0	0.0
14	14.6	100984.6	0.0	32266.8	0.0	0.0	0.0	0.0	0.0
15	14.6	111222.6	0.0	35562.3	0.0	0.0	0.0	0.0	0.0
16	14.7	121030.6	0.0	38598.0	0.0	0.0	0.0	0.0	0.0
17	13.3	117526.3	0.0	37295.9	0.0	0.0	0.0	0.0	0.0
18	1.4	12863.4	0.0	4076.8	0.0	0.0	0.0	0.0	0.0
19	14.8	139337.0	0.0	43885.5	0.0	0.0	0.0	0.0	0.0
20	14.8	147839.0	0.0	46135.5	0.0	0.0	0.0	0.0	0.0
21	14.9	155840.6	0.0	48122.0	0.0	0.0	0.0	0.0	0.0
22	14.9	163326.9	0.0	49843.9	0.0	0.0	0.0	0.0	0.0
23	14.9	170284.1	0.0	51301.0	0.0	0.0	0.0	0.0	0.0
24	15.0	176699.5	0.0	52492.4	0.0	0.0	0.0	0.0	0.0
25	15.0	182562.5	0.0	53418.1	0.0	0.0	0.0	0.0	0.0
26	15.0	187862.7	0.0	54077.5	0.0	0.0	0.0	0.0	0.0
27	15.0	192591.1	0.0	54470.2	0.0	0.0	0.0	0.0	0.0
28	15.0	196740.2	0.0	54596.3	0.0	0.0	0.0	0.0	0.0
29	15.0	200304.7	0.0	54455.7	0.0	0.0	0.0	0.0	0.0
30	15.0	203279.3	0.0	54048.6	0.0	0.0	0.0	0.0	0.0
31	15.0	205660.6	0.0	53374.8	0.0	0.0	0.0	0.0	0.0
32	15.0	207447.1	0.0	52435.1	0.0	0.0	0.0	0.0	0.0
33	14.9	208637.2	0.0	51229.2	0.0	0.0	0.0	0.0	0.0
34	14.9	209231.0	0.0	49757.6	0.0	0.0	0.0	0.0	0.0
35	14.9	209231.9	0.0	48021.3	0.0	0.0	0.0	0.0	0.0
36	14.8	208642.7	0.0	46020.8	0.0	0.0	0.0	0.0	0.0
37	14.8	207467.1	0.0	43756.4	0.0	0.0	0.0	0.0	0.0
38	14.7	205711.8	0.0	41229.4	0.0	0.0	0.0	0.0	0.0
39	14.7	203383.6	0.0	38440.4	0.0	0.0	0.0	0.0	0.0
40	14.6	200491.5	0.0	35390.7	0.0	0.0	0.0	0.0	0.0
41	14.5	197045.0	0.0	32080.9	0.0	0.0	0.0	0.0	0.0
42	14.4	193054.7	0.0	28512.9	0.0	0.0	0.0	0.0	0.0
43	14.4	188534.0	0.0	24687.5	0.0	0.0	0.0	0.0	0.0

44	14.3	183494.7	0.0	20606.2	0.0	0.0	0.0	0.0	0.0
45	14.2	177953.8	0.0	16270.4	0.0	0.0	0.0	0.0	0.0
46	14.1	171925.2	0.0	11681.8	0.0	0.0	0.0	0.0	0.0
47	14.0	165426.8	0.0	6841.9	0.0	0.0	0.0	0.0	0.0
48	11.6	132922.3	0.0	1822.7	0.0	0.0	0.0	0.0	0.0
49	2.3	25554.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
50	7.8	85816.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0
51	6.0	65277.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
52	2.0	21903.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
53	1.3	13391.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
54	10.4	109188.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
55	13.6	140352.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
56	13.4	136072.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
57	13.3	131533.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
58	13.2	126746.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
59	13.0	121726.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
60	12.9	116487.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0
61	12.7	111043.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0
62	12.6	105411.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
63	12.4	99604.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
64	12.3	93640.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0
65	12.1	87536.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0
66	11.9	81307.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0
67	11.8	74972.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0
68	11.6	68548.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0
69	11.4	62054.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
70	11.2	55507.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
71	11.0	48926.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0
72	10.8	42332.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
73	10.6	35741.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
74	10.4	29174.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
75	10.2	22651.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
76	10.0	16190.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
77	9.8	9812.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0
78	2.3	1409.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0
79	4.7	1250.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Failure Surface Specified By 73 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	184.59	1169.09
2	198.36	1163.14
3	212.23	1157.43
4	226.21	1151.99
5	240.28	1146.81
6	254.45	1141.89
7	268.71	1137.23
8	283.06	1132.84
9	297.48	1128.71
10	311.97	1124.86
11	326.54	1121.27
12	341.17	1117.95
13	355.85	1114.91
14	370.60	1112.14
15	385.39	1109.64
16	400.22	1107.42
17	415.09	1105.47
18	430.00	1103.80
19	444.94	1102.40
20	459.89	1101.29
21	474.87	1100.45
22	489.86	1099.88
23	504.86	1099.60
24	519.86	1099.60
25	534.85	1099.87
26	549.84	1100.42
27	564.82	1101.25
28	579.78	1102.36
29	594.72	1103.74
30	609.62	1105.40
31	624.50	1107.34

32	639.33	1109.55
33	654.13	1112.04
34	668.87	1114.80
35	683.56	1117.84
36	698.19	1121.14
37	712.76	1124.72
38	727.26	1128.57
39	741.68	1132.68
40	756.03	1137.07
41	770.29	1141.71
42	784.46	1146.63
43	798.54	1151.80
44	812.52	1157.23
45	826.40	1162.92
46	840.17	1168.87
47	853.83	1175.08
48	867.37	1181.53
49	880.79	1188.24
50	894.08	1195.19
51	907.24	1202.39
52	920.26	1209.83
53	933.14	1217.51
54	945.88	1225.43
55	958.47	1233.58
56	970.91	1241.97
57	983.19	1250.59
58	995.31	1259.43
59	1007.26	1268.49
60	1019.04	1277.78
61	1030.64	1287.28
62	1042.07	1297.00
63	1053.32	1306.92
64	1064.38	1317.06
65	1075.25	1327.39
66	1085.92	1337.93
67	1096.40	1348.66
68	1106.68	1359.59
69	1116.76	1370.70
70	1126.62	1382.00
71	1136.28	1393.48
72	1145.72	1405.14
73	1146.69	1406.39

Circle Center At X = 512.6 ; Y = 1908.2 and Radius, 808.6

*** 2.542 ***

Failure Surface Specified By 70 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	184.59	1169.09
2	198.68	1163.95
3	212.86	1159.06
4	227.12	1154.42
5	241.47	1150.03
6	255.89	1145.90
7	270.38	1142.03
8	284.94	1138.42
9	299.56	1135.07
10	314.24	1131.98
11	328.97	1129.15
12	343.75	1126.58
13	358.57	1124.28
14	373.43	1122.24
15	388.33	1120.47
16	403.25	1118.96
17	418.20	1117.72
18	433.17	1116.74
19	448.15	1116.04
20	463.14	1115.60
21	478.14	1115.42
22	493.14	1115.52
23	508.14	1115.88

24	523.13	1116.50
25	538.10	1117.40
26	553.05	1118.56
27	567.99	1119.99
28	582.89	1121.68
29	597.76	1123.64
30	612.60	1125.86
31	627.39	1128.35
32	642.13	1131.10
33	656.83	1134.11
34	671.47	1137.38
35	686.05	1140.92
36	700.56	1144.71
37	715.00	1148.76
38	729.37	1153.07
39	743.66	1157.63
40	757.86	1162.45
41	771.98	1167.51
42	786.01	1172.83
43	799.94	1178.40
44	813.76	1184.22
45	827.48	1190.28
46	841.09	1196.58
47	854.59	1203.13
48	867.97	1209.91
49	881.22	1216.94
50	894.35	1224.19
51	907.35	1231.68
52	920.21	1239.40
53	932.93	1247.35
54	945.50	1255.53
55	957.93	1263.92
56	970.21	1272.54
57	982.33	1281.37
58	994.30	1290.42
59	1006.10	1299.68
60	1017.73	1309.15
61	1029.20	1318.83
62	1040.48	1328.70
63	1051.60	1338.78
64	1062.53	1349.05
65	1073.27	1359.52
66	1083.83	1370.18
67	1094.19	1381.02
68	1104.36	1392.04
69	1114.34	1403.25
70	1116.39	1405.64

Circle Center At X = 480.4 ; Y = 1957.4 and Radius, 841.9

*** 2.542 ***

Failure Surface Specified By 74 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	184.59	1169.09
2	198.33	1163.08
3	212.18	1157.31
4	226.13	1151.80
5	240.18	1146.55
6	254.32	1141.55
7	268.55	1136.81
8	282.87	1132.33
9	297.27	1128.12
10	311.74	1124.16
11	326.27	1120.47
12	340.88	1117.05
13	355.54	1113.90
14	370.26	1111.01
15	385.03	1108.39
16	399.85	1106.05
17	414.70	1103.97
18	429.59	1102.16

19	444.52	1100.63
20	459.46	1099.37
21	474.43	1098.38
22	489.41	1097.67
23	504.41	1097.23
24	519.41	1097.06
25	534.41	1097.17
26	549.40	1097.55
27	564.39	1098.20
28	579.36	1099.13
29	594.31	1100.33
30	609.24	1101.81
31	624.14	1103.55
32	639.00	1105.57
33	653.82	1107.86
34	668.60	1110.42
35	683.33	1113.25
36	698.01	1116.34
37	712.63	1119.71
38	727.18	1123.34
39	741.67	1127.23
40	756.08	1131.39
41	770.41	1135.81
42	784.66	1140.49
43	798.83	1145.44
44	812.90	1150.64
45	826.87	1156.09
46	840.74	1161.80
47	854.51	1167.76
48	868.16	1173.97
49	881.70	1180.43
50	895.11	1187.14
51	908.41	1194.09
52	921.57	1201.28
53	934.60	1208.71
54	947.49	1216.38
55	960.24	1224.28
56	972.85	1232.41
57	985.30	1240.77
58	997.60	1249.36
59	1009.74	1258.17
60	1021.72	1267.20
61	1033.53	1276.45
62	1045.17	1285.91
63	1056.63	1295.58
64	1067.92	1305.46
65	1079.02	1315.55
66	1089.94	1325.83
67	1100.67	1336.32
68	1111.21	1346.99
69	1121.55	1357.86
70	1131.68	1368.91
71	1141.62	1380.15
72	1151.35	1391.57
73	1160.87	1403.16
74	1163.75	1406.81

Circle Center At X = 521.0 ; Y = 1918.7 and Radius, 821.7

*** 2.548 ***

Failure Surface Specified By 73 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	186.89	1170.24
2	200.86	1164.77
3	214.92	1159.55
4	229.07	1154.58
5	243.31	1149.85
6	257.62	1145.37
7	272.01	1141.14
8	286.48	1137.16
9	301.01	1133.44

10	315.60	1129.97
11	330.25	1126.75
12	344.95	1123.79
13	359.71	1121.09
14	374.51	1118.64
15	389.35	1116.45
16	404.22	1114.52
17	419.13	1112.86
18	434.06	1111.45
19	449.02	1110.30
20	463.99	1109.41
21	478.98	1108.78
22	493.98	1108.42
23	508.98	1108.31
24	523.97	1108.47
25	538.97	1108.89
26	553.95	1109.57
27	568.92	1110.51
28	583.88	1111.72
29	598.80	1113.18
30	613.70	1114.90
31	628.57	1116.88
32	643.40	1119.13
33	658.20	1121.63
34	672.94	1124.38
35	687.63	1127.40
36	702.27	1130.66
37	716.85	1134.19
38	731.37	1137.97
39	745.82	1141.99
40	760.19	1146.28
41	774.49	1150.81
42	788.71	1155.59
43	802.84	1160.61
44	816.89	1165.89
45	830.84	1171.40
46	844.69	1177.16
47	858.44	1183.16
48	872.08	1189.40
49	885.61	1195.87
50	899.02	1202.58
51	912.32	1209.52
52	925.49	1216.70
53	938.54	1224.10
54	951.46	1231.72
55	964.24	1239.58
56	976.88	1247.65
57	989.38	1255.94
58	1001.73	1264.45
59	1013.93	1273.17
60	1025.98	1282.11
61	1037.88	1291.25
62	1049.61	1300.60
63	1061.17	1310.15
64	1072.57	1319.90
65	1083.79	1329.85
66	1094.84	1340.00
67	1105.72	1350.33
68	1116.41	1360.85
69	1126.91	1371.56
70	1137.23	1382.45
71	1147.35	1393.52
72	1157.28	1404.76
73	1158.93	1406.69

Circle Center At X = 507.4 ; Y = 1968.8 and Radius, 860.5

*** 2.554 ***

Failure Surface Specified By 63 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	184.59	1169.09

2	198.62	1163.80
3	212.76	1158.79
4	227.00	1154.07
5	241.33	1149.63
6	255.75	1145.49
7	270.25	1141.64
8	284.82	1138.09
9	299.46	1134.83
10	314.17	1131.87
11	328.93	1129.21
12	343.74	1126.85
13	358.60	1124.79
14	373.49	1123.03
15	388.42	1121.57
16	403.38	1120.42
17	418.36	1119.56
18	433.35	1119.02
19	448.34	1118.77
20	463.34	1118.83
21	478.34	1119.20
22	493.32	1119.87
23	508.29	1120.84
24	523.24	1122.11
25	538.15	1123.69
26	553.04	1125.57
27	567.88	1127.75
28	582.67	1130.23
29	597.41	1133.01
30	612.09	1136.09
31	626.71	1139.46
32	641.25	1143.13
33	655.72	1147.10
34	670.10	1151.35
35	684.39	1155.90
36	698.59	1160.74
37	712.69	1165.86
38	726.68	1171.27
39	740.56	1176.96
40	754.32	1182.93
41	767.96	1189.18
42	781.47	1195.70
43	794.84	1202.50
44	808.07	1209.56
45	821.16	1216.89
46	834.09	1224.49
47	846.87	1232.34
48	859.49	1240.46
49	871.94	1248.82
50	884.21	1257.44
51	896.31	1266.31
52	908.23	1275.41
53	919.96	1284.76
54	931.50	1294.35
55	942.85	1304.16
56	953.99	1314.21
57	964.92	1324.47
58	975.65	1334.96
59	986.16	1345.66
60	996.45	1356.57
61	1006.52	1367.69
62	1016.36	1379.01
63	1019.54	1382.82

Circle Center At X = 452.9 ; Y = 1858.9 and Radius, 740.1

*** 2.555 ***

Failure Surface Specified By 61 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	184.59	1169.09
2	198.53	1163.56
3	212.59	1158.32

4	226.75	1153.39
5	241.02	1148.76
6	255.39	1144.44
7	269.84	1140.43
8	284.38	1136.73
9	298.99	1133.34
10	313.67	1130.27
11	328.42	1127.51
12	343.22	1125.07
13	358.07	1122.95
14	372.96	1121.15
15	387.88	1119.67
16	402.84	1118.51
17	417.81	1117.67
18	432.81	1117.15
19	447.80	1116.96
20	462.80	1117.08
21	477.80	1117.53
22	492.78	1118.30
23	507.74	1119.39
24	522.67	1120.81
25	537.57	1122.54
26	552.43	1124.59
27	567.24	1126.96
28	582.00	1129.65
29	596.69	1132.65
30	611.32	1135.97
31	625.88	1139.61
32	640.35	1143.55
33	654.73	1147.80
34	669.02	1152.37
35	683.21	1157.23
36	697.29	1162.41
37	711.26	1167.88
38	725.10	1173.65
39	738.82	1179.71
40	752.41	1186.07
41	765.85	1192.72
42	779.15	1199.66
43	792.30	1206.88
44	805.29	1214.38
45	818.11	1222.16
46	830.77	1230.22
47	843.25	1238.54
48	855.55	1247.13
49	867.66	1255.98
50	879.58	1265.08
51	891.29	1274.45
52	902.81	1284.06
53	914.12	1293.91
54	925.21	1304.01
55	936.08	1314.34
56	946.73	1324.91
57	957.15	1335.70
58	967.34	1346.71
59	977.29	1357.94
60	986.99	1369.37
61	992.43	1376.07

Circle Center At X = 449.4 ; Y = 1815.6 and Radius, 698.6

*** 2.558 ***

Failure Surface Specified By 70 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	191.48	1172.53
2	205.33	1166.77
3	219.29	1161.27
4	233.35	1156.04
5	247.50	1151.07
6	261.75	1146.38
7	276.08	1141.95

8	290.50	1137.80
9	304.98	1133.92
10	319.55	1130.32
11	334.17	1126.99
12	348.86	1123.94
13	363.60	1121.17
14	378.39	1118.68
15	393.23	1116.47
16	408.10	1114.54
17	423.01	1112.90
18	437.95	1111.53
19	452.91	1110.45
20	467.89	1109.66
21	482.88	1109.15
22	497.88	1108.92
23	512.88	1108.97
24	527.88	1109.31
25	542.86	1109.94
26	557.84	1110.84
27	572.79	1112.04
28	587.72	1113.51
29	602.61	1115.27
30	617.47	1117.31
31	632.29	1119.63
32	647.07	1122.23
33	661.79	1125.11
34	676.45	1128.27
35	691.05	1131.70
36	705.59	1135.41
37	720.05	1139.40
38	734.43	1143.66
39	748.73	1148.19
40	762.94	1152.99
41	777.06	1158.06
42	791.07	1163.40
43	804.99	1169.00
44	818.80	1174.86
45	832.49	1180.99
46	846.06	1187.37
47	859.51	1194.01
48	872.84	1200.90
49	886.03	1208.05
50	899.08	1215.44
51	911.99	1223.08
52	924.75	1230.96
53	937.36	1239.08
54	949.82	1247.44
55	962.11	1256.03
56	974.24	1264.86
57	986.20	1273.91
58	997.99	1283.19
59	1009.59	1292.69
60	1021.02	1302.41
61	1032.26	1312.34
62	1043.31	1322.48
63	1054.17	1332.83
64	1064.82	1343.39
65	1075.28	1354.15
66	1085.53	1365.10
67	1095.57	1376.24
68	1105.40	1387.57
69	1115.01	1399.09
70	1120.35	1405.74

Circle Center At X = 502.4 ; Y = 1900.5 and Radius, 791.6

*** 2.560 ***

Failure Surface Specified By 65 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	186.89	1170.24
2	200.98	1165.09

3	215.16	1160.22
4	229.44	1155.61
5	243.80	1151.28
6	258.24	1147.23
7	272.76	1143.45
8	287.34	1139.95
9	301.99	1136.73
10	316.70	1133.79
11	331.47	1131.13
12	346.28	1128.76
13	361.13	1126.66
14	376.02	1124.86
15	390.94	1123.34
16	405.89	1122.10
17	420.86	1121.15
18	435.85	1120.49
19	450.84	1120.11
20	465.84	1120.02
21	480.84	1120.21
22	495.83	1120.70
23	510.81	1121.47
24	525.78	1122.52
25	540.72	1123.86
26	555.63	1125.49
27	570.51	1127.40
28	585.34	1129.60
29	600.14	1132.08
30	614.88	1134.84
31	629.57	1137.89
32	644.20	1141.21
33	658.76	1144.81
34	673.25	1148.69
35	687.66	1152.85
36	701.99	1157.28
37	716.23	1161.99
38	730.38	1166.96
39	744.44	1172.21
40	758.39	1177.72
41	772.23	1183.50
42	785.96	1189.54
43	799.57	1195.85
44	813.06	1202.41
45	826.42	1209.23
46	839.64	1216.31
47	852.73	1223.63
48	865.68	1231.21
49	878.48	1239.03
50	891.13	1247.09
51	903.62	1255.40
52	915.95	1263.94
53	928.11	1272.72
54	940.11	1281.72
55	951.93	1290.96
56	963.57	1300.42
57	975.03	1310.10
58	986.30	1320.00
59	997.38	1330.11
60	1008.26	1340.43
61	1018.95	1350.96
62	1029.43	1361.69
63	1039.70	1372.61
64	1049.77	1383.74
65	1057.12	1392.18

Circle Center At X = 463.1 ; Y = 1904.5 and Radius, 784.5

*** 2.561 ***

Failure Surface Specified By 68 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	189.19	1171.38
2	203.30	1166.29

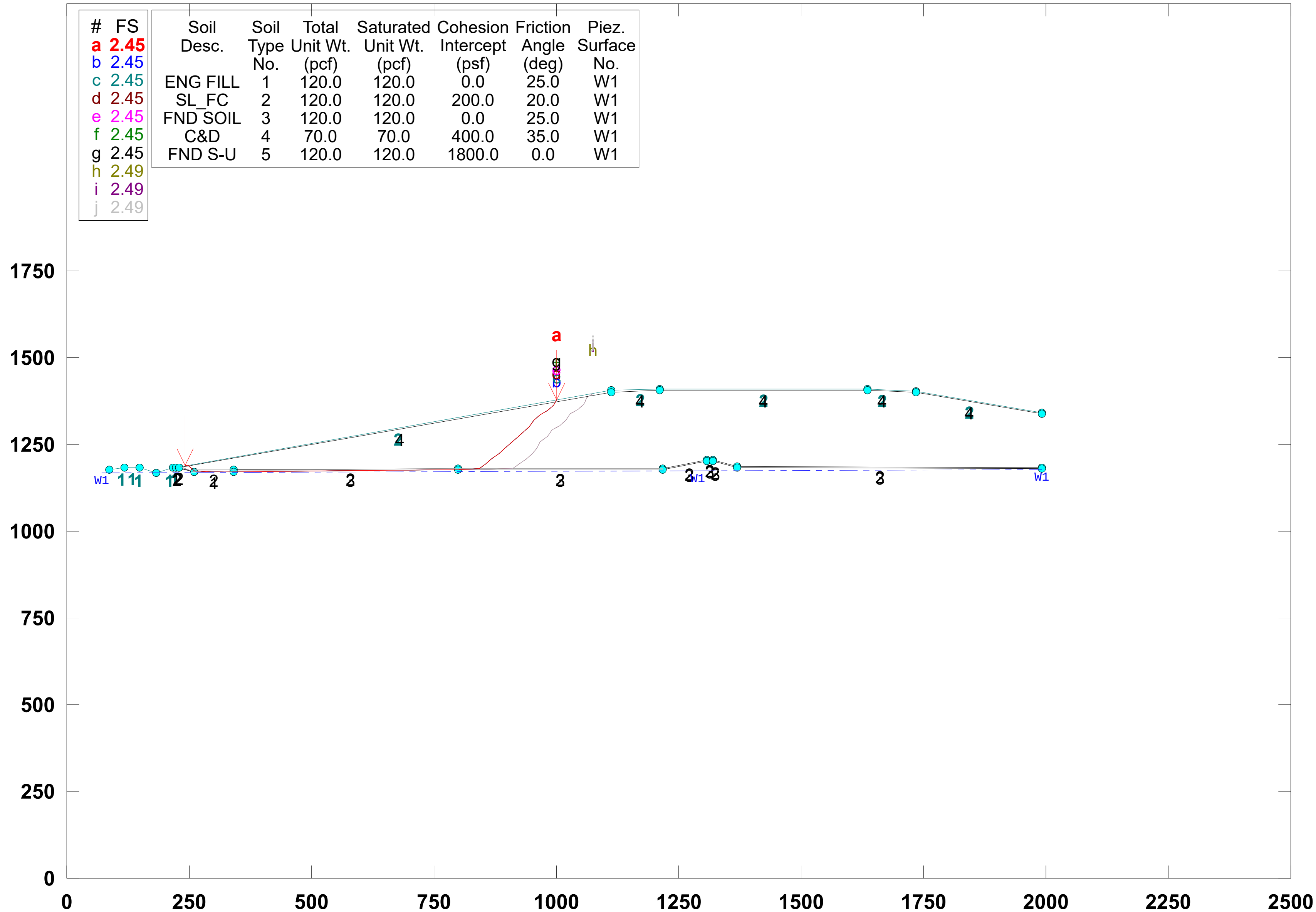
3	217.49	1161.46
4	231.78	1156.88
5	246.15	1152.57
6	260.59	1148.52
7	275.10	1144.73
8	289.69	1141.21
9	304.33	1137.96
10	319.03	1134.98
11	333.78	1132.26
12	348.58	1129.81
13	363.42	1127.64
14	378.30	1125.73
15	393.21	1124.10
16	408.15	1122.74
17	423.11	1121.65
18	438.09	1120.84
19	453.08	1120.30
20	468.08	1120.03
21	483.08	1120.04
22	498.07	1120.32
23	513.06	1120.88
24	528.04	1121.71
25	543.00	1122.81
26	557.94	1124.18
27	572.85	1125.83
28	587.72	1127.75
29	602.56	1129.94
30	617.36	1132.40
31	632.11	1135.13
32	646.80	1138.13
33	661.44	1141.40
34	676.02	1144.94
35	690.53	1148.74
36	704.97	1152.80
37	719.33	1157.13
38	733.61	1161.72
39	747.81	1166.56
40	761.91	1171.67
41	775.92	1177.04
42	789.83	1182.65
43	803.63	1188.53
44	817.33	1194.65
45	830.90	1201.02
46	844.37	1207.64
47	857.70	1214.50
48	870.91	1221.61
49	883.99	1228.95
50	896.93	1236.53
51	909.74	1244.35
52	922.39	1252.40
53	934.90	1260.68
54	947.25	1269.19
55	959.45	1277.92
56	971.49	1286.87
57	983.36	1296.05
58	995.06	1305.43
59	1006.58	1315.03
60	1017.93	1324.84
61	1029.10	1334.85
62	1040.09	1345.06
63	1050.88	1355.48
64	1061.49	1366.09
65	1071.90	1376.89
66	1082.11	1387.88
67	1092.11	1399.05
68	1094.15	1401.40

Circle Center At X = 475.2 ; Y = 1941.5 and Radius, 821.5

*** 2.565 ***

Northeast Landfill Cross Section B-B', WB

m:\projects\16219107.00\task 3 - tier iii modification app\permit application\app c - liner and final cover system stability analysis\stabl files\nelf\2023.4.13 nelf_xs_b_block.pl2 Run By: Username 5/11/2023



Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Piez. Surface No.
ENG FILL	1	120.0	120.0	0.0	25.0	W1
SL_FC	2	120.0	120.0	200.0	20.0	W1
FND SOIL	3	120.0	120.0	0.0	25.0	W1
C&D	4	70.0	70.0	400.0	35.0	W1
FND S-U	5	120.0	120.0	1800.0	0.0	W1

PCSTABL5M3 FSmin=2.45

Safety Factors Are Calculated By The Modified Janbu Method

**** PCSTABL5M3 ****
by Purdue University 1985
rev. for SCS Engineers HVA 2008
--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer`s Method of Slices

Run Date: 5/11/2023
Time of Run: 05:40PM
Run By: Username
Input Data Filename: M:2023.4.13 nelf_xs_b_block.in
Output Filename: M:2023.4.13 nelf_xs_b_block.OUT
Unit: ENGLISH
Plotted Output Filename: M:2023.4.13 nelf_xs_b_block.PLT
PROBLEM DESCRIPTION Northeast Landfill
Cross Section B-B', WB

BOUNDARY COORDINATES
Note: User origin value specified.
Add 0.00 to X-values and 0.00 to Y-values listed.

10 Top Boundaries
33 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	87.00	1176.00	118.70	1184.50	1
2	118.70	1184.50	149.60	1184.50	1
3	149.60	1184.50	183.40	1168.50	1
4	183.40	1168.50	215.50	1184.50	1
5	215.50	1184.50	223.10	1184.50	1
6	223.10	1184.50	1110.60	1405.50	2
7	1110.60	1405.50	1211.80	1408.00	2
8	1211.80	1408.00	1635.60	1408.00	2
9	1635.60	1408.00	1735.70	1404.00	2
10	1735.70	1404.00	1991.20	1340.20	2
11	223.10	1184.50	229.10	1184.50	2
12	229.10	1184.50	230.70	1182.90	2
13	230.70	1182.90	1110.60	1401.00	4
14	1110.60	1401.00	1211.80	1405.00	4
15	1211.80	1405.00	1635.60	1405.00	4
16	1635.60	1405.00	1735.70	1401.00	4
17	1735.70	1401.00	1991.20	1337.20	4
18	230.70	1182.90	261.10	1171.80	2
19	261.10	1175.90	341.50	1175.90	2
20	341.50	1175.90	800.00	1179.90	2
21	800.00	1179.90	1218.60	1181.00	2
22	1218.60	1181.00	1305.70	1206.00	2
23	1305.70	1206.00	1320.70	1206.00	2
24	1320.70	1206.00	1369.90	1186.00	2
25	1369.90	1186.00	1991.20	1184.40	2
26	223.10	1184.40	261.10	1171.80	1
27	261.10	1171.80	341.50	1171.90	1
28	341.50	1171.90	800.00	1175.90	3
29	800.00	1175.90	1218.60	1177.00	3
30	1218.60	1177.00	1305.70	1202.00	3
31	1305.70	1202.00	1320.70	1202.00	3
32	1320.70	1202.00	1369.90	1182.00	3
33	1369.90	1182.00	1991.20	1180.40	3

ISOTROPIC SOIL PARAMETERS
5 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	120.0	120.0	0.0	25.0	0.00	0.0	1
2	120.0	120.0	200.0	20.0	0.00	0.0	1
3	120.0	120.0	0.0	25.0	0.00	0.0	1
4	70.0	70.0	400.0	35.0	0.00	0.0	1
5	120.0	120.0	1800.0	0.0	0.00	0.0	1

1 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED
Unit Weight of Water = 62.40
Piezometric Surface No. 1 Specified by 3 Coordinate Points

Point X-Water Y-Water

No.	(ft)	(ft)
1	70.80	1167.90
2	1287.50	1174.20
3	1991.20	1176.50

A Critical Failure Surface Searching Method, Using A Random Technique For Generating Sliding Block Surfaces, Has Been Specified.

1000 Trial Surfaces Have Been Generated.

6 Boxes Specified For Generation Of Central Block Base

Length Of Line Segments For Active And Passive Portions Of Sliding Block Is 20.0

Box No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Height (ft)
1	261.10	1173.80	261.20	1173.80	4.00
2	261.70	1173.80	341.00	1173.90	4.00
3	341.50	1173.90	341.60	1173.90	4.00
4	342.10	1173.00	800.00	1177.90	4.00
5	800.50	1177.90	800.60	1177.90	4.00
6	801.10	1177.90	1216.60	1179.00	4.00

Following Are Displayed The Ten Most Critical Of The Trial Failure Surfaces Examined. They Are Ordered - Most Critical First.

* * Safety Factors Are Calculated By The Modified Janbu Method * *

Failure Surface Specified By 21 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	242.36	1189.30
2	246.94	1189.27
3	261.16	1175.20
4	293.81	1172.42
5	341.50	1172.39
6	532.45	1174.55
7	800.53	1176.92
8	841.96	1179.39
9	855.63	1193.99
10	868.75	1209.08
11	882.53	1223.58
12	896.57	1237.82
13	907.95	1254.27
14	919.25	1270.78
15	932.19	1286.02
16	945.24	1301.17
17	953.49	1319.39
18	967.36	1333.80
19	980.71	1348.69
20	993.20	1364.32
21	1001.84	1378.42

*** 2.446 ***

Individual data on the 25 slices

Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Tie Force Norm (lbs)	Tie Force Tan (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Surcharge Load (lbs)
1	4.6	320.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	1.9	532.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	12.3	11779.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	32.7	64585.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	47.7	135849.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6	0.0	9.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7	191.0	926002.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8	267.5	2324230.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
9	0.5	5783.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10	41.4	462674.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
11	0.6	6567.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0
12	13.1	143394.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
13	13.1	133244.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
14	13.8	128971.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15	14.0	120650.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0
16	11.4	88086.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
17	11.3	76704.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0

18	12.9	76209.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
19	13.1	65966.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
20	8.2	33564.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0
21	13.9	43293.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
22	13.4	31172.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
23	12.5	18629.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
24	5.5	4326.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
25	3.2	829.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Failure Surface Specified By 21 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	242.36	1189.30
2	246.94	1189.27
3	261.16	1175.20
4	293.81	1172.42
5	341.50	1172.39
6	532.45	1174.55
7	800.53	1176.92
8	841.96	1179.39
9	855.63	1193.99
10	868.75	1209.08
11	882.53	1223.58
12	896.57	1237.82
13	907.95	1254.27
14	919.25	1270.78
15	932.19	1286.02
16	945.24	1301.17
17	953.49	1319.39
18	967.36	1333.80
19	980.71	1348.69
20	993.20	1364.32
21	1001.84	1378.42

*** 2.446 ***

Failure Surface Specified By 21 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	242.36	1189.30
2	246.94	1189.27
3	261.16	1175.20
4	293.81	1172.42
5	341.50	1172.39
6	532.45	1174.55
7	800.53	1176.92
8	841.96	1179.39
9	855.63	1193.99
10	868.75	1209.08
11	882.53	1223.58
12	896.57	1237.82
13	907.95	1254.27
14	919.25	1270.78
15	932.19	1286.02
16	945.24	1301.17
17	953.49	1319.39
18	967.36	1333.80
19	980.71	1348.69
20	993.20	1364.32
21	1001.84	1378.42

*** 2.446 ***

Failure Surface Specified By 21 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	242.36	1189.30
2	246.94	1189.27
3	261.16	1175.20
4	293.81	1172.42
5	341.50	1172.39
6	532.45	1174.55
7	800.53	1176.92
8	841.96	1179.39
9	855.63	1193.99

10	868.75	1209.08
11	882.53	1223.58
12	896.57	1237.82
13	907.95	1254.27
14	919.25	1270.78
15	932.19	1286.02
16	945.24	1301.17
17	953.49	1319.39
18	967.36	1333.80
19	980.71	1348.69
20	993.20	1364.32
21	1001.84	1378.42

*** 2.446 ***

Failure Surface Specified By 21 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	242.36	1189.30
2	246.94	1189.27
3	261.16	1175.20
4	293.81	1172.42
5	341.50	1172.39
6	532.45	1174.55
7	800.53	1176.92
8	841.96	1179.39
9	855.63	1193.99
10	868.75	1209.08
11	882.53	1223.58
12	896.57	1237.82
13	907.95	1254.27
14	919.25	1270.78
15	932.19	1286.02
16	945.24	1301.17
17	953.49	1319.39
18	967.36	1333.80
19	980.71	1348.69
20	993.20	1364.32
21	1001.84	1378.42

*** 2.446 ***

Failure Surface Specified By 21 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	242.36	1189.30
2	246.94	1189.27
3	261.16	1175.20
4	293.81	1172.42
5	341.50	1172.39
6	532.45	1174.55
7	800.53	1176.92
8	841.96	1179.39
9	855.63	1193.99
10	868.75	1209.08
11	882.53	1223.58
12	896.57	1237.82
13	907.95	1254.27
14	919.25	1270.78
15	932.19	1286.02
16	945.24	1301.17
17	953.49	1319.39
18	967.36	1333.80
19	980.71	1348.69
20	993.20	1364.32
21	1001.84	1378.42

*** 2.446 ***

Failure Surface Specified By 21 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	242.36	1189.30
2	246.94	1189.27
3	261.16	1175.20
4	293.81	1172.42

5	341.50	1172.39
6	532.45	1174.55
7	800.53	1176.92
8	841.96	1179.39
9	855.63	1193.99
10	868.75	1209.08
11	882.53	1223.58
12	896.57	1237.82
13	907.95	1254.27
14	919.25	1270.78
15	932.19	1286.02
16	945.24	1301.17
17	953.49	1319.39
18	967.36	1333.80
19	980.71	1348.69
20	993.20	1364.32
21	1001.84	1378.42
***	2.446	***

Failure Surface Specified By 22 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	231.95	1186.70
2	242.66	1179.77
3	261.17	1172.21
4	275.13	1172.74
5	341.58	1172.01
6	587.34	1175.47
7	800.59	1176.90
8	909.62	1179.64
9	923.65	1193.88
10	937.41	1208.40
11	951.55	1222.54
12	961.46	1239.91
13	967.27	1259.05
14	981.04	1273.55
15	991.64	1290.52
16	1005.35	1305.08
17	1019.39	1319.32
18	1029.07	1336.82
19	1043.18	1350.99
20	1057.20	1365.26
21	1063.78	1384.14
22	1075.79	1396.83
***	2.485	***

Failure Surface Specified By 22 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	231.95	1186.70
2	242.66	1179.77
3	261.17	1172.21
4	275.13	1172.74
5	341.58	1172.01
6	587.34	1175.47
7	800.59	1176.90
8	909.62	1179.64
9	923.65	1193.88
10	937.41	1208.40
11	951.55	1222.54
12	961.46	1239.91
13	967.27	1259.05
14	981.04	1273.55
15	991.64	1290.52
16	1005.35	1305.08
17	1019.39	1319.32
18	1029.07	1336.82
19	1043.18	1350.99
20	1057.20	1365.26
21	1063.78	1384.14
22	1075.79	1396.83
***	2.485	***

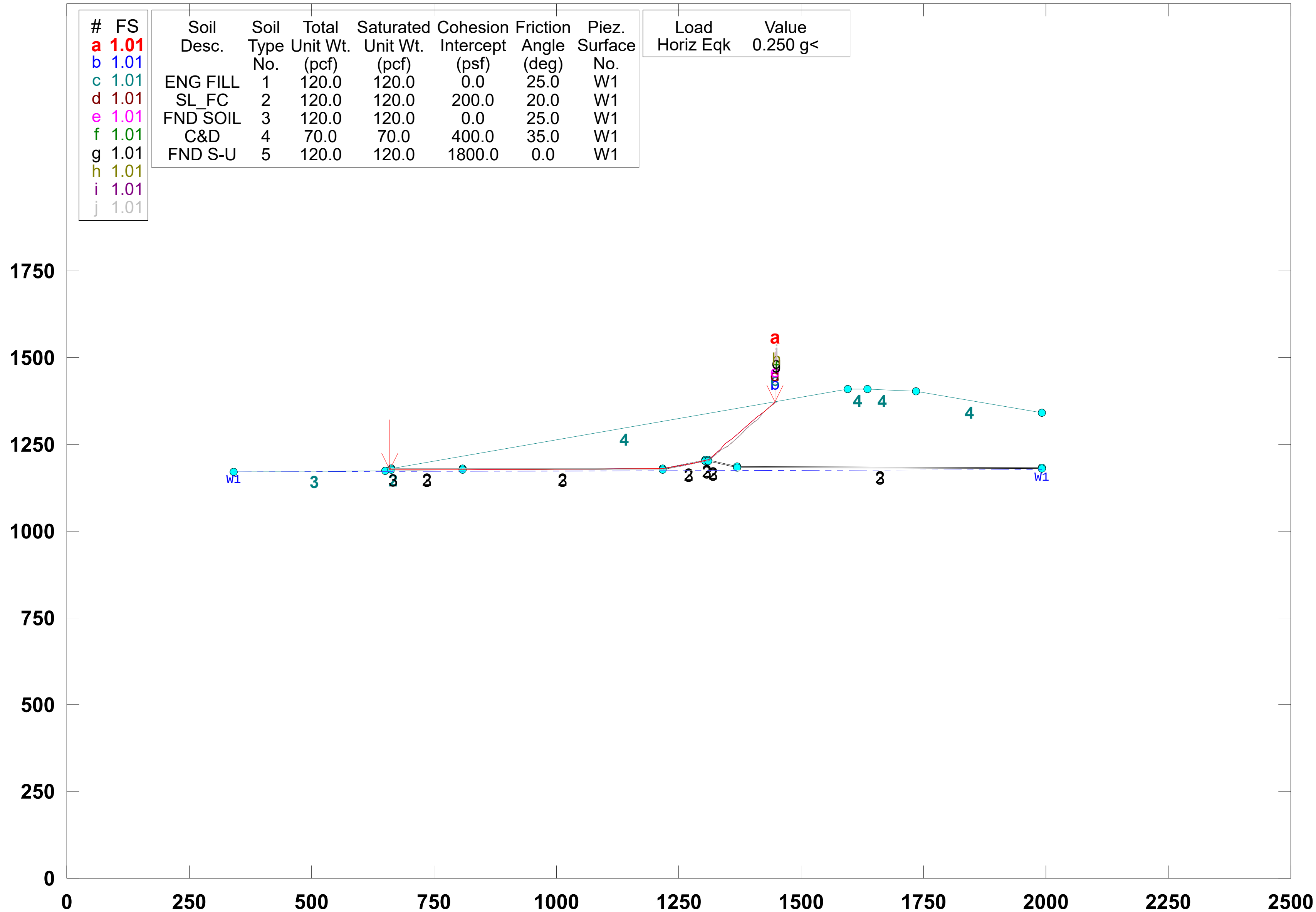
Failure Surface Specified By 22 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	231.95	1186.70
2	242.66	1179.77
3	261.17	1172.21
4	275.13	1172.74
5	341.58	1172.01
6	587.34	1175.47
7	800.59	1176.90
8	909.62	1179.64
9	923.65	1193.88
10	937.41	1208.40
11	951.55	1222.54
12	961.46	1239.91
13	967.27	1259.05
14	981.04	1273.55
15	991.64	1290.52
16	1005.35	1305.08
17	1019.39	1319.32
18	1029.07	1336.82
19	1043.18	1350.99
20	1057.20	1365.26
21	1063.78	1384.14
22	1075.79	1396.83

*** 2.485 ***

Northeast Landfill Cross Section B-B', PH12 WB (Seismic)

m:\projects\16219107.00\task 3 - tier iii modification app\permit application\app c - liner and final cover system stability analysis\stabl files\nelf\2023.4.13 nelf_xs_b_ph12 wb (seismic).pl2 Run By: Username 5/11/2023



PCSTABL5M3 FSmin=1.01

Safety Factors Are Calculated By The Modified Janbu Method

**** PCSTABL5M3 ****
by Purdue University 1985
rev. for SCS Engineers HVA 2008
--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer`s Method of Slices

Run Date: 5/11/2023
Time of Run: 05:46PM
Run By: Username
Input Data Filename: M:2023.4.13 nelf_xs_b_ph12 wb (seismic).in
Output Filename: M:2023.4.13 nelf_xs_b_ph12 wb (seismic).OUT
Unit: ENGLISH
Plotted Output Filename: M:2023.4.13 nelf_xs_b_ph12 wb (seismic).PLT
PROBLEM DESCRIPTION Northeast Landfill
Cross Section B-B', PH12 WB (Seismic)

BOUNDARY COORDINATES
Note: User origin value specified.
Add 0.00 to X-values and 0.00 to Y-values listed.

6 Top Boundaries
19 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	341.50	1171.90	651.40	1174.70	3
2	651.40	1174.70	663.40	1178.70	2
3	663.40	1178.70	1596.50	1408.00	4
4	1596.50	1408.00	1635.60	1408.00	4
5	1635.60	1408.00	1735.70	1404.00	4
6	1735.70	1404.00	1991.20	1340.20	4
7	663.40	1178.70	807.10	1180.00	2
8	807.10	1180.00	1218.60	1181.00	2
9	1218.60	1181.00	1305.60	1206.00	2
10	1305.60	1206.00	1310.60	1206.00	2
11	1310.60	1206.00	1369.90	1186.00	2
12	1369.90	1186.00	1991.20	1184.40	2
13	651.40	1174.70	663.40	1178.40	3
14	663.40	1178.40	807.10	1176.00	3
15	807.10	1176.00	1218.60	1177.00	3
16	1218.60	1177.00	1305.60	1202.00	3
17	1305.60	1202.00	1310.60	1202.00	3
18	1310.60	1202.00	1369.90	1182.00	3
19	1369.90	1182.00	1991.20	1180.40	3

ISOTROPIC SOIL PARAMETERS
5 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	120.0	120.0	0.0	25.0	0.00	0.0	1
2	120.0	120.0	200.0	20.0	0.00	0.0	1
3	120.0	120.0	0.0	25.0	0.00	0.0	1
4	70.0	70.0	400.0	35.0	0.00	0.0	1
5	120.0	120.0	1800.0	0.0	0.00	0.0	1

1 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED
Unit Weight of Water = 62.40
Piezometric Surface No. 1 Specified by 2 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	340.80	1170.40
2	1991.20	1176.50

A Horizontal Earthquake Loading Coefficient
Of0.250 Has Been Assigned
A Vertical Earthquake Loading Coefficient
Of0.000 Has Been Assigned
Cavitation Pressure = 0.0 (psf)
A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Sliding Block Surfaces, Has Been
Specified.
1000 Trial Surfaces Have Been Generated.
8 Boxes Specified For Generation Of Central Block Base
Length Of Line Segments For Active And Passive Portions Of

Sliding Block Is 20.0

Box No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Height (ft)
1	663.40	1176.70	663.50	1176.70	4.00
2	664.00	1176.70	806.50	1178.00	4.00
3	807.00	1178.00	807.10	1178.00	4.00
4	807.60	1178.00	1218.10	1179.00	4.00
5	1218.60	1179.00	1218.70	1179.00	4.00
6	1219.20	1179.00	1305.10	1204.00	4.00
7	1305.60	1204.00	1305.70	1204.00	4.00
8	1306.10	1204.00	1310.10	1204.00	4.00

The Factor Of Safety For The Trial Failure Surface Defined
By The Coordinates Listed Below Is Misleading.
Failure Surface Defined By 19 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	662.20	1178.30
2	663.41	1178.06
3	799.53	1178.07
4	807.01	1177.21
5	1043.69	1178.04
6	1218.62	1179.76
7	1277.92	1198.06
8	1305.62	1204.99
9	1306.21	1202.67
10	1319.77	1217.37
11	1332.46	1232.83
12	1341.40	1250.72
13	1346.01	1270.18
14	1349.60	1289.86
15	1361.70	1305.78
16	1375.56	1320.19
17	1377.85	1340.06
18	1389.56	1356.27
19	1389.61	1357.16

Factor Of Safety For The Preceding Specified Surface = 1.005
The Factor Of Safety For The Trial Failure Surface Defined
By The Coordinates Listed Below Is Misleading.
Failure Surface Defined By 19 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	660.40	1177.70
2	663.49	1174.84
3	759.00	1179.26
4	807.00	1176.98
5	1162.65	1179.24
6	1218.69	1178.26
7	1282.34	1197.37
8	1305.64	1205.97
9	1306.21	1203.55
10	1320.34	1217.71
11	1331.57	1234.26
12	1345.71	1248.40
13	1359.82	1262.57
14	1373.61	1277.06
15	1377.22	1296.74
16	1391.20	1311.04
17	1399.38	1329.29
18	1413.14	1343.81
19	1415.10	1363.42

Factor Of Safety For The Preceding Specified Surface = 0.985
The Factor Of Safety For The Trial Failure Surface Defined
By The Coordinates Listed Below Is Misleading.
Failure Surface Defined By 19 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	659.49	1177.40
2	663.41	1174.94
3	708.07	1176.46
4	807.02	1178.70

5	1131.38	1179.45
6	1218.67	1179.61
7	1257.01	1190.91
8	1305.62	1204.95
9	1306.15	1203.09
10	1314.33	1221.35
11	1327.71	1236.21
12	1341.82	1250.39
13	1354.09	1266.18
14	1367.61	1280.92
15	1369.86	1300.79
16	1374.99	1320.12
17	1385.29	1337.27
18	1399.19	1351.65
19	1402.09	1360.23

Factor Of Safety For The Preceding Specified Surface = 0.987
The Factor Of Safety For The Trial Failure Surface Defined
By The Coordinates Listed Below Is Misleading.
Failure Surface Defined By 19 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	662.79	1178.50
2	663.41	1178.05
3	673.87	1175.20
4	807.09	1179.01
5	842.05	1178.13
6	1218.60	1180.37
7	1290.75	1201.69
8	1305.63	1205.41
9	1306.37	1202.88
10	1316.99	1219.83
11	1327.63	1236.76
12	1341.77	1250.90
13	1355.53	1265.42
14	1364.47	1283.31
15	1364.90	1303.30
16	1378.89	1317.59
17	1392.11	1332.61
18	1394.61	1352.45
19	1402.01	1360.21

Factor Of Safety For The Preceding Specified Surface = 0.972
Factor Of Safety Calculation Has Gone Through Ten Iterations
The Trial Failure Surface In Question Is Defined
By The Following 19 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	662.07	1178.26
2	663.41	1177.15
3	782.17	1179.24
4	807.05	1179.32
5	963.22	1177.80
6	1218.64	1177.13
7	1238.59	1183.47
8	1305.64	1205.88
9	1306.58	1202.67
10	1318.93	1218.40
11	1324.27	1237.67
12	1324.71	1257.67
13	1325.66	1277.64
14	1339.78	1291.81
15	1353.90	1305.97
16	1366.01	1321.89
17	1380.15	1336.03
18	1388.24	1354.33
19	1389.90	1357.23

Factor Of Safety For The Preceding Specified Surface = 1.576
Factor Of Safety Calculation Has Gone Through Ten Iterations
The Trial Failure Surface In Question Is Defined
By The Following 19 Coordinate Points

Point	X-Surf	Y-Surf

```
    No.        (ft)        (ft)
     1        662.07     1178.26
     2        663.41     1177.15
     3        782.17     1179.24
     4        807.05     1179.32
     5        963.22     1177.80
     6       1218.64     1177.13
     7       1238.59     1183.47
     8       1305.64     1205.88
     9       1306.58     1202.67
    10       1318.93     1218.40
    11       1324.27     1237.67
    12       1324.71     1257.67
    13       1325.66     1277.64
    14       1339.78     1291.81
    15       1353.90     1305.97
    16       1366.01     1321.89
    17       1380.15     1336.03
    18       1388.24     1354.33
    19       1389.90     1357.23
 Factor Of Safety For The Preceding Specified Surface =  1.576
 Factor Of Safety Calculation Has Gone Through Ten Iterations
 The Trial Failure Surface In Question Is Defined
 By The Following 19 Coordinate Points
   Point      X-Surf      Y-Surf
    No.        (ft)        (ft)
     1        662.07     1178.26
     2        663.41     1177.15
     3        782.17     1179.24
     4        807.05     1179.32
     5        963.22     1177.80
     6       1218.64     1177.13
     7       1238.59     1183.47
     8       1305.64     1205.88
     9       1306.58     1202.67
    10       1318.93     1218.40
    11       1324.27     1237.67
    12       1324.71     1257.67
    13       1325.66     1277.64
    14       1339.78     1291.81
    15       1353.90     1305.97
    16       1366.01     1321.89
    17       1380.15     1336.03
    18       1388.24     1354.33
    19       1389.90     1357.23
 Factor Of Safety For The Preceding Specified Surface =  1.576
 Factor Of Safety Calculation Has Gone Through Ten Iterations
 The Trial Failure Surface In Question Is Defined
 By The Following 19 Coordinate Points
   Point      X-Surf      Y-Surf
    No.        (ft)        (ft)
     1        662.07     1178.26
     2        663.41     1177.15
     3        782.17     1179.24
     4        807.05     1179.32
     5        963.22     1177.80
     6       1218.64     1177.13
     7       1238.59     1183.47
     8       1305.64     1205.88
     9       1306.58     1202.67
    10       1318.93     1218.40
    11       1324.27     1237.67
    12       1324.71     1257.67
    13       1325.66     1277.64
    14       1339.78     1291.81
    15       1353.90     1305.97
    16       1366.01     1321.89
    17       1380.15     1336.03
    18       1388.24     1354.33
    19       1389.90     1357.23
```

Factor Of Safety For The Preceding Specified Surface = 1.576
Factor Of Safety Calculation Has Gone Through Ten Iterations
The Trial Failure Surface In Question Is Defined
By The Following 19 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	662.07	1178.26
2	663.41	1177.15
3	782.17	1179.24
4	807.05	1179.32
5	963.22	1177.80
6	1218.64	1177.13
7	1238.59	1183.47
8	1305.64	1205.88
9	1306.58	1202.67
10	1318.93	1218.40
11	1324.27	1237.67
12	1324.71	1257.67
13	1325.66	1277.64
14	1339.78	1291.81
15	1353.90	1305.97
16	1366.01	1321.89
17	1380.15	1336.03
18	1388.24	1354.33
19	1389.90	1357.23

Factor Of Safety For The Preceding Specified Surface = 1.576
Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Examined. They Are Ordered - Most Critical
First.
* * Safety Factors Are Calculated By The Modified Janbu Method * *
Failure Surface Specified By 20 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	658.70	1177.13
2	663.42	1176.33
3	678.36	1177.16
4	807.03	1177.38
5	1215.77	1179.16
6	1218.62	1180.06
7	1278.02	1195.56
8	1305.68	1203.68
9	1309.79	1205.16
10	1323.89	1219.34
11	1335.54	1235.60
12	1345.54	1252.92
13	1359.57	1267.17
14	1371.47	1283.25
15	1385.59	1297.41
16	1397.02	1313.82
17	1410.53	1328.57
18	1423.69	1343.63
19	1435.79	1359.55
20	1446.42	1371.12

*** 1.005 ***

Individual data on the 27 slices

Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Tie Force Norm (lbs)	Tie Force Tan (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Surcharge Load (lbs)
1	0.4	4.4	0.0	0.0	0.0	0.0	1.1	0.0	0.0
2	4.3	661.5	0.0	0.0	0.0	0.0	165.4	0.0	0.0
3	0.0	7.1	0.0	0.0	0.0	0.0	1.8	0.0	0.0
4	14.9	5479.4	0.0	0.0	0.0	0.0	1369.9	0.0	0.0
5	53.9	49572.8	0.0	0.0	0.0	0.0	12393.2	0.0	0.0
6	74.8	152657.0	0.0	0.0	0.0	0.0	38164.3	0.0	0.0
7	0.1	195.1	0.0	0.0	0.0	0.0	48.8	0.0	0.0
8	408.7	2504456.2	0.0	0.0	0.0	0.0	*******	0.0	0.0
9	2.8	26976.3	0.0	0.0	0.0	0.0	6744.1	0.0	0.0
10	0.0	213.4	0.0	0.0	0.0	0.0	53.4	0.0	0.0
11	59.4	564889.9	0.0	0.0	0.0	0.0	*******	0.0	0.0

12	27.6	261108.8	0.0	0.0	0.0	0.0	65277.2	0.0	0.0
13	0.1	795.4	0.0	0.0	0.0	0.0	198.9	0.0	0.0
14	4.1	38420.5	0.0	0.0	0.0	0.0	9605.1	0.0	0.0
15	0.8	7522.7	0.0	0.0	0.0	0.0	1880.7	0.0	0.0
16	0.0	175.7	0.0	0.0	0.0	0.0	43.9	0.0	0.0
17	13.3	117707.4	0.0	0.0	0.0	0.0	29426.8	0.0	0.0
18	11.7	93774.7	0.0	0.0	0.0	0.0	23443.7	0.0	0.0
19	10.0	70565.1	0.0	0.0	0.0	0.0	17641.3	0.0	0.0
20	14.0	86432.2	0.0	0.0	0.0	0.0	21608.0	0.0	0.0
21	11.9	63318.5	0.0	0.0	0.0	0.0	15829.6	0.0	0.0
22	14.1	63395.3	0.0	0.0	0.0	0.0	15848.8	0.0	0.0
23	11.4	41565.4	0.0	0.0	0.0	0.0	10391.3	0.0	0.0
24	13.5	37304.4	0.0	0.0	0.0	0.0	9326.1	0.0	0.0
25	13.2	25622.1	0.0	0.0	0.0	0.0	6405.5	0.0	0.0
26	12.1	13073.1	0.0	0.0	0.0	0.0	3268.3	0.0	0.0
27	10.6	3332.3	0.0	0.0	0.0	0.0	833.1	0.0	0.0

Failure Surface Specified By 20 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	658.70	1177.13
2	663.42	1176.33
3	678.36	1177.16
4	807.03	1177.38
5	1215.77	1179.16
6	1218.62	1180.06
7	1278.02	1195.56
8	1305.68	1203.68
9	1309.79	1205.16
10	1323.89	1219.34
11	1335.54	1235.60
12	1345.54	1252.92
13	1359.57	1267.17
14	1371.47	1283.25
15	1385.59	1297.41
16	1397.02	1313.82
17	1410.53	1328.57
18	1423.69	1343.63
19	1435.79	1359.55
20	1446.42	1371.12

*** 1.005 ***

Failure Surface Specified By 20 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	658.70	1177.13
2	663.42	1176.33
3	678.36	1177.16
4	807.03	1177.38
5	1215.77	1179.16
6	1218.62	1180.06
7	1278.02	1195.56
8	1305.68	1203.68
9	1309.79	1205.16
10	1323.89	1219.34
11	1335.54	1235.60
12	1345.54	1252.92
13	1359.57	1267.17
14	1371.47	1283.25
15	1385.59	1297.41
16	1397.02	1313.82
17	1410.53	1328.57
18	1423.69	1343.63
19	1435.79	1359.55
20	1446.42	1371.12

*** 1.005 ***

Failure Surface Specified By 20 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	658.70	1177.13
2	663.42	1176.33
3	678.36	1177.16

4	807.03	1177.38
5	1215.77	1179.16
6	1218.62	1180.06
7	1278.02	1195.56
8	1305.68	1203.68
9	1309.79	1205.16
10	1323.89	1219.34
11	1335.54	1235.60
12	1345.54	1252.92
13	1359.57	1267.17
14	1371.47	1283.25
15	1385.59	1297.41
16	1397.02	1313.82
17	1410.53	1328.57
18	1423.69	1343.63
19	1435.79	1359.55
20	1446.42	1371.12

*** 1.005 ***

Failure Surface Specified By 20 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	658.70	1177.13
2	663.42	1176.33
3	678.36	1177.16
4	807.03	1177.38
5	1215.77	1179.16
6	1218.62	1180.06
7	1278.02	1195.56
8	1305.68	1203.68
9	1309.79	1205.16
10	1323.89	1219.34
11	1335.54	1235.60
12	1345.54	1252.92
13	1359.57	1267.17
14	1371.47	1283.25
15	1385.59	1297.41
16	1397.02	1313.82
17	1410.53	1328.57
18	1423.69	1343.63
19	1435.79	1359.55
20	1446.42	1371.12

*** 1.005 ***

Failure Surface Specified By 20 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	655.33	1176.01
2	663.47	1175.96
3	720.49	1177.51
4	807.09	1177.62
5	867.31	1176.26
6	1218.61	1178.66
7	1251.74	1187.60
8	1305.63	1202.39
9	1309.49	1202.33
10	1323.16	1216.92
11	1336.28	1232.02
12	1350.06	1246.51
13	1364.10	1260.76
14	1375.48	1277.21
15	1386.78	1293.71
16	1399.72	1308.96
17	1412.77	1324.11
18	1421.02	1342.33
19	1434.89	1356.74
20	1448.17	1371.55

*** 1.006 ***

Failure Surface Specified By 20 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	655.33	1176.01

2	663.47	1175.96
3	720.49	1177.51
4	807.09	1177.62
5	867.31	1176.26
6	1218.61	1178.66
7	1251.74	1187.60
8	1305.63	1202.39
9	1309.49	1202.33
10	1323.16	1216.92
11	1336.28	1232.02
12	1350.06	1246.51
13	1364.10	1260.76
14	1375.48	1277.21
15	1386.78	1293.71
16	1399.72	1308.96
17	1412.77	1324.11
18	1421.02	1342.33
19	1434.89	1356.74
20	1448.17	1371.55
***	1.006	***

Failure Surface Specified By 20 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	655.33	1176.01
2	663.47	1175.96
3	720.49	1177.51
4	807.09	1177.62
5	867.31	1176.26
6	1218.61	1178.66
7	1251.74	1187.60
8	1305.63	1202.39
9	1309.49	1202.33
10	1323.16	1216.92
11	1336.28	1232.02
12	1350.06	1246.51
13	1364.10	1260.76
14	1375.48	1277.21
15	1386.78	1293.71
16	1399.72	1308.96
17	1412.77	1324.11
18	1421.02	1342.33
19	1434.89	1356.74
20	1448.17	1371.55
***	1.006	***

Failure Surface Specified By 20 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	655.33	1176.01
2	663.47	1175.96
3	720.49	1177.51
4	807.09	1177.62
5	867.31	1176.26
6	1218.61	1178.66
7	1251.74	1187.60
8	1305.63	1202.39
9	1309.49	1202.33
10	1323.16	1216.92
11	1336.28	1232.02
12	1350.06	1246.51
13	1364.10	1260.76
14	1375.48	1277.21
15	1386.78	1293.71
16	1399.72	1308.96
17	1412.77	1324.11
18	1421.02	1342.33
19	1434.89	1356.74
20	1448.17	1371.55
***	1.006	***

Failure Surface Specified By 20 Coordinate Points

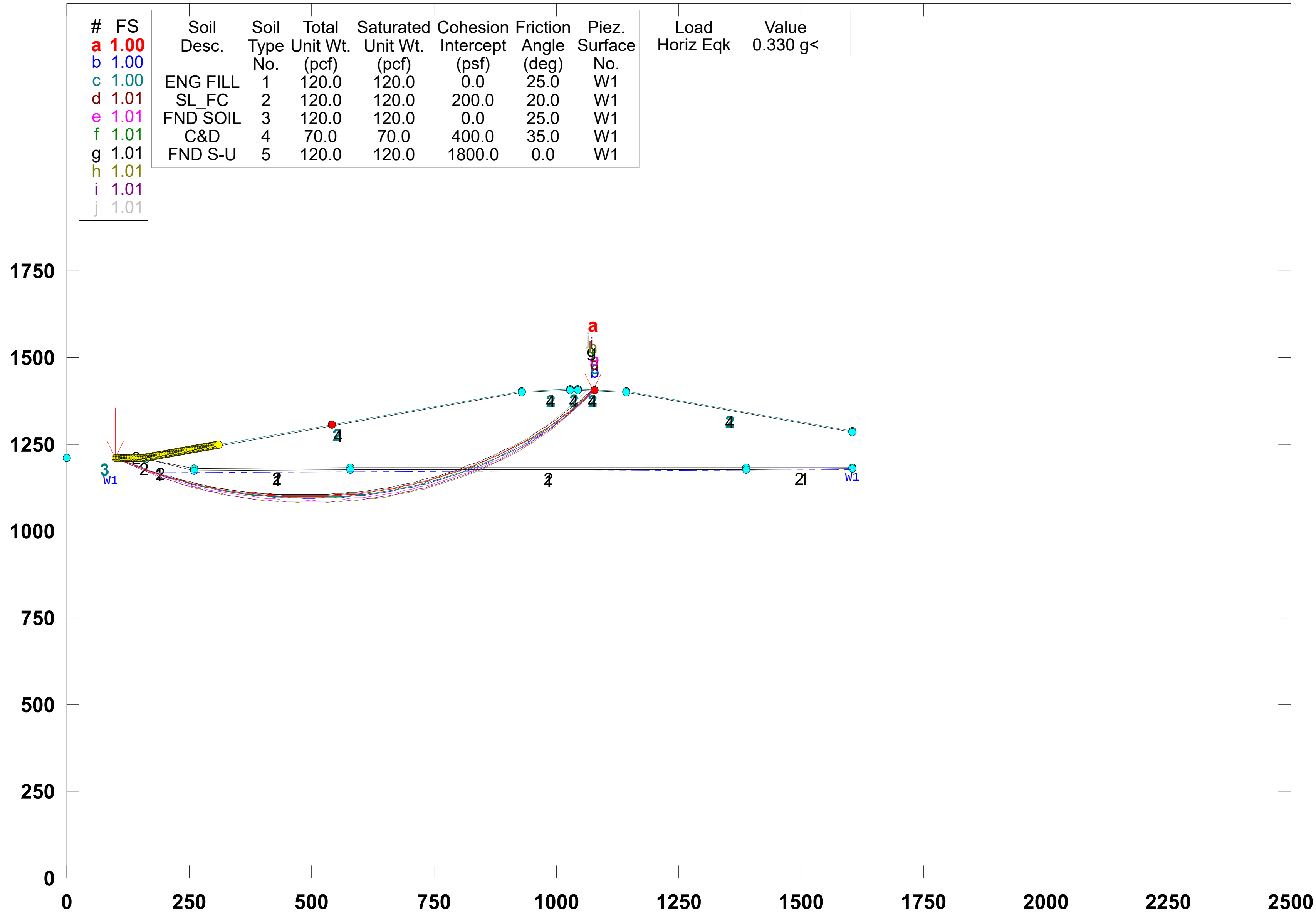
Point	X-Surf	Y-Surf

No.	(ft)	(ft)
1	655.33	1176.01
2	663.47	1175.96
3	720.49	1177.51
4	807.09	1177.62
5	867.31	1176.26
6	1218.61	1178.66
7	1251.74	1187.60
8	1305.63	1202.39
9	1309.49	1202.33
10	1323.16	1216.92
11	1336.28	1232.02
12	1350.06	1246.51
13	1364.10	1260.76
14	1375.48	1277.21
15	1386.78	1293.71
16	1399.72	1308.96
17	1412.77	1324.11
18	1421.02	1342.33
19	1434.89	1356.74
20	1448.17	1371.55

*** 1.006 ***

Northeast Landfill Cross Section AA', Circular (Seismic)

m:\projects\16219107.00\task 3 - tier iii modification app\permit application\app c - liner and final cover system stability analysis\stabl files\nelf\2023.4.13 nelf_xs_aa'_circ (seismic).pl2   Run By: Username   5/11/2023



PCSTABL5M3 FSmin=1.00

Safety Factors Are Calculated By The Modified Bishop Method

**** PCSTABL5M3 ****
by Purdue University 1985
rev. for SCS Engineers HVA 2008
--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer`s Method of Slices

Run Date: 5/11/2023
Time of Run: 06:06PM
Run By: Username
Input Data Filename: M:2023.4.13 nelf_xs_aa'_circ (seismic).in
Output Filename: M:2023.4.13 nelf_xs_aa'_circ (seismic).OUT
Unit: ENGLISH
Plotted Output Filename: M:2023.4.13 nelf_xs_aa'_circ (seismic).PLT
PROBLEM DESCRIPTION Northeast Landfill
Cross Section AA', Circular (Seismic)

BOUNDARY COORDINATES
Note: User origin value specified.
Add 0.00 to X-values and 0.00 to Y-values listed.

6 Top Boundaries
21 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	0.00	1212.00	154.70	1210.50	3
2	154.70	1210.50	928.90	1404.00	2
3	928.90	1404.00	1029.10	1408.00	2
4	1029.10	1408.00	1043.80	1408.00	2
5	1043.80	1408.00	1144.10	1404.00	2
6	1144.10	1404.00	1603.40	1289.90	2
7	154.70	1210.50	160.70	1210.50	2
8	160.70	1210.50	162.30	1209.40	2
9	162.30	1209.40	928.90	1401.00	4
10	928.90	1401.00	1029.10	1405.00	4
11	1029.10	1405.00	1043.80	1405.00	4
12	1043.80	1405.00	1144.10	1401.00	4
13	1144.10	1401.00	1603.40	1286.90	4
14	162.30	1209.40	261.10	1179.40	2
15	261.10	1179.40	579.00	1182.30	2
16	579.00	1182.30	1386.40	1182.10	2
17	1386.40	1182.10	1603.40	1184.20	2
18	154.70	1210.50	261.10	1175.40	1
19	261.10	1175.40	579.00	1178.30	1
20	579.00	1178.30	1386.40	1178.10	1
21	1386.40	1178.10	1603.40	1180.20	1

ISOTROPIC SOIL PARAMETERS
5 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	120.0	120.0	0.0	25.0	0.00	0.0	1
2	120.0	120.0	200.0	20.0	0.00	0.0	1
3	120.0	120.0	0.0	25.0	0.00	0.0	1
4	70.0	70.0	400.0	35.0	0.00	0.0	1
5	120.0	120.0	1800.0	0.0	0.00	0.0	1

1 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED
Unit Weight of Water = 62.40
Piezometric Surface No. 1 Specified by 2 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	88.50	1168.30
2	1603.40	1177.60

A Horizontal Earthquake Loading Coefficient
Of0.330 Has Been Assigned
A Vertical Earthquake Loading Coefficient
Of0.000 Has Been Assigned
Cavitation Pressure = 0.0 (psf)
A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Circular Surfaces, Has Been Specified.
10000 Trial Surfaces Have Been Generated.
100 Surfaces Initiate From Each Of100 Points Equally Spaced

Along The Ground Surface Between X = 100.00 ft.
and X = 310.00 ft.
Each Surface Terminates Between   X = 541.50 ft.
and   X =1078.00 ft.
Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y = 0.00 ft.
15.00 ft. Line Segments Define Each Trial Failure Surface.
Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Examined. They Are Ordered - Most Critical
First.
* * Safety Factors Are Calculated By The Modified Bishop Method * *
Failure Surface Specified By 75 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	100.00	1211.03
2	112.76	1203.15
3	125.69	1195.54
4	138.77	1188.19
5	152.00	1181.12
6	165.37	1174.33
7	178.88	1167.82
8	192.53	1161.59
9	206.30	1155.65
10	220.19	1149.99
11	234.20	1144.63
12	248.32	1139.55
13	262.54	1134.78
14	276.85	1130.30
15	291.26	1126.11
16	305.75	1122.23
17	320.31	1118.66
18	334.95	1115.38
19	349.66	1112.42
20	364.42	1109.75
21	379.23	1107.40
22	394.09	1105.36
23	408.99	1103.62
24	423.92	1102.20
25	438.88	1101.09
26	453.86	1100.29
27	468.85	1099.80
28	483.85	1099.62
29	498.85	1099.76
30	513.85	1100.21
31	528.83	1100.97
32	543.79	1102.04
33	558.72	1103.43
34	573.63	1105.12
35	588.49	1107.12
36	603.31	1109.44
37	618.08	1112.06
38	632.79	1114.99
39	647.44	1118.22
40	662.02	1121.76
41	676.52	1125.60
42	690.93	1129.75
43	705.26	1134.19
44	719.49	1138.93
45	733.62	1143.96
46	747.64	1149.29
47	761.55	1154.91
48	775.34	1160.82
49	789.00	1167.01
50	802.53	1173.49
51	815.92	1180.24
52	829.17	1187.28
53	842.27	1194.59
54	855.22	1202.17
55	868.00	1210.01
56	880.62	1218.12

57	893.06	1226.50
58	905.33	1235.13
59	917.42	1244.01
60	929.32	1253.15
61	941.02	1262.52
62	952.53	1272.15
63	963.83	1282.00
64	974.93	1292.10
65	985.82	1302.42
66	996.48	1312.96
67	1006.93	1323.73
68	1017.15	1334.71
69	1027.14	1345.90
70	1036.89	1357.30
71	1046.40	1368.89
72	1055.67	1380.69
73	1064.70	1392.67
74	1073.47	1404.84
75	1074.80	1406.76

Circle Center At X = 484.8 ; Y = 1819.9 and Radius, 720.3

*** 1.003 ***

Individual data on the 87 slices

Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Tie Force Norm (lbs)	Tie Force Tan (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Surcharge Load (lbs)
1	12.8	5940.4	0.0	0.0	0.0	0.0	1960.3	0.0	0.0
2	12.9	17838.0	0.0	0.0	0.0	0.0	5886.5	0.0	0.0
3	13.1	29592.9	0.0	0.0	0.0	0.0	9765.6	0.0	0.0
4	13.2	41170.1	0.0	0.0	0.0	0.0	13586.1	0.0	0.0
5	2.7	9756.5	0.0	0.0	0.0	0.0	3219.7	0.0	0.0
6	6.0	23776.5	0.0	0.0	0.0	0.0	7846.3	0.0	0.0
7	1.6	6893.3	0.0	0.0	0.0	0.0	2274.8	0.0	0.0
8	3.1	13752.0	0.0	0.0	0.0	0.0	4538.1	0.0	0.0
9	11.4	56016.0	0.0	0.0	0.0	0.0	18485.3	0.0	0.0
10	2.1	11299.6	0.0	76.1	0.0	0.0	3728.9	0.0	0.0
11	13.6	78836.8	0.0	3924.0	0.0	0.0	26016.1	0.0	0.0
12	13.8	90065.0	0.0	9699.6	0.0	0.0	29721.4	0.0	0.0
13	13.9	100968.2	0.0	15207.4	0.0	0.0	33319.5	0.0	0.0
14	14.0	111517.0	0.0	20445.3	0.0	0.0	36800.6	0.0	0.0
15	14.1	121681.7	0.0	25410.6	0.0	0.0	40154.9	0.0	0.0
16	12.8	117759.9	0.0	26852.5	0.0	0.0	38860.8	0.0	0.0
17	1.4	13691.2	0.0	3249.0	0.0	0.0	4518.1	0.0	0.0
18	14.3	142673.4	0.0	34515.7	0.0	0.0	47082.2	0.0	0.0
19	14.4	154772.5	0.0	38651.8	0.0	0.0	51074.9	0.0	0.0
20	14.5	166440.2	0.0	42507.2	0.0	0.0	54925.3	0.0	0.0
21	14.6	177649.9	0.0	46080.9	0.0	0.0	58624.5	0.0	0.0
22	14.6	188374.6	0.0	49371.0	0.0	0.0	62163.6	0.0	0.0
23	14.7	198589.1	0.0	52376.0	0.0	0.0	65534.4	0.0	0.0
24	14.8	208271.0	0.0	55095.1	0.0	0.0	68729.4	0.0	0.0
25	14.8	217397.2	0.0	57526.6	0.0	0.0	71741.1	0.0	0.0
26	14.9	225947.2	0.0	59669.6	0.0	0.0	74562.6	0.0	0.0
27	14.9	233902.9	0.0	61523.2	0.0	0.0	77188.0	0.0	0.0
28	14.9	241246.6	0.0	63086.7	0.0	0.0	79611.4	0.0	0.0
29	15.0	247962.4	0.0	64359.2	0.0	0.0	81827.6	0.0	0.0
30	15.0	254036.4	0.0	65340.3	0.0	0.0	83832.0	0.0	0.0
31	15.0	259455.9	0.0	66029.4	0.0	0.0	85620.4	0.0	0.0
32	15.0	264211.5	0.0	66426.6	0.0	0.0	87189.8	0.0	0.0
33	15.0	268293.8	0.0	66531.6	0.0	0.0	88536.9	0.0	0.0
34	15.0	271694.5	0.0	66343.9	0.0	0.0	89659.2	0.0	0.0
35	15.0	274410.1	0.0	65864.1	0.0	0.0	90555.3	0.0	0.0
36	15.0	276435.5	0.0	65092.0	0.0	0.0	91223.7	0.0	0.0
37	14.9	277769.9	0.0	64028.5	0.0	0.0	91664.1	0.0	0.0
38	14.9	278412.8	0.0	62673.5	0.0	0.0	91876.2	0.0	0.0
39	5.4	100548.2	0.0	22260.3	0.0	0.0	33180.9	0.0	0.0
40	9.5	177795.6	0.0	38767.3	0.0	0.0	58672.5	0.0	0.0
41	14.8	277515.3	0.0	59092.1	0.0	0.0	91580.1	0.0	0.0
42	14.8	275999.7	0.0	56867.3	0.0	0.0	91079.9	0.0	0.0
43	14.7	273811.1	0.0	54354.3	0.0	0.0	90357.7	0.0	0.0
44	14.6	270958.4	0.0	51554.3	0.0	0.0	89416.3	0.0	0.0

45	14.6	267452.6	0.0	48468.1	0.0	0.0	88259.4	0.0	0.0
46	14.5	263307.5	0.0	45097.8	0.0	0.0	86891.5	0.0	0.0
47	14.4	258535.2	0.0	41444.1	0.0	0.0	85316.6	0.0	0.0
48	14.3	253151.7	0.0	37509.0	0.0	0.0	83540.1	0.0	0.0
49	14.2	247175.7	0.0	33294.2	0.0	0.0	81568.0	0.0	0.0
50	14.1	240624.1	0.0	28801.3	0.0	0.0	79405.9	0.0	0.0
51	14.0	233518.8	0.0	24032.5	0.0	0.0	77061.2	0.0	0.0
52	13.9	225881.9	0.0	18989.8	0.0	0.0	74541.0	0.0	0.0
53	13.8	217734.8	0.0	13675.3	0.0	0.0	71852.5	0.0	0.0
54	13.7	209104.9	0.0	8091.3	0.0	0.0	69004.6	0.0	0.0
55	11.8	175291.7	0.0	2287.5	0.0	0.0	57846.3	0.0	0.0
56	1.7	24724.6	0.0	0.0	0.0	0.0	8159.1	0.0	0.0
57	9.4	134890.1	0.0	0.0	0.0	0.0	44513.7	0.0	0.0
58	4.0	55607.5	0.0	0.0	0.0	0.0	18350.5	0.0	0.0
59	3.8	52099.1	0.0	0.0	0.0	0.0	17192.7	0.0	0.0
60	9.5	129674.7	0.0	0.0	0.0	0.0	42792.6	0.0	0.0
61	13.1	175982.4	0.0	0.0	0.0	0.0	58074.2	0.0	0.0
62	12.9	170103.8	0.0	0.0	0.0	0.0	56134.3	0.0	0.0
63	12.8	163967.4	0.0	0.0	0.0	0.0	54109.2	0.0	0.0
64	12.6	157591.5	0.0	0.0	0.0	0.0	52005.2	0.0	0.0
65	12.4	150994.9	0.0	0.0	0.0	0.0	49828.3	0.0	0.0
66	12.3	144197.8	0.0	0.0	0.0	0.0	47585.3	0.0	0.0
67	12.1	137220.5	0.0	0.0	0.0	0.0	45282.8	0.0	0.0
68	11.5	125624.4	0.0	0.0	0.0	0.0	41456.1	0.0	0.0
69	0.4	4457.7	0.0	0.0	0.0	0.0	1471.1	0.0	0.0
70	11.7	121729.5	0.0	0.0	0.0	0.0	40170.8	0.0	0.0
71	11.5	112391.9	0.0	0.0	0.0	0.0	37089.3	0.0	0.0
72	11.3	103063.0	0.0	0.0	0.0	0.0	34010.8	0.0	0.0
73	11.1	93767.3	0.0	0.0	0.0	0.0	30943.2	0.0	0.0
74	10.9	84529.2	0.0	0.0	0.0	0.0	27894.6	0.0	0.0
75	10.7	75372.4	0.0	0.0	0.0	0.0	24872.9	0.0	0.0
76	10.4	66321.5	0.0	0.0	0.0	0.0	21886.1	0.0	0.0
77	10.2	57401.0	0.0	0.0	0.0	0.0	18942.3	0.0	0.0
78	10.0	48635.6	0.0	0.0	0.0	0.0	16049.7	0.0	0.0
79	2.0	8664.2	0.0	0.0	0.0	0.0	2859.2	0.0	0.0
80	7.8	31299.8	0.0	0.0	0.0	0.0	10328.9	0.0	0.0
81	6.9	23524.5	0.0	0.0	0.0	0.0	7763.1	0.0	0.0
82	2.6	7797.7	0.0	0.0	0.0	0.0	2573.3	0.0	0.0
83	9.3	22753.5	0.0	0.0	0.0	0.0	7508.6	0.0	0.0
84	9.0	14407.5	0.0	0.0	0.0	0.0	4754.5	0.0	0.0
85	8.1	6142.0	0.0	0.0	0.0	0.0	2026.9	0.0	0.0
86	0.7	213.7	0.0	0.0	0.0	0.0	70.5	0.0	0.0
87	1.3	157.8	0.0	0.0	0.0	0.0	52.1	0.0	0.0

Failure Surface Specified By 75 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	104.24	1210.99
2	116.86	1202.87
3	129.64	1195.03
4	142.59	1187.46
5	155.70	1180.17
6	168.96	1173.15
7	182.36	1166.42
8	195.91	1159.98
9	209.59	1153.82
10	223.40	1147.96
11	237.32	1142.39
12	251.37	1137.12
13	265.52	1132.15
14	279.78	1127.48
15	294.13	1123.12
16	308.57	1119.06
17	323.09	1115.31
18	337.69	1111.86
19	352.36	1108.73
20	367.09	1105.91
21	381.88	1103.41
22	396.72	1101.22
23	411.60	1099.35
24	426.52	1097.79

25	441.47	1096.55
26	456.44	1095.63
27	471.43	1095.02
28	486.43	1094.74
29	501.43	1094.77
30	516.42	1095.13
31	531.41	1095.80
32	546.38	1096.79
33	561.32	1098.09
34	576.23	1099.72
35	591.10	1101.66
36	605.93	1103.92
37	620.71	1106.49
38	635.43	1109.37
39	650.09	1112.57
40	664.67	1116.08
41	679.18	1119.90
42	693.60	1124.02
43	707.93	1128.45
44	722.16	1133.18
45	736.29	1138.22
46	750.31	1143.55
47	764.22	1149.18
48	778.00	1155.11
49	791.65	1161.33
50	805.16	1167.83
51	818.54	1174.62
52	831.76	1181.70
53	844.84	1189.05
54	857.75	1196.68
55	870.50	1204.58
56	883.08	1212.75
57	895.48	1221.19
58	907.70	1229.89
59	919.74	1238.84
60	931.58	1248.05
61	943.22	1257.51
62	954.66	1267.22
63	965.88	1277.16
64	976.90	1287.34
65	987.70	1297.76
66	998.27	1308.40
67	1008.61	1319.26
68	1018.72	1330.34
69	1028.59	1341.64
70	1038.23	1353.14
71	1047.61	1364.84
72	1056.74	1376.74
73	1065.62	1388.83
74	1074.24	1401.10
75	1077.95	1406.64

Circle Center At X = 492.3 ; Y = 1800.5 and Radius, 705.8

*** 1.004 ***

Failure Surface Specified By 75 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	104.24	1210.99
2	116.88	1202.91
3	129.69	1195.10
4	142.65	1187.56
5	155.78	1180.30
6	169.06	1173.32
7	182.48	1166.62
8	196.04	1160.21
9	209.73	1154.09
10	223.55	1148.26
11	237.50	1142.72
12	251.55	1137.48
13	265.71	1132.54
14	279.98	1127.91

15	294.34	1123.57
16	308.79	1119.55
17	323.32	1115.83
18	337.93	1112.41
19	352.60	1109.31
20	367.34	1106.53
21	382.14	1104.05
22	396.98	1101.89
23	411.87	1100.05
24	426.79	1098.52
25	441.74	1097.30
26	456.71	1096.41
27	471.70	1095.83
28	486.70	1095.58
29	501.70	1095.64
30	516.69	1096.01
31	531.68	1096.71
32	546.64	1097.72
33	561.58	1099.06
34	576.49	1100.70
35	591.36	1102.67
36	606.19	1104.95
37	620.96	1107.54
38	635.68	1110.45
39	650.33	1113.67
40	664.91	1117.19
41	679.41	1121.03
42	693.83	1125.17
43	708.15	1129.62
44	722.38	1134.37
45	736.50	1139.42
46	750.52	1144.78
47	764.41	1150.42
48	778.19	1156.36
49	791.83	1162.59
50	805.34	1169.11
51	818.71	1175.92
52	831.93	1183.00
53	845.00	1190.37
54	857.90	1198.01
55	870.65	1205.92
56	883.22	1214.11
57	895.61	1222.55
58	907.83	1231.26
59	919.85	1240.23
60	931.69	1249.45
61	943.32	1258.91
62	954.75	1268.62
63	965.98	1278.58
64	976.98	1288.77
65	987.77	1299.19
66	998.34	1309.83
67	1008.68	1320.70
68	1018.79	1331.78
69	1028.65	1343.08
70	1038.28	1354.59
71	1047.66	1366.29
72	1056.79	1378.19
73	1065.66	1390.29
74	1074.28	1402.56
75	1077.04	1406.67

Circle Center At X = 491.4 ; Y = 1802.4 and Radius, 706.9

*** 1.004 ***

Failure Surface Specified By 74 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	102.12	1211.01
2	114.97	1203.27
3	127.97	1195.79
4	141.12	1188.58

5	154.42	1181.64
6	167.86	1174.98
7	181.44	1168.59
8	195.14	1162.49
9	208.96	1156.67
10	222.90	1151.13
11	236.96	1145.88
12	251.11	1140.93
13	265.37	1136.26
14	279.72	1131.89
15	294.15	1127.82
16	308.67	1124.04
17	323.26	1120.57
18	337.92	1117.39
19	352.65	1114.52
20	367.42	1111.95
21	382.25	1109.68
22	397.12	1107.72
23	412.03	1106.07
24	426.97	1104.72
25	441.94	1103.68
26	456.92	1102.95
27	471.91	1102.53
28	486.91	1102.42
29	501.91	1102.61
30	516.90	1103.12
31	531.88	1103.93
32	546.84	1105.05
33	561.77	1106.47
34	576.67	1108.21
35	591.53	1110.25
36	606.34	1112.60
37	621.11	1115.25
38	635.82	1118.20
39	650.46	1121.45
40	665.03	1125.01
41	679.53	1128.87
42	693.94	1133.02
43	708.27	1137.47
44	722.50	1142.21
45	736.63	1147.24
46	750.65	1152.57
47	764.56	1158.18
48	778.35	1164.07
49	792.02	1170.25
50	805.56	1176.71
51	818.96	1183.44
52	832.22	1190.45
53	845.34	1197.73
54	858.30	1205.28
55	871.10	1213.10
56	883.74	1221.17
57	896.22	1229.51
58	908.51	1238.10
59	920.63	1246.94
60	932.56	1256.03
61	944.31	1265.36
62	955.86	1274.93
63	967.21	1284.74
64	978.35	1294.78
65	989.29	1305.04
66	1000.01	1315.53
67	1010.52	1326.24
68	1020.80	1337.16
69	1030.86	1348.29
70	1040.68	1359.62
71	1050.27	1371.16
72	1059.62	1382.88
73	1068.73	1394.80
74	1077.41	1406.66

Circle Center At X = 484.9 ; Y = 1831.4 and Radius, 729.0
*** 1.005 ***
Failure Surface Specified By 75 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	104.24	1210.99
2	116.68	1202.60
3	129.29	1194.48
4	142.07	1186.63
5	155.03	1179.07
6	168.14	1171.79
7	181.41	1164.80
8	194.83	1158.09
9	208.39	1151.68
10	222.09	1145.57
11	235.92	1139.76
12	249.87	1134.25
13	263.94	1129.04
14	278.12	1124.15
15	292.40	1119.56
16	306.77	1115.28
17	321.24	1111.32
18	335.79	1107.67
19	350.42	1104.34
20	365.11	1101.33
21	379.87	1098.64
22	394.68	1096.28
23	409.54	1094.23
24	424.44	1092.51
25	439.38	1091.11
26	454.34	1090.04
27	469.32	1089.30
28	484.31	1088.88
29	499.31	1088.79
30	514.31	1089.02
31	529.30	1089.58
32	544.28	1090.47
33	559.23	1091.68
34	574.15	1093.22
35	589.03	1095.08
36	603.87	1097.27
37	618.66	1099.78
38	633.39	1102.60
39	648.06	1105.75
40	662.65	1109.22
41	677.16	1113.01
42	691.59	1117.10
43	705.93	1121.52
44	720.17	1126.24
45	734.30	1131.27
46	748.32	1136.61
47	762.21	1142.25
48	775.99	1148.20
49	789.63	1154.44
50	803.13	1160.98
51	816.48	1167.81
52	829.69	1174.92
53	842.73	1182.33
54	855.61	1190.01
55	868.32	1197.98
56	880.86	1206.22
57	893.21	1214.73
58	905.37	1223.51
59	917.34	1232.55
60	929.11	1241.84
61	940.68	1251.40
62	952.03	1261.20
63	963.17	1271.24
64	974.09	1281.53
65	984.78	1292.05

66	995.24	1302.80
67	1005.46	1313.78
68	1015.44	1324.98
69	1025.18	1336.39
70	1034.66	1348.01
71	1043.89	1359.83
72	1052.86	1371.86
73	1061.57	1384.07
74	1070.01	1396.47
75	1076.64	1406.69

Circle Center At X = 496.0 ; Y = 1778.0 and Radius, 689.2
*** 1.005 ***
Failure Surface Specified By 74 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	106.36	1210.97
2	119.02	1202.92
3	131.85	1195.14
4	144.84	1187.64
5	157.99	1180.42
6	171.28	1173.48
7	184.72	1166.82
8	198.30	1160.45
9	212.02	1154.37
10	225.86	1148.59
11	239.82	1143.10
12	253.89	1137.90
13	268.07	1133.01
14	282.35	1128.42
15	296.73	1124.14
16	311.19	1120.17
17	325.73	1116.50
18	340.35	1113.14
19	355.04	1110.10
20	369.79	1107.36
21	384.59	1104.95
22	399.45	1102.85
23	414.34	1101.06
24	429.27	1099.59
25	444.22	1098.44
26	459.20	1097.61
27	474.19	1097.10
28	489.19	1096.91
29	504.19	1097.04
30	519.18	1097.48
31	534.16	1098.25
32	549.12	1099.33
33	564.06	1100.73
34	578.96	1102.45
35	593.82	1104.49
36	608.64	1106.84
37	623.40	1109.51
38	638.10	1112.49
39	652.73	1115.78
40	667.29	1119.39
41	681.77	1123.30
42	696.17	1127.52
43	710.47	1132.04
44	724.67	1136.87
45	738.77	1142.00
46	752.75	1147.43
47	766.61	1153.16
48	780.35	1159.17
49	793.96	1165.49
50	807.43	1172.08
51	820.76	1178.97
52	833.94	1186.13
53	846.96	1193.58
54	859.82	1201.30
55	872.51	1209.29

56	885.03	1217.55
57	897.38	1226.07
58	909.53	1234.86
59	921.50	1243.90
60	933.27	1253.20
61	944.85	1262.74
62	956.21	1272.53
63	967.37	1282.56
64	978.31	1292.82
65	989.03	1303.31
66	999.52	1314.03
67	1009.78	1324.97
68	1019.81	1336.13
69	1029.60	1347.50
70	1039.14	1359.07
71	1048.43	1370.84
72	1057.48	1382.81
73	1066.26	1394.97
74	1074.42	1406.78

Circle Center At X = 490.7 ; Y = 1801.6 and Radius, 704.7

*** 1.005 ***

Failure Surface Specified By 74 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	102.12	1211.01
2	115.01	1203.34
3	128.06	1195.93
4	141.25	1188.80
5	154.59	1181.94
6	168.07	1175.35
7	181.68	1169.05
8	195.41	1163.02
9	209.27	1157.28
10	223.25	1151.83
11	237.33	1146.66
12	251.52	1141.79
13	265.80	1137.21
14	280.17	1132.93
15	294.64	1128.94
16	309.18	1125.26
17	323.79	1121.87
18	338.47	1118.78
19	353.21	1116.00
20	368.00	1113.52
21	382.84	1111.35
22	397.73	1109.48
23	412.64	1107.93
24	427.59	1106.67
25	442.56	1105.73
26	457.55	1105.10
27	472.55	1104.77
28	487.55	1104.76
29	502.54	1105.05
30	517.53	1105.65
31	532.50	1106.56
32	547.45	1107.78
33	562.38	1109.31
34	577.26	1111.14
35	592.11	1113.28
36	606.91	1115.73
37	621.65	1118.48
38	636.34	1121.53
39	650.96	1124.89
40	665.51	1128.55
41	679.98	1132.50
42	694.36	1136.75
43	708.65	1141.30
44	722.85	1146.14
45	736.95	1151.28
46	750.93	1156.70

47	764.80	1162.41
48	778.55	1168.41
49	792.18	1174.68
50	805.67	1181.24
51	819.02	1188.07
52	832.23	1195.18
53	845.29	1202.55
54	858.20	1210.20
55	870.94	1218.11
56	883.52	1226.28
57	895.93	1234.71
58	908.16	1243.39
59	920.21	1252.32
60	932.08	1261.50
61	943.75	1270.92
62	955.23	1280.58
63	966.50	1290.47
64	977.57	1300.60
65	988.43	1310.95
66	999.07	1321.52
67	1009.49	1332.31
68	1019.69	1343.31
69	1029.65	1354.52
70	1039.39	1365.93
71	1048.89	1377.54
72	1058.14	1389.34
73	1067.15	1401.33
74	1071.17	1406.91

Circle Center At X = 480.8 ; Y = 1832.5 and Radius, 727.8

*** 1.006 ***

Failure Surface Specified By 76 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	102.12	1211.01
2	114.35	1202.33
3	126.78	1193.92
4	139.38	1185.79
5	152.17	1177.95
6	165.12	1170.38
7	178.24	1163.11
8	191.52	1156.13
9	204.95	1149.45
10	218.52	1143.07
11	232.24	1136.99
12	246.08	1131.22
13	260.05	1125.75
14	274.14	1120.60
15	288.34	1115.76
16	302.64	1111.24
17	317.04	1107.04
18	331.53	1103.16
19	346.10	1099.60
20	360.74	1096.36
21	375.46	1093.45
22	390.24	1090.87
23	405.07	1088.62
24	419.94	1086.70
25	434.86	1085.11
26	449.81	1083.85
27	464.78	1082.92
28	479.76	1082.33
29	494.76	1082.06
30	509.76	1082.14
31	524.76	1082.54
32	539.74	1083.28
33	554.70	1084.35
34	569.63	1085.75
35	584.53	1087.48
36	599.39	1089.55
37	614.20	1091.94

38	628.95	1094.66
39	643.64	1097.71
40	658.25	1101.08
41	672.79	1104.78
42	687.24	1108.80
43	701.60	1113.14
44	715.86	1117.80
45	730.01	1122.77
46	744.05	1128.06
47	757.96	1133.66
48	771.75	1139.56
49	785.41	1145.77
50	798.92	1152.28
51	812.29	1159.09
52	825.50	1166.20
53	838.55	1173.59
54	851.43	1181.28
55	864.14	1189.25
56	876.66	1197.49
57	889.01	1206.02
58	901.16	1214.82
59	913.11	1223.88
60	924.85	1233.21
61	936.39	1242.80
62	947.71	1252.64
63	958.81	1262.73
64	969.68	1273.06
65	980.32	1283.63
66	990.73	1294.44
67	1000.89	1305.47
68	1010.80	1316.73
69	1020.46	1328.21
70	1029.87	1339.89
71	1039.01	1351.79
72	1047.88	1363.88
73	1056.49	1376.16
74	1064.82	1388.64
75	1072.87	1401.30
76	1076.14	1406.71

Circle Center At X = 499.0 ; Y = 1757.3 and Radius, 675.3

*** 1.006 ***

Failure Surface Specified By 76 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	102.12	1211.01
2	114.37	1202.36
3	126.82	1193.98
4	139.44	1185.88
5	152.25	1178.07
6	165.22	1170.54
7	178.36	1163.30
8	191.65	1156.35
9	205.10	1149.71
10	218.69	1143.36
11	232.42	1137.32
12	246.28	1131.59
13	260.27	1126.16
14	274.37	1121.05
15	288.58	1116.25
16	302.90	1111.77
17	317.31	1107.61
18	331.81	1103.77
19	346.39	1100.26
20	361.05	1097.07
21	375.77	1094.21
22	390.56	1091.67
23	405.39	1089.47
24	420.28	1087.59
25	435.20	1086.05
26	450.15	1084.84

27	465.12	1083.97
28	480.11	1083.42
29	495.11	1083.21
30	510.11	1083.34
31	525.10	1083.80
32	540.08	1084.59
33	555.04	1085.71
34	569.97	1087.17
35	584.86	1088.96
36	599.71	1091.08
37	614.51	1093.53
38	629.25	1096.31
39	643.93	1099.41
40	658.53	1102.85
41	673.05	1106.60
42	687.49	1110.68
43	701.83	1115.08
44	716.06	1119.80
45	730.20	1124.83
46	744.21	1130.17
47	758.10	1135.83
48	771.87	1141.79
49	785.49	1148.06
50	798.98	1154.63
51	812.31	1161.50
52	825.49	1168.66
53	838.51	1176.12
54	851.36	1183.86
55	864.03	1191.89
56	876.52	1200.19
57	888.82	1208.78
58	900.93	1217.63
59	912.84	1226.75
60	924.54	1236.14
61	936.03	1245.78
62	947.30	1255.68
63	958.35	1265.82
64	969.17	1276.21
65	979.76	1286.83
66	990.11	1297.69
67	1000.21	1308.78
68	1010.07	1320.09
69	1019.67	1331.61
70	1029.01	1343.35
71	1038.09	1355.29
72	1046.90	1367.43
73	1055.44	1379.76
74	1063.70	1392.28
75	1071.68	1404.98
76	1072.79	1406.84

Circle Center At X = 497.0 ; Y = 1757.2 and Radius, 674.0

*** 1.006 ***

Failure Surface Specified By 74 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	106.36	1210.97
2	119.07	1202.99
3	131.93	1195.28
4	144.97	1187.86
5	158.15	1180.71
6	171.49	1173.85
7	184.97	1167.27
8	198.60	1160.99
9	212.35	1155.00
10	226.22	1149.30
11	240.22	1143.91
12	254.33	1138.81
13	268.54	1134.02
14	282.86	1129.54
15	297.26	1125.36

16	311.76	1121.49
17	326.33	1117.94
18	340.97	1114.70
19	355.69	1111.77
20	370.46	1109.16
21	385.28	1106.87
22	400.15	1104.89
23	415.06	1103.23
24	430.00	1101.90
25	444.96	1100.88
26	459.95	1100.19
27	474.94	1099.82
28	489.94	1099.77
29	504.94	1100.04
30	519.93	1100.63
31	534.90	1101.54
32	549.85	1102.78
33	564.77	1104.33
34	579.65	1106.21
35	594.49	1108.40
36	609.28	1110.91
37	624.01	1113.74
38	638.68	1116.88
39	653.27	1120.34
40	667.79	1124.10
41	682.23	1128.18
42	696.57	1132.57
43	710.82	1137.26
44	724.96	1142.26
45	738.99	1147.56
46	752.91	1153.16
47	766.70	1159.06
48	780.36	1165.25
49	793.89	1171.74
50	807.28	1178.51
51	820.51	1185.56
52	833.59	1192.90
53	846.51	1200.52
54	859.27	1208.42
55	871.85	1216.58
56	884.26	1225.01
57	896.48	1233.71
58	908.51	1242.67
59	920.35	1251.88
60	931.98	1261.35
61	943.42	1271.06
62	954.64	1281.01
63	965.64	1291.21
64	976.42	1301.63
65	986.98	1312.29
66	997.31	1323.17
67	1007.40	1334.27
68	1017.25	1345.58
69	1026.85	1357.10
70	1036.21	1368.83
71	1045.31	1380.75
72	1054.15	1392.87
73	1062.74	1405.17
74	1064.09	1407.19

Circle Center At X = 484.8 ; Y = 1799.2 and Radius, 699.4

*** 1.006 ***

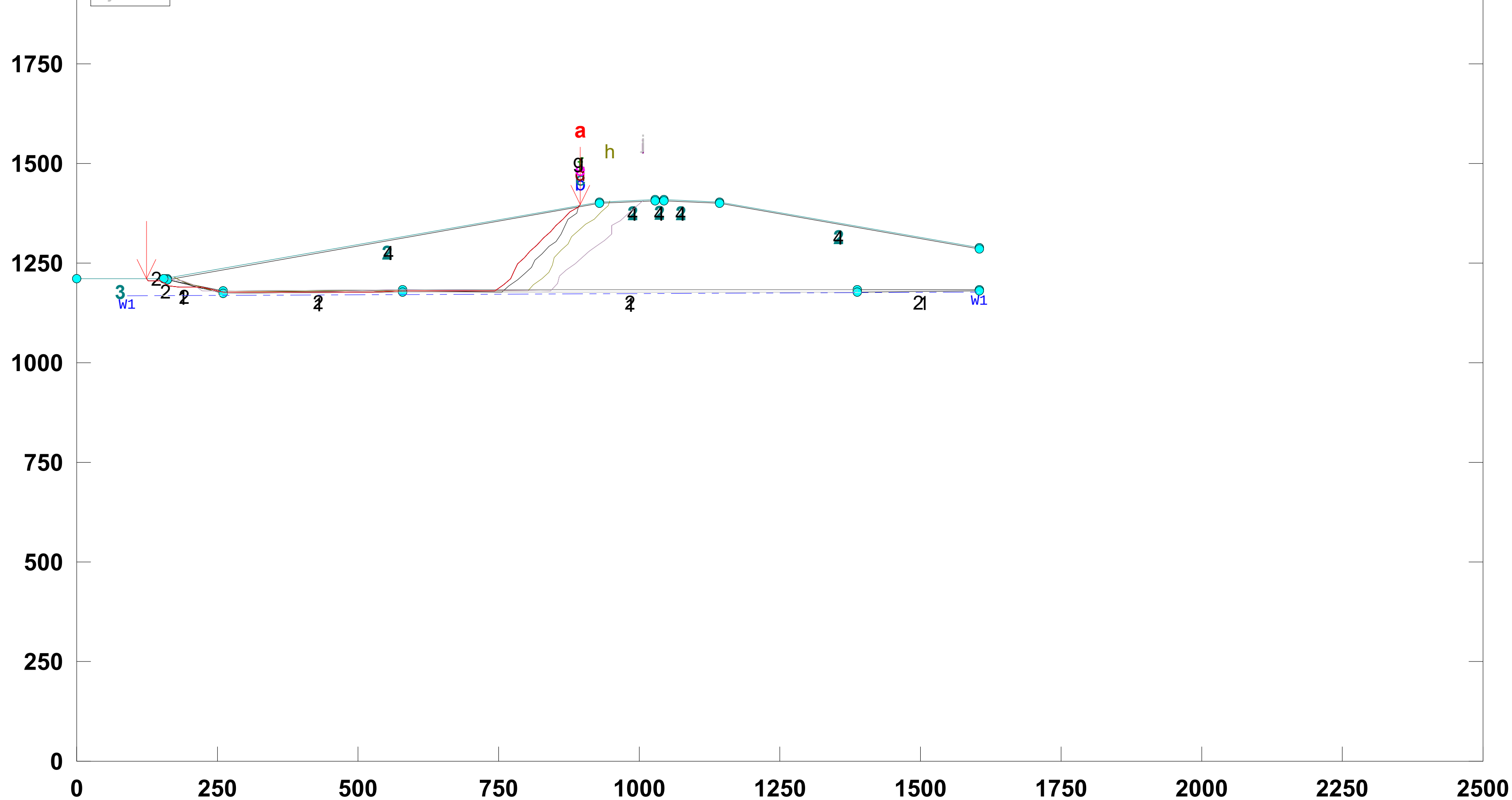
Northeast Landfill Cross Section A-A', WB (Seismic)

m:\projects\16219107.00\task 3 - tier iii modification app\permit application\app c - liner and final cover system stability analysis\stabl files\nelf\2023.4.13 nelf_xs_a_wb (seismic).pl2 Run By: Username 5/11/2023

#	FS
a	1.00
b	1.00
c	1.00
d	1.00
e	1.00
f	1.00
g	1.01
h	1.02
i	1.02
j	1.02

Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Piez. Surface No.
ENG FILL	1	120.0	120.0	0.0	25.0	W1
SL_FC	2	120.0	120.0	200.0	20.0	W1
FND SOIL	3	120.0	120.0	0.0	25.0	W1
C&D	4	70.0	70.0	400.0	35.0	W1
FND S-U	5	120.0	120.0	1800.0	0.0	W1

Load	Value
Horiz Eqk	0.300 g<



PCSTABL5M3 FSmin=1.00
Safety Factors Are Calculated By The Modified Janbu Method

**** PCSTABL5M3 ****
by Purdue University 1985
rev. for SCS Engineers HVA 2008
--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer`s Method of Slices

Run Date: 5/11/2023
Time of Run: 06:18PM
Run By: Username
Input Data Filename: M:2023.4.13 nelf_xs_a_wb (seismic).in
Output Filename: M:2023.4.13 nelf_xs_a_wb (seismic).OUT
Unit: ENGLISH
Plotted Output Filename: M:2023.4.13 nelf_xs_a_wb (seismic).PLT
PROBLEM DESCRIPTION Northeast Landfill
Cross Section A-A', WB (Seismic)

BOUNDARY COORDINATES
Note: User origin value specified.
Add 0.00 to X-values and 0.00 to Y-values listed.

6 Top Boundaries
21 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	0.00	1212.00	154.70	1210.50	3
2	154.70	1210.50	928.90	1404.00	2
3	928.90	1404.00	1029.10	1408.00	2
4	1029.10	1408.00	1043.80	1408.00	2
5	1043.80	1408.00	1144.10	1404.00	2
6	1144.10	1404.00	1603.40	1289.90	2
7	154.70	1210.50	160.70	1210.50	2
8	160.70	1210.50	162.30	1209.40	2
9	162.30	1209.40	928.90	1401.00	4
10	928.90	1401.00	1029.10	1405.00	4
11	1029.10	1405.00	1043.80	1405.00	4
12	1043.80	1405.00	1144.10	1401.00	4
13	1144.10	1401.00	1603.40	1286.90	4
14	162.30	1209.40	261.10	1179.40	2
15	261.10	1179.40	579.00	1182.30	2
16	579.00	1182.30	1386.40	1182.10	2
17	1386.40	1182.10	1603.40	1184.20	2
18	154.70	1210.50	261.10	1175.40	1
19	261.10	1175.40	579.00	1178.30	1
20	579.00	1178.30	1386.40	1178.10	1
21	1386.40	1178.10	1603.40	1180.20	1

ISOTROPIC SOIL PARAMETERS
5 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	120.0	120.0	0.0	25.0	0.00	0.0	1
2	120.0	120.0	200.0	20.0	0.00	0.0	1
3	120.0	120.0	0.0	25.0	0.00	0.0	1
4	70.0	70.0	400.0	35.0	0.00	0.0	1
5	120.0	120.0	1800.0	0.0	0.00	0.0	1

1 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED
Unit Weight of Water = 62.40
Piezometric Surface No. 1 Specified by 2 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	88.50	1168.30
2	1603.40	1177.60

A Horizontal Earthquake Loading Coefficient
Of0.300 Has Been Assigned
A Vertical Earthquake Loading Coefficient
Of0.000 Has Been Assigned
Cavitation Pressure = 0.0 (psf)
A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Sliding Block Surfaces, Has Been
Specified.
1000 Trial Surfaces Have Been Generated.

4 Boxes Specified For Generation Of Central Block Base
Length Of Line Segments For Active And Passive Portions Of
Sliding Block Is 20.0

Box No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Height (ft)
1	261.10	1177.40	261.20	1177.40	4.00
2	261.70	1177.40	579.00	1180.30	4.00
3	579.50	1180.30	579.60	1180.30	4.00
4	580.10	1180.30	1386.40	1180.10	4.00

Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Examined. They Are Ordered - Most Critical
First.
* * Safety Factors Are Calculated By The Modified Janbu Method * *
Failure Surface Specified By 26 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	122.56	1210.81
2	128.16	1205.31
3	148.12	1204.07
4	163.73	1191.56
5	183.65	1189.76
6	203.64	1189.21
7	223.64	1189.07
8	243.09	1184.40
9	261.12	1175.75
10	526.23	1178.57
11	579.57	1180.93
12	744.42	1180.63
13	757.72	1195.57
14	771.86	1209.72
15	776.30	1229.22
16	783.80	1247.76
17	796.06	1263.56
18	806.78	1280.44
19	819.01	1296.27
20	829.31	1313.41
21	843.39	1327.61
22	852.25	1345.54
23	864.68	1361.21
24	877.08	1376.90
25	891.20	1391.07
26	895.74	1395.71

*** 1.002 ***

Individual data on the 33 slices

Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Tie Force Norm (lbs)	Tie Force Tan (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Surcharge Load (lbs)
1	5.6	1832.6	0.0	0.0	0.0	0.0	549.8	0.0	0.0
2	20.0	14310.6	0.0	0.0	0.0	0.0	4293.2	0.0	0.0
3	6.6	7184.5	0.0	0.0	0.0	0.0	2155.4	0.0	0.0
4	6.0	10695.9	0.0	0.0	0.0	0.0	3208.8	0.0	0.0
5	1.6	3619.0	0.0	0.0	0.0	0.0	1085.7	0.0	0.0
6	1.4	3484.0	0.0	0.0	0.0	0.0	1045.2	0.0	0.0
7	19.9	52487.0	0.0	0.0	0.0	0.0	15746.1	0.0	0.0
8	20.0	56433.5	0.0	0.0	0.0	0.0	16930.1	0.0	0.0
9	15.9	46237.3	0.0	0.0	0.0	0.0	13871.2	0.0	0.0
10	4.1	11958.8	0.0	0.0	0.0	0.0	3587.7	0.0	0.0
11	19.4	63081.6	0.0	0.0	0.0	0.0	18924.5	0.0	0.0
12	18.0	73597.4	0.0	0.0	0.0	0.0	22079.2	0.0	0.0
13	0.0	105.7	0.0	0.0	0.0	0.0	31.7	0.0	0.0
14	265.1	1812561.2	0.0	0.0	0.0	0.0	*******	0.0	0.0
15	52.8	495081.9	0.0	0.0	0.0	0.0	*******	0.0	0.0
16	0.6	5509.1	0.0	0.0	0.0	0.0	1652.7	0.0	0.0
17	164.9	1843180.9	0.0	0.0	0.0	0.0	*******	0.0	0.0
18	1.4	18203.8	0.0	0.0	0.0	0.0	5461.1	0.0	0.0
19	11.8	143463.8	0.0	0.0	0.0	0.0	43039.1	0.0	0.0
20	14.1	160790.0	0.0	0.0	0.0	0.0	48237.0	0.0	0.0
21	4.4	46035.3	0.0	0.0	0.0	0.0	13810.6	0.0	0.0
22	7.5	68442.2	0.0	0.0	0.0	0.0	20532.6	0.0	0.0

23	12.3	99354.7	0.0	0.0	0.0	0.0	29806.4	0.0	0.0
24	10.7	76767.7	0.0	0.0	0.0	0.0	23030.3	0.0	0.0
25	12.2	76005.6	0.0	0.0	0.0	0.0	22801.7	0.0	0.0
26	10.3	54187.7	0.0	0.0	0.0	0.0	16256.3	0.0	0.0
27	14.1	61603.9	0.0	0.0	0.0	0.0	18481.2	0.0	0.0
28	8.9	30560.6	0.0	0.0	0.0	0.0	9168.2	0.0	0.0
29	12.4	30584.6	0.0	0.0	0.0	0.0	9175.4	0.0	0.0
30	12.4	19612.4	0.0	0.0	0.0	0.0	5883.7	0.0	0.0
31	14.1	10843.0	0.0	0.0	0.0	0.0	3252.9	0.0	0.0
32	0.7	249.3	0.0	0.0	0.0	0.0	74.8	0.0	0.0
33	3.9	698.4	0.0	0.0	0.0	0.0	209.5	0.0	0.0

Failure Surface Specified By 26 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	122.56	1210.81
2	128.16	1205.31
3	148.12	1204.07
4	163.73	1191.56
5	183.65	1189.76
6	203.64	1189.21
7	223.64	1189.07
8	243.09	1184.40
9	261.12	1175.75
10	526.23	1178.57
11	579.57	1180.93
12	744.42	1180.63
13	757.72	1195.57
14	771.86	1209.72
15	776.30	1229.22
16	783.80	1247.76
17	796.06	1263.56
18	806.78	1280.44
19	819.01	1296.27
20	829.31	1313.41
21	843.39	1327.61
22	852.25	1345.54
23	864.68	1361.21
24	877.08	1376.90
25	891.20	1391.07
26	895.74	1395.71

*** 1.002 ***

Failure Surface Specified By 26 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	122.56	1210.81
2	128.16	1205.31
3	148.12	1204.07
4	163.73	1191.56
5	183.65	1189.76
6	203.64	1189.21
7	223.64	1189.07
8	243.09	1184.40
9	261.12	1175.75
10	526.23	1178.57
11	579.57	1180.93
12	744.42	1180.63
13	757.72	1195.57
14	771.86	1209.72
15	776.30	1229.22
16	783.80	1247.76
17	796.06	1263.56
18	806.78	1280.44
19	819.01	1296.27
20	829.31	1313.41
21	843.39	1327.61
22	852.25	1345.54
23	864.68	1361.21
24	877.08	1376.90
25	891.20	1391.07
26	895.74	1395.71

*** 1.002 ***

Failure Surface Specified By 26 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	122.56	1210.81
2	128.16	1205.31
3	148.12	1204.07
4	163.73	1191.56
5	183.65	1189.76
6	203.64	1189.21
7	223.64	1189.07
8	243.09	1184.40
9	261.12	1175.75
10	526.23	1178.57
11	579.57	1180.93
12	744.42	1180.63
13	757.72	1195.57
14	771.86	1209.72
15	776.30	1229.22
16	783.80	1247.76
17	796.06	1263.56
18	806.78	1280.44
19	819.01	1296.27
20	829.31	1313.41
21	843.39	1327.61
22	852.25	1345.54
23	864.68	1361.21
24	877.08	1376.90
25	891.20	1391.07
26	895.74	1395.71

*** 1.002 ***

Failure Surface Specified By 26 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	122.56	1210.81
2	128.16	1205.31
3	148.12	1204.07
4	163.73	1191.56
5	183.65	1189.76
6	203.64	1189.21
7	223.64	1189.07
8	243.09	1184.40
9	261.12	1175.75
10	526.23	1178.57
11	579.57	1180.93
12	744.42	1180.63
13	757.72	1195.57
14	771.86	1209.72
15	776.30	1229.22
16	783.80	1247.76
17	796.06	1263.56
18	806.78	1280.44
19	819.01	1296.27
20	829.31	1313.41
21	843.39	1327.61
22	852.25	1345.54
23	864.68	1361.21
24	877.08	1376.90
25	891.20	1391.07
26	895.74	1395.71

*** 1.002 ***

Failure Surface Specified By 26 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	122.56	1210.81
2	128.16	1205.31
3	148.12	1204.07
4	163.73	1191.56
5	183.65	1189.76
6	203.64	1189.21

7	223.64	1189.07
8	243.09	1184.40
9	261.12	1175.75
10	526.23	1178.57
11	579.57	1180.93
12	744.42	1180.63
13	757.72	1195.57
14	771.86	1209.72
15	776.30	1229.22
16	783.80	1247.76
17	796.06	1263.56
18	806.78	1280.44
19	819.01	1296.27
20	829.31	1313.41
21	843.39	1327.61
22	852.25	1345.54
23	864.68	1361.21
24	877.08	1376.90
25	891.20	1391.07
26	895.74	1395.71

*** 1.002 ***

Failure Surface Specified By 23 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	174.52	1215.45
2	187.03	1203.80
3	203.14	1191.94
4	221.93	1185.09
5	241.80	1182.84
6	261.14	1177.73
7	535.83	1179.10
8	579.55	1180.60
9	756.23	1178.26
10	768.63	1193.95
11	782.36	1208.50
12	794.99	1224.01
13	807.22	1239.84
14	814.92	1258.29
15	827.94	1273.48
16	838.85	1290.24
17	852.77	1304.60
18	861.84	1322.43
19	866.03	1341.98
20	874.71	1360.00
21	888.51	1374.48
22	890.88	1394.33
23	890.99	1394.53

*** 1.011 ***

Failure Surface Specified By 23 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	173.76	1215.26
2	186.46	1204.05
3	204.36	1195.13
4	223.85	1190.68
5	241.44	1181.15
6	261.10	1177.49
7	441.25	1179.33
8	579.57	1178.96
9	802.49	1179.33
10	812.23	1196.80
11	826.36	1210.95
12	838.27	1227.02
13	846.66	1245.17
14	850.24	1264.85
15	860.48	1282.03
16	872.77	1297.81
17	878.49	1316.97
18	892.14	1331.59
19	905.79	1346.21

20	919.01	1361.22
21	931.25	1377.04
22	944.07	1392.38
23	949.07	1404.81

*** 1.015 ***

Failure Surface Specified By 25 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	159.25	1211.64
2	170.50	1209.38
3	189.90	1204.52
4	207.54	1195.11
5	221.77	1181.05
6	241.76	1180.52
7	261.15	1175.59
8	416.53	1177.34
9	579.56	1182.14
10	843.63	1180.75
11	854.47	1197.56
12	859.29	1216.97
13	871.75	1232.62
14	884.41	1248.10
15	896.91	1263.71
16	911.04	1277.86
17	924.61	1292.56
18	938.27	1307.17
19	950.52	1322.98
20	951.46	1342.96
21	965.44	1357.26
22	979.27	1371.70
23	991.99	1387.13
24	1004.34	1402.86
25	1005.51	1407.06

*** 1.020 ***

Failure Surface Specified By 25 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	159.25	1211.64
2	170.50	1209.38
3	189.90	1204.52
4	207.54	1195.11
5	221.77	1181.05
6	241.76	1180.52
7	261.15	1175.59
8	416.53	1177.34
9	579.56	1182.14
10	843.63	1180.75
11	854.47	1197.56
12	859.29	1216.97
13	871.75	1232.62
14	884.41	1248.10
15	896.91	1263.71
16	911.04	1277.86
17	924.61	1292.56
18	938.27	1307.17
19	950.52	1322.98
20	951.46	1342.96
21	965.44	1357.26
22	979.27	1371.70
23	991.99	1387.13
24	1004.34	1402.86
25	1005.51	1407.06

*** 1.020 ***

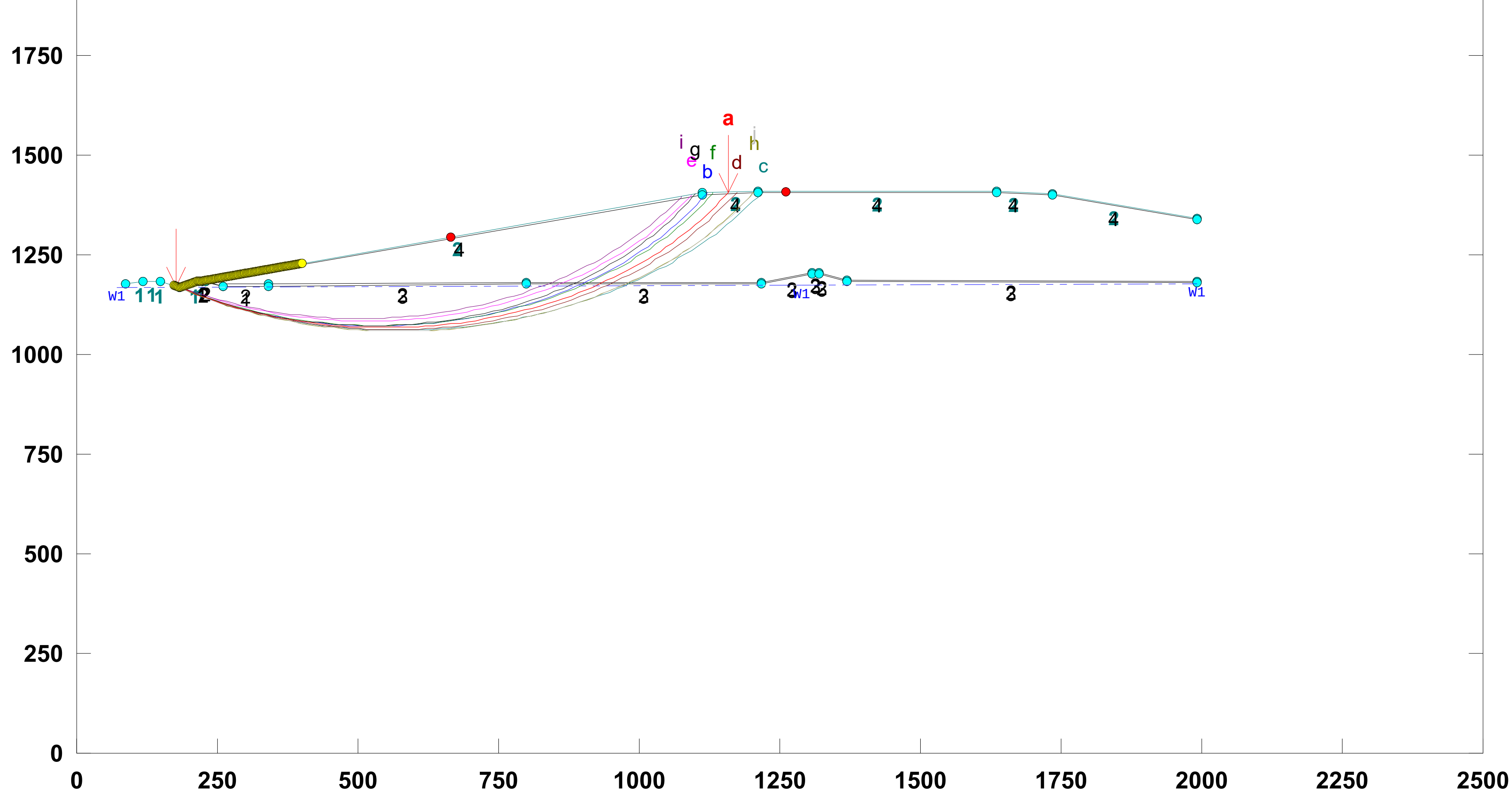
Northeast Landfill Cross Section B-B', Circular (Seismic)

m:\projects\16219107.00\task 3 - tier iii modification app\permit application\app c - liner and final cover system stability analysis\stabl files\nelf\2023.4.13 nelf_xs_b_circ (seismic).pl2 Run By: Username 5/11/2023

#	FS
a	1.00
b	1.00
c	1.00
d	1.00
e	1.00
f	1.00
g	1.00
h	1.00
i	1.00
j	1.00

Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Piez. Surface No.
ENG FILL	1	120.0	120.0	0.0	25.0	W1
SL_FC	2	120.0	120.0	200.0	20.0	W1
FND SOIL	3	120.0	120.0	0.0	25.0	W1
C&D	4	70.0	70.0	400.0	35.0	W1
FND S-U	5	120.0	120.0	1800.0	0.0	W1

Load	Value
Horiz Eqk	0.270 g<



PCSTABL5M3 FSmin=1.00

Safety Factors Are Calculated By The Modified Bishop Method

**** PCSTABL5M3 ****
by Purdue University 1985
rev. for SCS Engineers HVA 2008
--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer`s Method of Slices

Run Date: 5/11/2023
Time of Run: 06:21PM
Run By: Username
Input Data Filename: M:2023.4.13 nelf_xs_b_circ (seismic).in
Output Filename: M:2023.4.13 nelf_xs_b_circ (seismic).OUT
Unit: ENGLISH
Plotted Output Filename: M:2023.4.13 nelf_xs_b_circ (seismic).PLT
PROBLEM DESCRIPTION Northeast Landfill
Cross Section B-B', Circular (Seismic)

BOUNDARY COORDINATES
Note: User origin value specified.
Add 0.00 to X-values and 0.00 to Y-values listed.

10 Top Boundaries
33 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	87.00	1176.00	118.70	1184.50	1
2	118.70	1184.50	149.60	1184.50	1
3	149.60	1184.50	183.40	1168.50	1
4	183.40	1168.50	215.50	1184.50	1
5	215.50	1184.50	223.10	1184.50	1
6	223.10	1184.50	1110.60	1405.50	2
7	1110.60	1405.50	1211.80	1408.00	2
8	1211.80	1408.00	1635.60	1408.00	2
9	1635.60	1408.00	1735.70	1404.00	2
10	1735.70	1404.00	1991.20	1340.20	2
11	223.10	1184.50	229.10	1184.50	2
12	229.10	1184.50	230.70	1182.90	2
13	230.70	1182.90	1110.60	1401.00	4
14	1110.60	1401.00	1211.80	1405.00	4
15	1211.80	1405.00	1635.60	1405.00	4
16	1635.60	1405.00	1735.70	1401.00	4
17	1735.70	1401.00	1991.20	1337.20	4
18	230.70	1182.90	261.10	1171.80	2
19	261.10	1175.90	341.50	1175.90	2
20	341.50	1175.90	800.00	1179.90	2
21	800.00	1179.90	1218.60	1181.00	2
22	1218.60	1181.00	1305.70	1206.00	2
23	1305.70	1206.00	1320.70	1206.00	2
24	1320.70	1206.00	1369.90	1186.00	2
25	1369.90	1186.00	1991.20	1184.40	2
26	223.10	1184.40	261.10	1171.80	1
27	261.10	1171.80	341.50	1171.90	1
28	341.50	1171.90	800.00	1175.90	3
29	800.00	1175.90	1218.60	1177.00	3
30	1218.60	1177.00	1305.70	1202.00	3
31	1305.70	1202.00	1320.70	1202.00	3
32	1320.70	1202.00	1369.90	1182.00	3
33	1369.90	1182.00	1991.20	1180.40	3

ISOTROPIC SOIL PARAMETERS
5 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	120.0	120.0	0.0	25.0	0.00	0.0	1
2	120.0	120.0	200.0	20.0	0.00	0.0	1
3	120.0	120.0	0.0	25.0	0.00	0.0	1
4	70.0	70.0	400.0	35.0	0.00	0.0	1
5	120.0	120.0	1800.0	0.0	0.00	0.0	1

1 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED
Unit Weight of Water = 62.40
Piezometric Surface No. 1 Specified by 3 Coordinate Points

Point X-Water Y-Water

No.	(ft)	(ft)
1	70.80	1167.90
2	1287.50	1174.20
3	1991.20	1176.50

A Horizontal Earthquake Loading Coefficient
Of0.270 Has Been Assigned
A Vertical Earthquake Loading Coefficient
Of0.000 Has Been Assigned
Cavitation Pressure = 0.0 (psf)
A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Circular Surfaces, Has Been Specified.
10000 Trial Surfaces Have Been Generated.
100 Surfaces Initiate From Each Of100 Points Equally Spaced
Along The Ground Surface Between X = 173.10 ft.
and X = 400.60 ft.
Each Surface Terminates Between X = 665.00 ft.
and X =1260.60 ft.
Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y = 0.00 ft.
15.00 ft. Line Segments Define Each Trial Failure Surface.
Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Examined. They Are Ordered - Most Critical
First.
* * Safety Factors Are Calculated By The Modified Bishop Method * *
Failure Surface Specified By 76 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	175.40	1172.29
2	188.28	1164.60
3	201.32	1157.19
4	214.52	1150.06
5	227.86	1143.20
6	241.34	1136.62
7	254.95	1130.32
8	268.69	1124.31
9	282.56	1118.59
10	296.54	1113.16
11	310.64	1108.03
12	324.84	1103.19
13	339.13	1098.65
14	353.52	1094.41
15	367.99	1090.47
16	382.55	1086.83
17	397.17	1083.50
18	411.86	1080.48
19	426.62	1077.76
20	441.42	1075.36
21	456.28	1073.26
22	471.17	1071.48
23	486.10	1070.01
24	501.05	1068.85
25	516.03	1068.00
26	531.02	1067.47
27	546.02	1067.25
28	561.02	1067.34
29	576.01	1067.75
30	590.99	1068.47
31	605.96	1069.51
32	620.90	1070.85
33	635.80	1072.51
34	650.67	1074.49
35	665.50	1076.77
36	680.27	1079.36
37	694.99	1082.26
38	709.64	1085.47
39	724.23	1088.98
40	738.73	1092.80
41	753.16	1096.92
42	767.49	1101.34
43	781.73	1106.06

44	795.86	1111.08
45	809.89	1116.39
46	823.80	1122.00
47	837.60	1127.89
48	851.26	1134.07
49	864.80	1140.54
50	878.20	1147.29
51	891.45	1154.31
52	904.55	1161.62
53	917.50	1169.19
54	930.28	1177.04
55	942.90	1185.15
56	955.35	1193.52
57	967.62	1202.15
58	979.70	1211.03
59	991.60	1220.17
60	1003.30	1229.55
61	1014.80	1239.18
62	1026.10	1249.05
63	1037.19	1259.14
64	1048.07	1269.47
65	1058.73	1280.03
66	1069.17	1290.80
67	1079.37	1301.79
68	1089.35	1313.00
69	1099.09	1324.40
70	1108.59	1336.01
71	1117.84	1347.82
72	1126.85	1359.82
73	1135.60	1372.00
74	1144.09	1384.36
75	1152.33	1396.90
76	1158.46	1406.68

Circle Center At X = 549.0 ; Y = 1784.1 and Radius, 716.9

*** 0.995 ***

Individual data on the 89 slices

Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Tie Force Norm (lbs)	Tie Force Tan (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Surcharge Load (lbs)
1	6.4	301.6	0.0	0.0	0.0	0.0	81.4	0.0	0.0
2	1.6	170.7	0.0	56.5	0.0	0.0	46.1	0.0	0.0
3	4.9	2141.7	0.0	863.7	0.0	0.0	578.3	0.0	0.0
4	13.0	20788.6	0.0	7153.6	0.0	0.0	5612.9	0.0	0.0
5	13.2	42899.1	0.0	14025.9	0.0	0.0	11582.8	0.0	0.0
6	1.0	4068.1	0.0	1301.0	0.0	0.0	1098.4	0.0	0.0
7	7.6	33656.2	0.0	11237.2	0.0	0.0	9087.2	0.0	0.0
8	4.8	23211.0	0.0	8102.3	0.0	0.0	6267.0	0.0	0.0
9	1.2	6412.6	0.0	2231.1	0.0	0.0	1731.4	0.0	0.0
10	1.6	8446.8	0.0	2946.7	0.0	0.0	2280.6	0.0	0.0
11	10.6	60172.2	0.0	21816.8	0.0	0.0	16246.5	0.0	0.0
12	13.6	86281.8	0.0	33085.2	0.0	0.0	23296.1	0.0	0.0
13	6.1	42235.7	0.0	16705.0	0.0	0.0	11403.6	0.0	0.0
14	7.6	56947.5	0.0	22205.0	0.0	0.0	15375.8	0.0	0.0
15	13.9	114098.9	0.0	44466.3	0.0	0.0	30806.7	0.0	0.0
16	14.0	127817.8	0.0	49751.6	0.0	0.0	34510.8	0.0	0.0
17	14.1	141221.5	0.0	54763.4	0.0	0.0	38129.8	0.0	0.0
18	14.2	154276.3	0.0	59499.9	0.0	0.0	41654.6	0.0	0.0
19	14.3	166950.9	0.0	63958.8	0.0	0.0	45076.8	0.0	0.0
20	2.4	28743.2	0.0	10936.7	0.0	0.0	7760.7	0.0	0.0
21	12.0	150502.4	0.0	57201.7	0.0	0.0	40635.6	0.0	0.0
22	14.5	191157.6	0.0	72036.4	0.0	0.0	51612.6	0.0	0.0
23	14.6	202603.7	0.0	75651.6	0.0	0.0	54703.0	0.0	0.0
24	14.6	213555.2	0.0	78982.0	0.0	0.0	57659.9	0.0	0.0
25	14.7	223987.2	0.0	82026.4	0.0	0.0	60476.5	0.0	0.0
26	14.8	233874.8	0.0	84783.5	0.0	0.0	63146.2	0.0	0.0
27	14.8	243195.9	0.0	87251.9	0.0	0.0	65662.9	0.0	0.0
28	14.9	251929.3	0.0	89430.4	0.0	0.0	68020.9	0.0	0.0
29	14.9	260055.5	0.0	91318.4	0.0	0.0	70215.0	0.0	0.0
30	14.9	267557.8	0.0	92915.1	0.0	0.0	72240.6	0.0	0.0

31	15.0	274418.5	0.0	94219.3	0.0	0.0	74093.0	0.0	0.0
32	15.0	280624.7	0.0	95231.3	0.0	0.0	75768.7	0.0	0.0
33	15.0	286162.4	0.0	95949.6	0.0	0.0	77263.8	0.0	0.0
34	15.0	291021.1	0.0	96374.5	0.0	0.0	78575.7	0.0	0.0
35	15.0	295191.2	0.0	96505.5	0.0	0.0	79701.6	0.0	0.0
36	15.0	298666.4	0.0	96343.1	0.0	0.0	80639.9	0.0	0.0
37	15.0	301440.0	0.0	95886.8	0.0	0.0	81388.8	0.0	0.0
38	15.0	303509.1	0.0	95137.2	0.0	0.0	81947.5	0.0	0.0
39	14.9	304871.8	0.0	94094.6	0.0	0.0	82315.4	0.0	0.0
40	14.9	305526.4	0.0	92759.1	0.0	0.0	82492.1	0.0	0.0
41	14.9	305474.9	0.0	91131.2	0.0	0.0	82478.2	0.0	0.0
42	14.8	304722.0	0.0	89212.3	0.0	0.0	82274.9	0.0	0.0
43	14.8	303272.4	0.0	87002.9	0.0	0.0	81883.5	0.0	0.0
44	14.7	301131.8	0.0	84503.5	0.0	0.0	81305.6	0.0	0.0
45	14.7	298310.9	0.0	81716.1	0.0	0.0	80543.9	0.0	0.0
46	14.6	294819.3	0.0	78641.3	0.0	0.0	79601.2	0.0	0.0
47	14.5	290668.4	0.0	75280.3	0.0	0.0	78480.5	0.0	0.0
48	14.4	285872.9	0.0	71634.9	0.0	0.0	77185.7	0.0	0.0
49	14.3	280449.4	0.0	67707.1	0.0	0.0	75721.3	0.0	0.0
50	14.2	274413.9	0.0	63497.8	0.0	0.0	74091.8	0.0	0.0
51	14.1	267786.0	0.0	59009.4	0.0	0.0	72302.2	0.0	0.0
52	4.1	77423.4	0.0	16509.1	0.0	0.0	20904.3	0.0	0.0
53	9.9	183146.7	0.0	37734.1	0.0	0.0	49449.6	0.0	0.0
54	13.9	252763.3	0.0	49202.1	0.0	0.0	68246.1	0.0	0.0
55	13.8	244428.4	0.0	43888.2	0.0	0.0	65995.7	0.0	0.0
56	13.7	235593.4	0.0	38303.3	0.0	0.0	63610.2	0.0	0.0
57	13.5	226284.7	0.0	32450.1	0.0	0.0	61096.9	0.0	0.0
58	13.4	216530.8	0.0	26331.3	0.0	0.0	58463.3	0.0	0.0
59	13.3	206359.9	0.0	19949.3	0.0	0.0	55717.2	0.0	0.0
60	13.1	195802.2	0.0	13307.3	0.0	0.0	52866.6	0.0	0.0
61	12.9	184890.5	0.0	6407.8	0.0	0.0	49920.4	0.0	0.0
62	5.1	70132.2	0.0	575.3	0.0	0.0	18935.7	0.0	0.0
63	6.4	86292.2	0.0	0.0	0.0	0.0	23298.9	0.0	0.0
64	1.3	17232.3	0.0	0.0	0.0	0.0	4652.7	0.0	0.0
65	5.0	65493.9	0.0	0.0	0.0	0.0	17683.3	0.0	0.0
66	7.6	97567.0	0.0	0.0	0.0	0.0	26343.1	0.0	0.0
67	12.4	155984.7	0.0	0.0	0.0	0.0	42115.9	0.0	0.0
68	12.3	149106.2	0.0	0.0	0.0	0.0	40258.7	0.0	0.0
69	12.1	142042.8	0.0	0.0	0.0	0.0	38351.6	0.0	0.0
70	11.9	134817.5	0.0	0.0	0.0	0.0	36400.7	0.0	0.0
71	11.7	127450.6	0.0	0.0	0.0	0.0	34411.7	0.0	0.0
72	11.5	119965.5	0.0	0.0	0.0	0.0	32390.7	0.0	0.0
73	11.3	112383.6	0.0	0.0	0.0	0.0	30343.6	0.0	0.0
74	11.1	104727.5	0.0	0.0	0.0	0.0	28276.4	0.0	0.0
75	10.9	97022.8	0.0	0.0	0.0	0.0	26196.2	0.0	0.0
76	10.7	89290.4	0.0	0.0	0.0	0.0	24108.4	0.0	0.0
77	10.4	81555.6	0.0	0.0	0.0	0.0	22020.0	0.0	0.0
78	10.2	73841.8	0.0	0.0	0.0	0.0	19937.3	0.0	0.0
79	10.0	66174.2	0.0	0.0	0.0	0.0	17867.0	0.0	0.0
80	9.7	58577.5	0.0	0.0	0.0	0.0	15815.9	0.0	0.0
81	9.5	51074.4	0.0	0.0	0.0	0.0	13790.1	0.0	0.0
82	2.0	10026.5	0.0	0.0	0.0	0.0	2707.1	0.0	0.0
83	7.2	33232.0	0.0	0.0	0.0	0.0	8972.6	0.0	0.0
84	9.0	34706.5	0.0	0.0	0.0	0.0	9370.8	0.0	0.0
85	8.8	26402.3	0.0	0.0	0.0	0.0	7128.6	0.0	0.0
86	8.5	18402.2	0.0	0.0	0.0	0.0	4968.6	0.0	0.0
87	8.2	10729.7	0.0	0.0	0.0	0.0	2897.0	0.0	0.0
88	3.7	2454.8	0.0	0.0	0.0	0.0	662.8	0.0	0.0
89	2.4	559.8	0.0	0.0	0.0	0.0	151.1	0.0	0.0

Failure Surface Specified By 74 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	173.10	1173.38
2	185.95	1165.63
3	198.96	1158.17
4	212.13	1150.99
5	225.46	1144.11
6	238.93	1137.52
7	252.55	1131.22
8	266.30	1125.23

9	280.18	1119.54
10	294.18	1114.16
11	308.29	1109.08
12	322.52	1104.31
13	336.84	1099.86
14	351.26	1095.72
15	365.76	1091.90
16	380.35	1088.40
17	395.01	1085.22
18	409.73	1082.36
19	424.52	1079.83
20	439.35	1077.62
21	454.23	1075.74
22	469.15	1074.18
23	484.10	1072.95
24	499.08	1072.05
25	514.06	1071.47
26	529.06	1071.23
27	544.06	1071.32
28	559.06	1071.73
29	574.04	1072.47
30	589.00	1073.54
31	603.93	1074.94
32	618.84	1076.67
33	633.69	1078.72
34	648.50	1081.10
35	663.26	1083.80
36	677.95	1086.82
37	692.57	1090.17
38	707.12	1093.83
39	721.58	1097.82
40	735.95	1102.12
41	750.22	1106.73
42	764.39	1111.66
43	778.45	1116.89
44	792.39	1122.44
45	806.20	1128.28
46	819.88	1134.43
47	833.42	1140.88
48	846.82	1147.62
49	860.07	1154.66
50	873.16	1161.98
51	886.09	1169.59
52	898.85	1177.48
53	911.43	1185.65
54	923.83	1194.09
55	936.04	1202.80
56	948.05	1211.78
57	959.87	1221.02
58	971.48	1230.52
59	982.88	1240.26
60	994.07	1250.26
61	1005.03	1260.50
62	1015.76	1270.98
63	1026.27	1281.69
64	1036.53	1292.62
65	1046.55	1303.78
66	1056.33	1315.16
67	1065.85	1326.75
68	1075.12	1338.54
69	1084.13	1350.54
70	1092.87	1362.73
71	1101.34	1375.11
72	1109.54	1387.67
73	1117.46	1400.41
74	1120.62	1405.75

Circle Center At X = 532.7 ; Y = 1755.1 and Radius, 683.9

*** 0.995 ***

Failure Surface Specified By 81 Coordinate Points

Point	X-Surf	Y-Surf

No.	(ft)	(ft)
1	173.10	1173.38
2	185.99	1165.71
3	199.04	1158.30
4	212.22	1151.14
5	225.54	1144.24
6	238.99	1137.60
7	252.56	1131.22
8	266.26	1125.11
9	280.07	1119.26
10	294.00	1113.68
11	308.03	1108.37
12	322.16	1103.34
13	336.38	1098.58
14	350.70	1094.10
15	365.10	1089.90
16	379.57	1085.97
17	394.12	1082.33
18	408.74	1078.97
19	423.42	1075.90
20	438.16	1073.11
21	452.95	1070.60
22	467.79	1068.39
23	482.66	1066.46
24	497.57	1064.82
25	512.51	1063.47
26	527.48	1062.42
27	542.46	1061.65
28	557.45	1061.17
29	572.45	1060.98
30	587.45	1061.09
31	602.44	1061.48
32	617.43	1062.17
33	632.39	1063.15
34	647.34	1064.41
35	662.26	1065.97
36	677.15	1067.82
37	691.99	1069.95
38	706.80	1072.37
39	721.55	1075.08
40	736.25	1078.08
41	750.89	1081.35
42	765.46	1084.92
43	779.96	1088.76
44	794.38	1092.89
45	808.72	1097.29
46	822.97	1101.97
47	837.12	1106.93
48	851.18	1112.16
49	865.14	1117.66
50	878.98	1123.43
51	892.71	1129.47
52	906.32	1135.77
53	919.81	1142.34
54	933.17	1149.17
55	946.39	1156.25
56	959.47	1163.60
57	972.40	1171.19
58	985.19	1179.03
59	997.82	1187.12
60	1010.30	1195.45
61	1022.60	1204.03
62	1034.74	1212.84
63	1046.71	1221.88
64	1058.50	1231.15
65	1070.11	1240.66
66	1081.53	1250.38
67	1092.76	1260.33
68	1103.79	1270.49
69	1114.63	1280.86

70	1125.26	1291.44
71	1135.68	1302.22
72	1145.90	1313.21
73	1155.90	1324.39
74	1165.68	1335.76
75	1175.23	1347.33
76	1184.57	1359.07
77	1193.67	1370.99
78	1202.54	1383.09
79	1211.17	1395.36
80	1219.56	1407.79
81	1219.70	1408.00

Circle Center At X = 574.6 ; Y = 1834.2 and Radius, 773.2

***   0.996   ***

Failure Surface Specified By 77 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	177.70	1171.20
2	190.50	1163.39
3	203.47	1155.85
4	216.59	1148.58
5	229.86	1141.58
6	243.27	1134.86
7	256.82	1128.43
8	270.50	1122.28
9	284.30	1116.41
10	298.23	1110.83
11	312.27	1105.55
12	326.41	1100.56
13	340.66	1095.86
14	355.00	1091.47
15	369.43	1087.37
16	383.94	1083.57
17	398.53	1080.08
18	413.19	1076.89
19	427.91	1074.01
20	442.69	1071.44
21	457.51	1069.18
22	472.39	1067.22
23	487.30	1065.58
24	502.24	1064.24
25	517.20	1063.22
26	532.18	1062.51
27	547.18	1062.11
28	562.18	1062.03
29	577.18	1062.26
30	592.17	1062.80
31	607.14	1063.65
32	622.10	1064.82
33	637.02	1066.30
34	651.92	1068.08
35	666.77	1070.18
36	681.58	1072.59
37	696.33	1075.31
38	711.02	1078.33
39	725.65	1081.66
40	740.20	1085.29
41	754.67	1089.22
42	769.06	1093.46
43	783.36	1097.99
44	797.56	1102.83
45	811.66	1107.95
46	825.65	1113.37
47	839.52	1119.08
48	853.27	1125.08
49	866.89	1131.36
50	880.37	1137.93
51	893.72	1144.78
52	906.92	1151.90
53	919.97	1159.29

54	932.86	1166.96
55	945.59	1174.90
56	958.15	1183.09
57	970.54	1191.55
58	982.75	1200.26
59	994.78	1209.23
60	1006.61	1218.45
61	1018.25	1227.91
62	1029.69	1237.61
63	1040.93	1247.54
64	1051.96	1257.71
65	1062.77	1268.11
66	1073.36	1278.73
67	1083.73	1289.57
68	1093.87	1300.62
69	1103.78	1311.88
70	1113.45	1323.35
71	1122.88	1335.01
72	1132.07	1346.87
73	1141.00	1358.92
74	1149.69	1371.15
75	1158.11	1383.56
76	1166.28	1396.14
77	1173.03	1407.04

Circle Center At X = 558.7 ; Y = 1781.5 and Radius, 719.5

*** 0.997 ***

Failure Surface Specified By 70 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	184.59	1169.09
2	197.81	1162.00
3	211.17	1155.19
4	224.69	1148.68
5	238.34	1142.46
6	252.12	1136.55
7	266.03	1130.94
8	280.06	1125.63
9	294.20	1120.63
10	308.45	1115.94
11	322.80	1111.56
12	337.24	1107.50
13	351.76	1103.76
14	366.37	1100.33
15	381.04	1097.23
16	395.78	1094.44
17	410.58	1091.98
18	425.43	1089.84
19	440.32	1088.03
20	455.24	1086.54
21	470.20	1085.38
22	485.17	1084.55
23	500.17	1084.05
24	515.16	1083.87
25	530.16	1084.02
26	545.16	1084.50
27	560.13	1085.30
28	575.09	1086.44
29	590.02	1087.90
30	604.91	1089.68
31	619.76	1091.80
32	634.56	1094.23
33	649.31	1096.99
34	663.99	1100.07
35	678.60	1103.47
36	693.13	1107.19
37	707.58	1111.23
38	721.93	1115.58
39	736.19	1120.24
40	750.34	1125.21
41	764.38	1130.50

42	778.30	1136.09
43	792.09	1141.98
44	805.76	1148.17
45	819.28	1154.66
46	832.66	1161.44
47	845.89	1168.51
48	858.96	1175.87
49	871.86	1183.52
50	884.60	1191.44
51	897.16	1199.64
52	909.53	1208.12
53	921.72	1216.86
54	933.72	1225.87
55	945.51	1235.14
56	957.10	1244.66
57	968.48	1254.43
58	979.64	1264.45
59	990.58	1274.72
60	1001.30	1285.22
61	1011.78	1295.95
62	1022.02	1306.90
63	1032.02	1318.08
64	1041.78	1329.48
65	1051.28	1341.08
66	1060.53	1352.89
67	1069.52	1364.90
68	1078.24	1377.10
69	1086.69	1389.49
70	1094.50	1401.49

Circle Center At X = 515.8 ; Y = 1769.9 and Radius, 686.1

*** 0.997 ***

Failure Surface Specified By 74 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	184.59	1169.09
2	197.59	1161.61
3	210.75	1154.41
4	224.06	1147.49
5	237.51	1140.86
6	251.11	1134.53
7	264.84	1128.48
8	278.70	1122.74
9	292.67	1117.30
10	306.76	1112.15
11	320.96	1107.32
12	335.26	1102.79
13	349.66	1098.57
14	364.14	1094.66
15	378.70	1091.06
16	393.34	1087.78
17	408.04	1084.82
18	422.81	1082.17
19	437.62	1079.84
20	452.49	1077.83
21	467.39	1076.15
22	482.33	1074.78
23	497.30	1073.74
24	512.28	1073.02
25	527.27	1072.62
26	542.27	1072.55
27	557.27	1072.80
28	572.26	1073.37
29	587.23	1074.27
30	602.18	1075.48
31	617.10	1077.02
32	631.99	1078.89
33	646.83	1081.07
34	661.62	1083.57
35	676.35	1086.39
36	691.02	1089.53

37	705.62	1092.98
38	720.14	1096.75
39	734.57	1100.83
40	748.91	1105.22
41	763.16	1109.91
42	777.30	1114.92
43	791.33	1120.22
44	805.24	1125.83
45	819.03	1131.74
46	832.69	1137.94
47	846.21	1144.44
48	859.59	1151.22
49	872.81	1158.29
50	885.89	1165.65
51	898.80	1173.29
52	911.54	1181.20
53	924.11	1189.38
54	936.50	1197.84
55	948.71	1206.56
56	960.72	1215.54
57	972.54	1224.78
58	984.15	1234.27
59	995.56	1244.01
60	1006.76	1253.99
61	1017.74	1264.21
62	1028.49	1274.67
63	1039.02	1285.35
64	1049.31	1296.26
65	1059.37	1307.39
66	1069.19	1318.73
67	1078.75	1330.29
68	1088.07	1342.04
69	1097.13	1354.00
70	1105.93	1366.14
71	1114.47	1378.48
72	1122.74	1390.99
73	1130.74	1403.68
74	1132.15	1406.03

Circle Center At X = 538.2 ; Y = 1768.2 and Radius, 695.7

*** 0.998 ***

Failure Surface Specified By 72 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	177.70	1171.20
2	190.56	1163.48
3	203.59	1156.05
4	216.78	1148.91
5	230.13	1142.08
6	243.64	1135.55
7	257.28	1129.32
8	271.07	1123.41
9	284.99	1117.81
10	299.02	1112.53
11	313.18	1107.56
12	327.44	1102.92
13	341.81	1098.60
14	356.27	1094.61
15	370.81	1090.94
16	385.44	1087.61
17	400.13	1084.61
18	414.89	1081.94
19	429.71	1079.60
20	444.58	1077.60
21	459.48	1075.94
22	474.43	1074.61
23	489.39	1073.63
24	504.38	1072.98
25	519.38	1072.67
26	534.38	1072.70
27	549.37	1073.07

28	564.35	1073.78
29	579.32	1074.83
30	594.25	1076.21
31	609.15	1077.93
32	624.01	1079.99
33	638.82	1082.39
34	653.57	1085.12
35	668.25	1088.18
36	682.86	1091.58
37	697.39	1095.30
38	711.84	1099.35
39	726.18	1103.73
40	740.43	1108.43
41	754.56	1113.45
42	768.58	1118.79
43	782.47	1124.45
44	796.24	1130.41
45	809.86	1136.69
46	823.34	1143.28
47	836.66	1150.17
48	849.83	1157.35
49	862.83	1164.84
50	875.65	1172.61
51	888.30	1180.68
52	900.76	1189.02
53	913.03	1197.65
54	925.11	1206.56
55	936.97	1215.73
56	948.63	1225.17
57	960.07	1234.87
58	971.29	1244.83
59	982.28	1255.04
60	993.04	1265.49
61	1003.55	1276.19
62	1013.83	1287.12
63	1023.85	1298.28
64	1033.62	1309.66
65	1043.12	1321.26
66	1052.37	1333.08
67	1061.34	1345.10
68	1070.04	1357.32
69	1078.46	1369.73
70	1086.60	1382.33
71	1094.45	1395.11
72	1098.79	1402.56

Circle Center At X = 525.5 ; Y = 1735.6 and Radius, 663.0

*** 0.998 ***

Failure Surface Specified By 80 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	175.40	1172.29
2	188.18	1164.43
3	201.11	1156.84
4	214.20	1149.51
5	227.43	1142.44
6	240.80	1135.64
7	254.30	1129.11
8	267.93	1122.85
9	281.69	1116.87
10	295.56	1111.16
11	309.55	1105.74
12	323.64	1100.60
13	337.83	1095.74
14	352.12	1091.17
15	366.50	1086.89
16	380.95	1082.90
17	395.49	1079.20
18	410.10	1075.80
19	424.77	1072.68
20	439.51	1069.87

21	454.29	1067.35
22	469.13	1065.13
23	484.01	1063.21
24	498.92	1061.59
25	513.86	1060.27
26	528.82	1059.25
27	543.81	1058.53
28	558.80	1058.11
29	573.80	1058.00
30	588.80	1058.18
31	603.79	1058.67
32	618.77	1059.46
33	633.73	1060.55
34	648.67	1061.94
35	663.57	1063.64
36	678.44	1065.63
37	693.26	1067.92
38	708.04	1070.51
39	722.76	1073.39
40	737.42	1076.57
41	752.01	1080.05
42	766.53	1083.82
43	780.97	1087.88
44	795.32	1092.23
45	809.59	1096.87
46	823.76	1101.79
47	837.82	1107.00
48	851.78	1112.49
49	865.63	1118.26
50	879.36	1124.30
51	892.96	1130.63
52	906.43	1137.22
53	919.77	1144.08
54	932.96	1151.22
55	946.01	1158.61
56	958.91	1166.27
57	971.65	1174.18
58	984.23	1182.35
59	996.65	1190.77
60	1008.89	1199.44
61	1020.95	1208.36
62	1032.84	1217.51
63	1044.53	1226.90
64	1056.04	1236.53
65	1067.34	1246.38
66	1078.45	1256.46
67	1089.36	1266.77
68	1100.05	1277.28
69	1110.53	1288.02
70	1120.79	1298.96
71	1130.83	1310.10
72	1140.64	1321.45
73	1150.22	1332.99
74	1159.57	1344.72
75	1168.68	1356.64
76	1177.55	1368.73
77	1186.17	1381.01
78	1194.55	1393.45
79	1202.67	1406.06
80	1203.74	1407.80

Circle Center At X = 572.0 ; Y = 1803.3 and Radius, 745.3

*** 0.998 ***

Failure Surface Specified By 69 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	184.59	1169.09
2	197.93	1162.23
3	211.41	1155.66
4	225.04	1149.39
5	238.80	1143.42

6	252.69	1137.75
7	266.70	1132.39
8	280.82	1127.34
9	295.05	1122.60
10	309.38	1118.17
11	323.81	1114.06
12	338.32	1110.26
13	352.91	1106.79
14	367.58	1103.63
15	382.31	1100.80
16	397.10	1098.29
17	411.94	1096.10
18	426.82	1094.25
19	441.74	1092.71
20	456.69	1091.51
21	471.67	1090.64
22	486.66	1090.09
23	501.66	1089.87
24	516.66	1089.98
25	531.65	1090.42
26	546.63	1091.19
27	561.59	1092.29
28	576.52	1093.72
29	591.42	1095.47
30	606.27	1097.55
31	621.08	1099.95
32	635.83	1102.68
33	650.52	1105.73
34	665.13	1109.11
35	679.67	1112.80
36	694.12	1116.81
37	708.49	1121.14
38	722.75	1125.78
39	736.91	1130.73
40	750.96	1135.99
41	764.88	1141.56
42	778.69	1147.44
43	792.36	1153.61
44	805.89	1160.08
45	819.27	1166.85
46	832.51	1173.91
47	845.59	1181.26
48	858.50	1188.89
49	871.24	1196.81
50	883.80	1205.00
51	896.19	1213.47
52	908.38	1222.21
53	920.38	1231.21
54	932.18	1240.47
55	943.77	1249.99
56	955.15	1259.76
57	966.31	1269.78
58	977.26	1280.04
59	987.97	1290.54
60	998.45	1301.27
61	1008.69	1312.23
62	1018.69	1323.41
63	1028.45	1334.80
64	1037.95	1346.41
65	1047.19	1358.22
66	1056.17	1370.24
67	1064.89	1382.45
68	1073.33	1394.84
69	1074.40	1396.49

Circle Center At X = 504.1 ; Y = 1773.6 and Radius, 683.8

*** 0.998 ***

Failure Surface Specified By 79 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	179.99	1170.11

2	192.84	1162.36
3	205.83	1154.87
4	218.98	1147.65
5	232.27	1140.68
6	245.69	1133.99
7	259.24	1127.57
8	272.93	1121.42
9	286.73	1115.54
10	300.64	1109.95
11	314.67	1104.63
12	328.80	1099.60
13	343.03	1094.85
14	357.35	1090.39
15	371.76	1086.22
16	386.25	1082.34
17	400.81	1078.74
18	415.44	1075.45
19	430.14	1072.44
20	444.89	1069.73
21	459.70	1067.32
22	474.55	1065.21
23	489.44	1063.39
24	504.36	1061.87
25	519.31	1060.66
26	534.28	1059.74
27	549.27	1059.13
28	564.27	1058.81
29	579.27	1058.80
30	594.27	1059.08
31	609.25	1059.67
32	624.23	1060.56
33	639.18	1061.75
34	654.11	1063.24
35	669.00	1065.03
36	683.85	1067.11
37	698.66	1069.50
38	713.42	1072.18
39	728.12	1075.16
40	742.76	1078.43
41	757.33	1081.99
42	771.83	1085.85
43	786.24	1090.00
44	800.57	1094.43
45	814.81	1099.15
46	828.95	1104.16
47	842.99	1109.45
48	856.91	1115.02
49	870.73	1120.87
50	884.42	1126.99
51	897.99	1133.39
52	911.42	1140.06
53	924.72	1147.00
54	937.88	1154.20
55	950.89	1161.67
56	963.75	1169.39
57	976.45	1177.37
58	988.98	1185.61
59	1001.35	1194.09
60	1013.55	1202.82
61	1025.57	1211.80
62	1037.41	1221.01
63	1049.06	1230.46
64	1060.51	1240.14
65	1071.77	1250.05
66	1082.83	1260.19
67	1093.69	1270.54
68	1104.33	1281.11
69	1114.76	1291.89
70	1124.97	1302.88
71	1134.96	1314.07

72	1144.72	1325.46
73	1154.25	1337.04
74	1163.55	1348.81
75	1172.61	1360.77
76	1181.43	1372.90
77	1190.00	1385.21
78	1198.32	1397.69
79	1204.79	1407.83

Circle Center At X = 572.5 ; Y = 1806.1 and Radius, 747.3

*** 0.998 ***

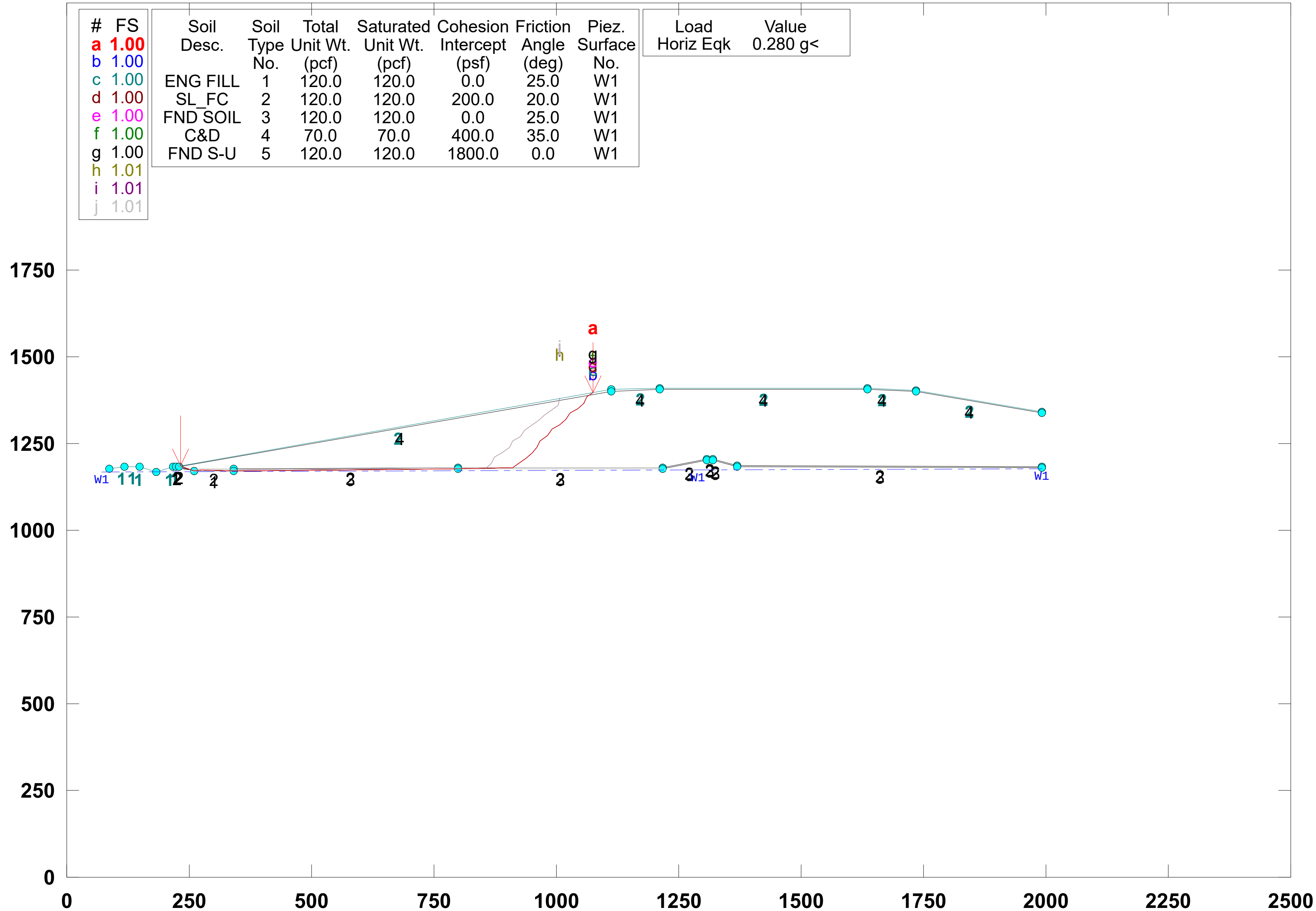
Northeast Landfill Cross Section B-B', WB (Seismic)

m:\projects\16219107.00\task 3 - tier iii modification app\permit application\app c - liner and final cover system stability analysis\stabl files\nelf\2023.4.13 nelf_xs_b_block (seismic).pl2 Run By: Username 5/11/2023

#	FS
a	1.00
b	1.00
c	1.00
d	1.00
e	1.00
f	1.00
g	1.00
h	1.01
i	1.01
j	1.01

Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Piez. Surface No.
ENG FILL	1	120.0	120.0	0.0	25.0	W1
SL_FC	2	120.0	120.0	200.0	20.0	W1
FND SOIL	3	120.0	120.0	0.0	25.0	W1
C&D	4	70.0	70.0	400.0	35.0	W1
FND S-U	5	120.0	120.0	1800.0	0.0	W1

Load	Value
Horiz Eqk	0.280 g<



PCSTABL5M3 FSmin=1.00
Safety Factors Are Calculated By The Modified Janbu Method

**** PCSTABL5M3 ****

by Purdue University 1985
rev. for SCS Engineers HVA 2008
--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer`s Method of Slices

Run Date: 5/11/2023
Time of Run: 06:23PM
Run By: Username
Input Data Filename: M:2023.4.13 nelf_xs_b_block (seismic).in
Output Filename: M:2023.4.13 nelf_xs_b_block (seismic).OUT
Unit: ENGLISH
Plotted Output Filename: M:2023.4.13 nelf_xs_b_block (seismic).PLT
PROBLEM DESCRIPTION Northeast Landfill
Cross Section B-B', WB (Seismic)

BOUNDARY COORDINATES
Note: User origin value specified.
Add 0.00 to X-values and 0.00 to Y-values listed.

10 Top Boundaries
33 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	87.00	1176.00	118.70	1184.50	1
2	118.70	1184.50	149.60	1184.50	1
3	149.60	1184.50	183.40	1168.50	1
4	183.40	1168.50	215.50	1184.50	1
5	215.50	1184.50	223.10	1184.50	1
6	223.10	1184.50	1110.60	1405.50	2
7	1110.60	1405.50	1211.80	1408.00	2
8	1211.80	1408.00	1635.60	1408.00	2
9	1635.60	1408.00	1735.70	1404.00	2
10	1735.70	1404.00	1991.20	1340.20	2
11	223.10	1184.50	229.10	1184.50	2
12	229.10	1184.50	230.70	1182.90	2
13	230.70	1182.90	1110.60	1401.00	4
14	1110.60	1401.00	1211.80	1405.00	4
15	1211.80	1405.00	1635.60	1405.00	4
16	1635.60	1405.00	1735.70	1401.00	4
17	1735.70	1401.00	1991.20	1337.20	4
18	230.70	1182.90	261.10	1171.80	2
19	261.10	1175.90	341.50	1175.90	2
20	341.50	1175.90	800.00	1179.90	2
21	800.00	1179.90	1218.60	1181.00	2
22	1218.60	1181.00	1305.70	1206.00	2
23	1305.70	1206.00	1320.70	1206.00	2
24	1320.70	1206.00	1369.90	1186.00	2
25	1369.90	1186.00	1991.20	1184.40	2
26	223.10	1184.40	261.10	1171.80	1
27	261.10	1171.80	341.50	1171.90	1
28	341.50	1171.90	800.00	1175.90	3
29	800.00	1175.90	1218.60	1177.00	3
30	1218.60	1177.00	1305.70	1202.00	3
31	1305.70	1202.00	1320.70	1202.00	3
32	1320.70	1202.00	1369.90	1182.00	3
33	1369.90	1182.00	1991.20	1180.40	3

ISOTROPIC SOIL PARAMETERS
5 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	120.0	120.0	0.0	25.0	0.00	0.0	1
2	120.0	120.0	200.0	20.0	0.00	0.0	1
3	120.0	120.0	0.0	25.0	0.00	0.0	1
4	70.0	70.0	400.0	35.0	0.00	0.0	1
5	120.0	120.0	1800.0	0.0	0.00	0.0	1

1 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED
Unit Weight of Water = 62.40
Piezometric Surface No. 1 Specified by 3 Coordinate Points

Point X-Water Y-Water

No.	(ft)	(ft)
1	70.80	1167.90
2	1287.50	1174.20
3	1991.20	1176.50

A Horizontal Earthquake Loading Coefficient
Of0.280 Has Been Assigned
A Vertical Earthquake Loading Coefficient
Of0.000 Has Been Assigned
Cavitation Pressure =   0.0 (psf)
A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Sliding Block Surfaces, Has Been
Specified.
1000 Trial Surfaces Have Been Generated.
6 Boxes Specified For Generation Of Central Block Base
Length Of Line Segments For Active And Passive Portions Of
Sliding Block Is 20.0

Box No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Height (ft)
1	261.10	1173.80	261.20	1173.80	4.00
2	261.70	1173.80	341.00	1173.90	4.00
3	341.50	1173.90	341.60	1173.90	4.00
4	342.10	1173.00	800.00	1177.90	4.00
5	800.50	1177.90	800.60	1177.90	4.00
6	801.10	1177.90	1216.60	1179.00	4.00

Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Examined. They Are Ordered - Most Critical
First.
* * Safety Factors Are Calculated By The Modified Janbu Method * *
Failure Surface Specified By 22 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	231.95	1186.70
2	242.66	1179.77
3	261.17	1172.21
4	275.13	1172.74
5	341.58	1172.01
6	587.34	1175.47
7	800.59	1176.90
8	909.62	1179.64
9	923.65	1193.88
10	937.41	1208.40
11	951.55	1222.54
12	961.46	1239.91
13	967.27	1259.05
14	981.04	1273.55
15	991.64	1290.52
16	1005.35	1305.08
17	1019.39	1319.32
18	1029.07	1336.82
19	1043.18	1350.99
20	1057.20	1365.26
21	1063.78	1384.14
22	1075.79	1396.83

***   1.004   ***

Individual data on the   26 slices

Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Tie Force Norm (lbs)	Tie Force Tan (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Surcharge Load (lbs)
1	3.9	818.8	0.0	0.0	0.0	0.0	229.3	0.0	0.0
2	6.8	4313.1	0.0	0.0	0.0	0.0	1207.7	0.0	0.0
3	18.5	23589.7	0.0	0.0	0.0	0.0	6605.1	0.0	0.0
4	14.0	27566.3	0.0	0.0	0.0	0.0	7718.6	0.0	0.0
5	66.4	178485.1	0.0	0.0	0.0	0.0	49975.8	0.0	0.0
6	0.1	272.9	0.0	0.0	0.0	0.0	76.4	0.0	0.0
7	245.8	1305046.1	0.0	0.0	0.0	0.0	*******	0.0	0.0
8	212.7	1940637.6	0.0	0.0	0.0	0.0	*******	0.0	0.0
9	0.6	6461.4	0.0	0.0	0.0	0.0	1809.2	0.0	0.0
10	109.0	1281286.1	0.0	0.0	0.0	0.0	*******	0.0	0.0
11	0.5	6839.2	0.0	0.0	0.0	0.0	1915.0	0.0	0.0

12	13.5	163671.8	0.0	0.0	0.0	0.0	45828.1	0.0	0.0
13	13.8	156559.4	0.0	0.0	0.0	0.0	43836.6	0.0	0.0
14	14.1	150211.3	0.0	0.0	0.0	0.0	42059.2	0.0	0.0
15	9.9	96394.2	0.0	0.0	0.0	0.0	26990.4	0.0	0.0
16	5.8	49885.0	0.0	0.0	0.0	0.0	13967.8	0.0	0.0
17	13.8	104461.6	0.0	0.0	0.0	0.0	29249.2	0.0	0.0
18	10.6	70899.5	0.0	0.0	0.0	0.0	19851.9	0.0	0.0
19	13.7	79575.4	0.0	0.0	0.0	0.0	22281.1	0.0	0.0
20	14.0	70754.1	0.0	0.0	0.0	0.0	19811.1	0.0	0.0
21	9.7	40019.0	0.0	0.0	0.0	0.0	11205.3	0.0	0.0
22	14.1	45638.1	0.0	0.0	0.0	0.0	12778.7	0.0	0.0
23	14.0	34837.4	0.0	0.0	0.0	0.0	9754.5	0.0	0.0
24	6.6	9894.0	0.0	0.0	0.0	0.0	2770.3	0.0	0.0
25	6.5	4662.8	0.0	0.0	0.0	0.0	1305.6	0.0	0.0
26	5.5	1474.8	0.0	0.0	0.0	0.0	412.9	0.0	0.0

Failure Surface Specified By 22 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	231.95	1186.70
2	242.66	1179.77
3	261.17	1172.21
4	275.13	1172.74
5	341.58	1172.01
6	587.34	1175.47
7	800.59	1176.90
8	909.62	1179.64
9	923.65	1193.88
10	937.41	1208.40
11	951.55	1222.54
12	961.46	1239.91
13	967.27	1259.05
14	981.04	1273.55
15	991.64	1290.52
16	1005.35	1305.08
17	1019.39	1319.32
18	1029.07	1336.82
19	1043.18	1350.99
20	1057.20	1365.26
21	1063.78	1384.14
22	1075.79	1396.83

*** 1.004 ***

Failure Surface Specified By 22 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	231.95	1186.70
2	242.66	1179.77
3	261.17	1172.21
4	275.13	1172.74
5	341.58	1172.01
6	587.34	1175.47
7	800.59	1176.90
8	909.62	1179.64
9	923.65	1193.88
10	937.41	1208.40
11	951.55	1222.54
12	961.46	1239.91
13	967.27	1259.05
14	981.04	1273.55
15	991.64	1290.52
16	1005.35	1305.08
17	1019.39	1319.32
18	1029.07	1336.82
19	1043.18	1350.99
20	1057.20	1365.26
21	1063.78	1384.14
22	1075.79	1396.83

*** 1.004 ***

Failure Surface Specified By 22 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)

```
    1        231.95     1186.70
    2        242.66     1179.77
    3        261.17     1172.21
    4        275.13     1172.74
    5        341.58     1172.01
    6        587.34     1175.47
    7        800.59     1176.90
    8        909.62     1179.64
    9        923.65     1193.88
   10        937.41     1208.40
   11        951.55     1222.54
   12        961.46     1239.91
   13        967.27     1259.05
   14        981.04     1273.55
   15        991.64     1290.52
   16       1005.35     1305.08
   17       1019.39     1319.32
   18       1029.07     1336.82
   19       1043.18     1350.99
   20       1057.20     1365.26
   21       1063.78     1384.14
   22       1075.79     1396.83
      ***     1.004   ***
Failure Surface Specified By 22 Coordinate Points
  Point      X-Surf      Y-Surf
   No.        (ft)        (ft)
    1        231.95     1186.70
    2        242.66     1179.77
    3        261.17     1172.21
    4        275.13     1172.74
    5        341.58     1172.01
    6        587.34     1175.47
    7        800.59     1176.90
    8        909.62     1179.64
    9        923.65     1193.88
   10        937.41     1208.40
   11        951.55     1222.54
   12        961.46     1239.91
   13        967.27     1259.05
   14        981.04     1273.55
   15        991.64     1290.52
   16       1005.35     1305.08
   17       1019.39     1319.32
   18       1029.07     1336.82
   19       1043.18     1350.99
   20       1057.20     1365.26
   21       1063.78     1384.14
   22       1075.79     1396.83
      ***     1.004   ***
Failure Surface Specified By 22 Coordinate Points
  Point      X-Surf      Y-Surf
   No.        (ft)        (ft)
    1        231.95     1186.70
    2        242.66     1179.77
    3        261.17     1172.21
    4        275.13     1172.74
    5        341.58     1172.01
    6        587.34     1175.47
    7        800.59     1176.90
    8        909.62     1179.64
    9        923.65     1193.88
   10        937.41     1208.40
   11        951.55     1222.54
   12        961.46     1239.91
   13        967.27     1259.05
   14        981.04     1273.55
   15        991.64     1290.52
   16       1005.35     1305.08
   17       1019.39     1319.32
   18       1029.07     1336.82
```

19	1043.18	1350.99
20	1057.20	1365.26
21	1063.78	1384.14
22	1075.79	1396.83

*** 1.004 ***

Failure Surface Specified By 22 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	231.95	1186.70
2	242.66	1179.77
3	261.17	1172.21
4	275.13	1172.74
5	341.58	1172.01
6	587.34	1175.47
7	800.59	1176.90
8	909.62	1179.64
9	923.65	1193.88
10	937.41	1208.40
11	951.55	1222.54
12	961.46	1239.91
13	967.27	1259.05
14	981.04	1273.55
15	991.64	1290.52
16	1005.35	1305.08
17	1019.39	1319.32
18	1029.07	1336.82
19	1043.18	1350.99
20	1057.20	1365.26
21	1063.78	1384.14
22	1075.79	1396.83

*** 1.004 ***

Failure Surface Specified By 21 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	226.95	1185.46
2	241.28	1174.86
3	261.17	1172.77
4	283.67	1174.38
5	341.55	1173.02
6	681.36	1175.68
7	800.53	1177.61
8	853.72	1177.52
9	867.48	1192.04
10	875.00	1210.57
11	889.02	1224.84
12	903.13	1239.01
13	911.64	1257.11
14	925.76	1271.27
15	935.76	1288.59
16	949.89	1302.74
17	962.89	1317.94
18	976.92	1332.20
19	990.96	1346.44
20	1004.96	1360.72
21	1008.18	1380.00

*** 1.005 ***

Failure Surface Specified By 21 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	226.95	1185.46
2	241.28	1174.86
3	261.17	1172.77
4	283.67	1174.38
5	341.55	1173.02
6	681.36	1175.68
7	800.53	1177.61
8	853.72	1177.52
9	867.48	1192.04
10	875.00	1210.57
11	889.02	1224.84

12	903.13	1239.01
13	911.64	1257.11
14	925.76	1271.27
15	935.76	1288.59
16	949.89	1302.74
17	962.89	1317.94
18	976.92	1332.20
19	990.96	1346.44
20	1004.96	1360.72
21	1008.18	1380.00

*** 1.005 ***

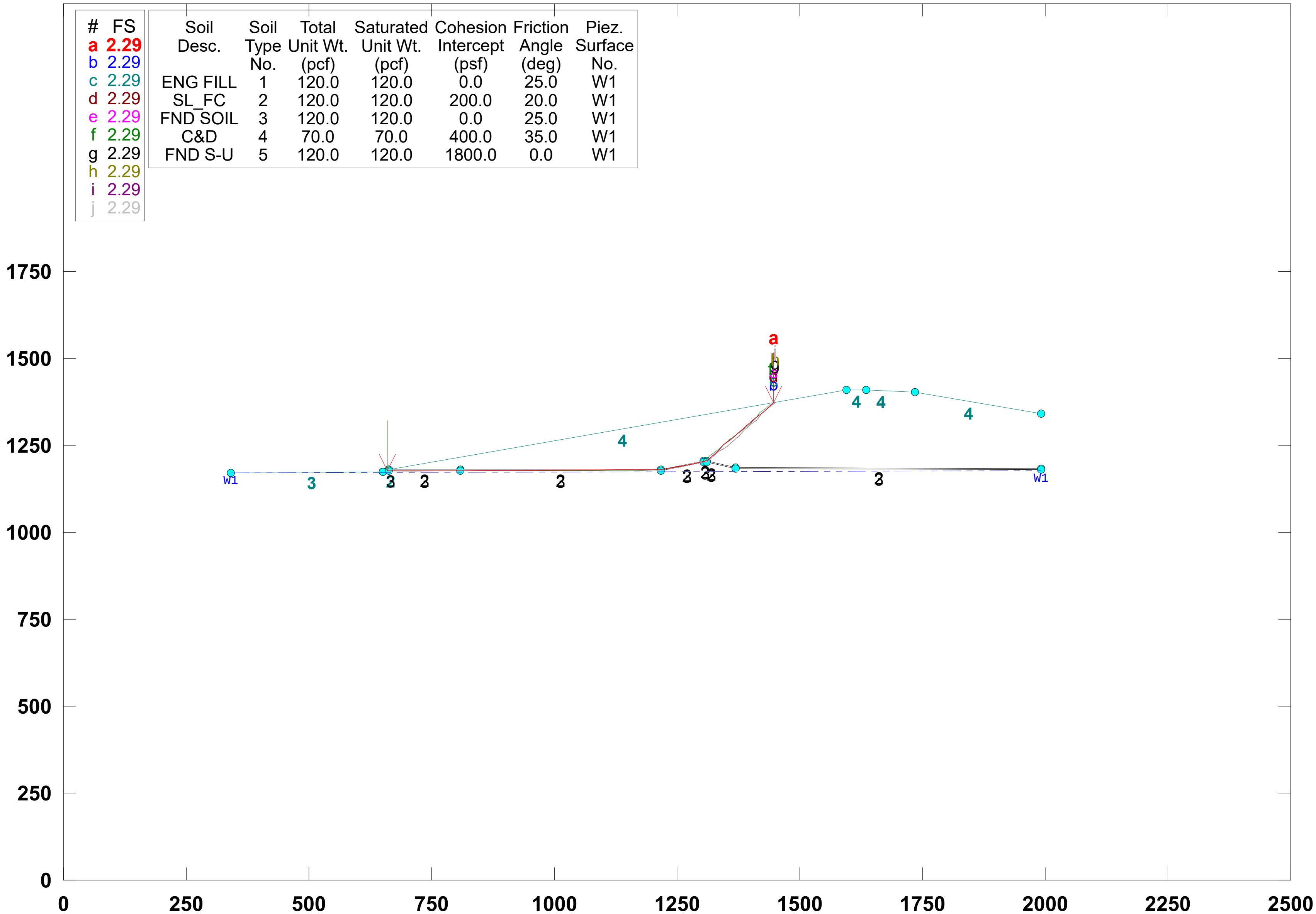
Failure Surface Specified By 21 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	226.95	1185.46
2	241.28	1174.86
3	261.17	1172.77
4	283.67	1174.38
5	341.55	1173.02
6	681.36	1175.68
7	800.53	1177.61
8	853.72	1177.52
9	867.48	1192.04
10	875.00	1210.57
11	889.02	1224.84
12	903.13	1239.01
13	911.64	1257.11
14	925.76	1271.27
15	935.76	1288.59
16	949.89	1302.74
17	962.89	1317.94
18	976.92	1332.20
19	990.96	1346.44
20	1004.96	1360.72
21	1008.18	1380.00

*** 1.005 ***

Northeast Landfill Cross Section B-B', PH12 WB

m:\projects\16219107.00\task 3 - tier iii modification app\permit application\app c - liner and final cover system stability analysis\stabl files\nelf\2023.4.13 nelf_xs_b_ph12 wb.pl2   Run By: Username   5/11/2023



PCSTABL5M3 FSmin=2.29

Safety Factors Are Calculated By The Modified Janbu Method

**** PCSTABL5M3 ****
by Purdue University 1985
rev. for SCS Engineers HVA 2008
--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer`s Method of Slices

Run Date: 5/11/2023
Time of Run: 05:17PM
Run By: Username
Input Data Filename: M:2023.4.13 nelf_xs_b_ph12 wb.in
Output Filename: M:2023.4.13 nelf_xs_b_ph12 wb.OUT
Unit: ENGLISH
Plotted Output Filename: M:2023.4.13 nelf_xs_b_ph12 wb.PLT
PROBLEM DESCRIPTION Northeast Landfill
Cross Section B-B', PH12 WB

BOUNDARY COORDINATES
Note: User origin value specified.
Add 0.00 to X-values and 0.00 to Y-values listed.

6 Top Boundaries
19 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	341.50	1171.90	651.40	1174.70	3
2	651.40	1174.70	663.40	1178.70	2
3	663.40	1178.70	1596.50	1408.00	4
4	1596.50	1408.00	1635.60	1408.00	4
5	1635.60	1408.00	1735.70	1404.00	4
6	1735.70	1404.00	1991.20	1340.20	4
7	663.40	1178.70	807.10	1180.00	2
8	807.10	1180.00	1218.60	1181.00	2
9	1218.60	1181.00	1305.60	1206.00	2
10	1305.60	1206.00	1310.60	1206.00	2
11	1310.60	1206.00	1369.90	1186.00	2
12	1369.90	1186.00	1991.20	1184.40	2
13	651.40	1174.70	663.40	1178.40	3
14	663.40	1178.40	807.10	1176.00	3
15	807.10	1176.00	1218.60	1177.00	3
16	1218.60	1177.00	1305.60	1202.00	3
17	1305.60	1202.00	1310.60	1202.00	3
18	1310.60	1202.00	1369.90	1182.00	3
19	1369.90	1182.00	1991.20	1180.40	3

ISOTROPIC SOIL PARAMETERS
5 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	120.0	120.0	0.0	25.0	0.00	0.0	1
2	120.0	120.0	200.0	20.0	0.00	0.0	1
3	120.0	120.0	0.0	25.0	0.00	0.0	1
4	70.0	70.0	400.0	35.0	0.00	0.0	1
5	120.0	120.0	1800.0	0.0	0.00	0.0	1

1 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED
Unit Weight of Water = 62.40
Piezometric Surface No. 1 Specified by 2 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	340.80	1170.40
2	1991.20	1176.50

A Critical Failure Surface Searching Method, Using A Random Technique For Generating Sliding Block Surfaces, Has Been Specified.
1000 Trial Surfaces Have Been Generated.
8 Boxes Specified For Generation Of Central Block Base
Length Of Line Segments For Active And Passive Portions Of Sliding Block Is 20.0

Box No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Height (ft)
1	663.40	1176.70	663.50	1176.70	4.00
2	664.00	1176.70	806.50	1178.00	4.00

3	807.00	1178.00	807.10	1178.00	4.00
4	807.60	1178.00	1218.10	1179.00	4.00
5	1218.60	1179.00	1218.70	1179.00	4.00
6	1219.20	1179.00	1305.10	1204.00	4.00
7	1305.60	1204.00	1305.70	1204.00	4.00
8	1306.10	1204.00	1310.10	1204.00	4.00

Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Examined. They Are Ordered - Most Critical
First.

* * Safety Factors Are Calculated By The Modified Janbu Method * *

Failure Surface Specified By 20 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	658.70	1177.13
2	663.42	1176.33
3	678.36	1177.16
4	807.03	1177.38
5	1215.77	1179.16
6	1218.62	1180.06
7	1278.02	1195.56
8	1305.68	1203.68
9	1309.79	1205.16
10	1323.89	1219.34
11	1335.54	1235.60
12	1345.54	1252.92
13	1359.57	1267.17
14	1371.47	1283.25
15	1385.59	1297.41
16	1397.02	1313.82
17	1410.53	1328.57
18	1423.69	1343.63
19	1435.79	1359.55
20	1446.42	1371.12

*** 2.290 ***

Individual data on the 27 slices

Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Tie Force Norm (lbs)	Tie Force Tan (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Surcharge Load (lbs)
1	0.4	4.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	4.3	661.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	0.0	7.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	14.9	5479.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	53.9	49572.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6	74.8	152657.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7	0.1	195.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8	408.7	2504456.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
9	2.8	26976.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10	0.0	213.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0
11	59.4	564889.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
12	27.6	261108.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0
13	0.1	795.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0
14	4.1	38420.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15	0.8	7522.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0
16	0.0	175.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0
17	13.3	117707.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0
18	11.7	93774.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0
19	10.0	70565.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
20	14.0	86432.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
21	11.9	63318.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
22	14.1	63395.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
23	11.4	41565.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0
24	13.5	37304.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0
25	13.2	25622.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
26	12.1	13073.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
27	10.6	3332.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Failure Surface Specified By 20 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	658.70	1177.13

2	663.42	1176.33
3	678.36	1177.16
4	807.03	1177.38
5	1215.77	1179.16
6	1218.62	1180.06
7	1278.02	1195.56
8	1305.68	1203.68
9	1309.79	1205.16
10	1323.89	1219.34
11	1335.54	1235.60
12	1345.54	1252.92
13	1359.57	1267.17
14	1371.47	1283.25
15	1385.59	1297.41
16	1397.02	1313.82
17	1410.53	1328.57
18	1423.69	1343.63
19	1435.79	1359.55
20	1446.42	1371.12

*** 2.290 ***

Failure Surface Specified By 20 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	658.70	1177.13
2	663.42	1176.33
3	678.36	1177.16
4	807.03	1177.38
5	1215.77	1179.16
6	1218.62	1180.06
7	1278.02	1195.56
8	1305.68	1203.68
9	1309.79	1205.16
10	1323.89	1219.34
11	1335.54	1235.60
12	1345.54	1252.92
13	1359.57	1267.17
14	1371.47	1283.25
15	1385.59	1297.41
16	1397.02	1313.82
17	1410.53	1328.57
18	1423.69	1343.63
19	1435.79	1359.55
20	1446.42	1371.12

*** 2.290 ***

Failure Surface Specified By 20 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	658.70	1177.13
2	663.42	1176.33
3	678.36	1177.16
4	807.03	1177.38
5	1215.77	1179.16
6	1218.62	1180.06
7	1278.02	1195.56
8	1305.68	1203.68
9	1309.79	1205.16
10	1323.89	1219.34
11	1335.54	1235.60
12	1345.54	1252.92
13	1359.57	1267.17
14	1371.47	1283.25
15	1385.59	1297.41
16	1397.02	1313.82
17	1410.53	1328.57
18	1423.69	1343.63
19	1435.79	1359.55
20	1446.42	1371.12

*** 2.290 ***

Failure Surface Specified By 20 Coordinate Points

Point	X-Surf	Y-Surf

No.	(ft)	(ft)
1	658.70	1177.13
2	663.42	1176.33
3	678.36	1177.16
4	807.03	1177.38
5	1215.77	1179.16
6	1218.62	1180.06
7	1278.02	1195.56
8	1305.68	1203.68
9	1309.79	1205.16
10	1323.89	1219.34
11	1335.54	1235.60
12	1345.54	1252.92
13	1359.57	1267.17
14	1371.47	1283.25
15	1385.59	1297.41
16	1397.02	1313.82
17	1410.53	1328.57
18	1423.69	1343.63
19	1435.79	1359.55
20	1446.42	1371.12

*** 2.290 ***

Failure Surface Specified By 20 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	662.10	1178.27
2	663.50	1176.87
3	695.96	1178.05
4	807.07	1177.44
5	1154.23	1178.53
6	1218.69	1180.16
7	1295.34	1199.40
8	1305.65	1204.31
9	1306.50	1203.74
10	1317.93	1220.15
11	1331.44	1234.90
12	1344.60	1249.96
13	1356.70	1265.88
14	1370.23	1280.61
15	1384.35	1294.77
16	1396.75	1310.47
17	1409.55	1325.83
18	1419.22	1343.34
19	1432.51	1358.29
20	1440.60	1369.69

*** 2.292 ***

Failure Surface Specified By 20 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	655.33	1176.01
2	663.47	1175.96
3	720.49	1177.51
4	807.09	1177.62
5	867.31	1176.26
6	1218.61	1178.66
7	1251.74	1187.60
8	1305.63	1202.39
9	1309.49	1202.33
10	1323.16	1216.92
11	1336.28	1232.02
12	1350.06	1246.51
13	1364.10	1260.76
14	1375.48	1277.21
15	1386.78	1293.71
16	1399.72	1308.96
17	1412.77	1324.11
18	1421.02	1342.33
19	1434.89	1356.74
20	1448.17	1371.55

*** 2.293 ***

Failure Surface Specified By 20 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	655.33	1176.01
2	663.47	1175.96
3	720.49	1177.51
4	807.09	1177.62
5	867.31	1176.26
6	1218.61	1178.66
7	1251.74	1187.60
8	1305.63	1202.39
9	1309.49	1202.33
10	1323.16	1216.92
11	1336.28	1232.02
12	1350.06	1246.51
13	1364.10	1260.76
14	1375.48	1277.21
15	1386.78	1293.71
16	1399.72	1308.96
17	1412.77	1324.11
18	1421.02	1342.33
19	1434.89	1356.74
20	1448.17	1371.55

*** 2.293 ***

Failure Surface Specified By 20 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	655.33	1176.01
2	663.47	1175.96
3	720.49	1177.51
4	807.09	1177.62
5	867.31	1176.26
6	1218.61	1178.66
7	1251.74	1187.60
8	1305.63	1202.39
9	1309.49	1202.33
10	1323.16	1216.92
11	1336.28	1232.02
12	1350.06	1246.51
13	1364.10	1260.76
14	1375.48	1277.21
15	1386.78	1293.71
16	1399.72	1308.96
17	1412.77	1324.11
18	1421.02	1342.33
19	1434.89	1356.74
20	1448.17	1371.55

*** 2.293 ***

Failure Surface Specified By 20 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	655.33	1176.01
2	663.47	1175.96
3	720.49	1177.51
4	807.09	1177.62
5	867.31	1176.26
6	1218.61	1178.66
7	1251.74	1187.60
8	1305.63	1202.39
9	1309.49	1202.33
10	1323.16	1216.92
11	1336.28	1232.02
12	1350.06	1246.51
13	1364.10	1260.76
14	1375.48	1277.21
15	1386.78	1293.71
16	1399.72	1308.96
17	1412.77	1324.11
18	1421.02	1342.33
19	1434.89	1356.74

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 20        1448.17     1371.55
    ***      2.293   ***
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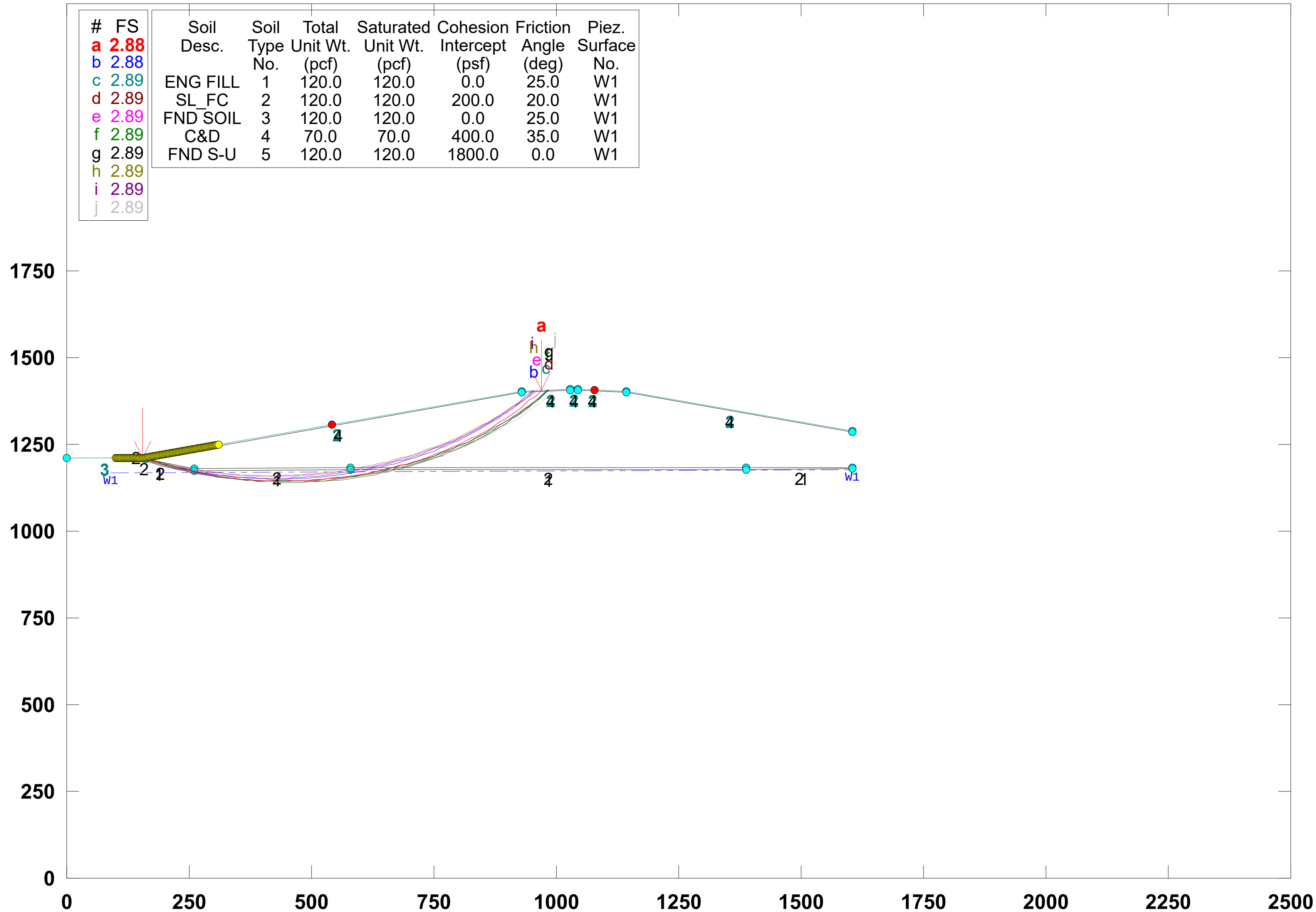
Northeast Landfill Cross Section A, Circular

m:\projects\16219107.00\task 3 - tier iii modification app\permit application\app c - liner and final cover system stability analysis\stabl files\nelf\2023.4.13 nelf_xs_a_circ.pl2 Run By: Username 5/11/2023 0



Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Piez. Surface No.
ENG FILL	1	120.0	120.0	0.0	25.0	W1
SL_FC	2	120.0	120.0	200.0	20.0	W1
FND SOIL	3	120.0	120.0	0.0	25.0	W1
C&D	4	70.0	70.0	400.0	35.0	W1
FND S-U	5	120.0	120.0	1800.0	0.0	W1

PCSTABL5M3 FSmin=2.88

Safety Factors Are Calculated By The Modified Bishop Method

**** PCSTABL5M3 ****

by Purdue University 1985
rev. for SCS Engineers HVA 2008
--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer`s Method of Slices

Run Date: 5/11/2023
Time of Run: 05:29PM
Run By: Username
Input Data Filename: M:2023.4.13 nelf_xs_a_circ.in
Output Filename: M:2023.4.13 nelf_xs_a_circ.OUT
Unit: ENGLISH
Plotted Output Filename: M:2023.4.13 nelf_xs_a_circ.PLT
PROBLEM DESCRIPTION Northeast Landfill
Cross Section A, Circular

BOUNDARY COORDINATES
Note: User origin value specified.
Add 0.00 to X-values and 0.00 to Y-values listed.

6 Top Boundaries
21 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	0.00	1212.00	154.70	1210.50	3
2	154.70	1210.50	928.90	1404.00	2
3	928.90	1404.00	1029.10	1408.00	2
4	1029.10	1408.00	1043.80	1408.00	2
5	1043.80	1408.00	1144.10	1404.00	2
6	1144.10	1404.00	1603.40	1289.90	2
7	154.70	1210.50	160.70	1210.50	2
8	160.70	1210.50	162.30	1209.40	2
9	162.30	1209.40	928.90	1401.00	4
10	928.90	1401.00	1029.10	1405.00	4
11	1029.10	1405.00	1043.80	1405.00	4
12	1043.80	1405.00	1144.10	1401.00	4
13	1144.10	1401.00	1603.40	1286.90	4
14	162.30	1209.40	261.10	1179.40	2
15	261.10	1179.40	579.00	1182.30	2
16	579.00	1182.30	1386.40	1182.10	2
17	1386.40	1182.10	1603.40	1184.20	2
18	154.70	1210.50	261.10	1175.40	1
19	261.10	1175.40	579.00	1178.30	1
20	579.00	1178.30	1386.40	1178.10	1
21	1386.40	1178.10	1603.40	1180.20	1

ISOTROPIC SOIL PARAMETERS
5 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	120.0	120.0	0.0	25.0	0.00	0.0	1
2	120.0	120.0	200.0	20.0	0.00	0.0	1
3	120.0	120.0	0.0	25.0	0.00	0.0	1
4	70.0	70.0	400.0	35.0	0.00	0.0	1
5	120.0	120.0	1800.0	0.0	0.00	0.0	1

1 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED
Unit Weight of Water = 62.40
Piezometric Surface No. 1 Specified by 2 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	88.50	1168.30
2	1603.40	1177.60

A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Circular Surfaces, Has Been Specified.
10000 Trial Surfaces Have Been Generated.
100 Surfaces Initiate From Each Of100 Points Equally Spaced
Along The Ground Surface Between X = 100.00 ft.
and X = 310.00 ft.
Each Surface Terminates Between X = 541.50 ft.
and X =1078.00 ft.
Unless Further Limitations Were Imposed, The Minimum Elevation

At Which A Surface Extends Is Y = 0.00 ft.
15.00 ft. Line Segments Define Each Trial Failure Surface.
Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Examined. They Are Ordered - Most Critical
First.
* * Safety Factors Are Calculated By The Modified Bishop Method * *
Failure Surface Specified By 62 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	155.15	1210.61
2	168.72	1204.22
3	182.43	1198.14
4	196.28	1192.37
5	210.25	1186.91
6	224.34	1181.78
7	238.55	1176.96
8	252.86	1172.47
9	267.27	1168.31
10	281.78	1164.47
11	296.36	1160.97
12	311.02	1157.80
13	325.75	1154.96
14	340.54	1152.45
15	355.38	1150.29
16	370.27	1148.46
17	385.20	1146.97
18	400.15	1145.82
19	415.13	1145.01
20	430.12	1144.54
21	445.12	1144.41
22	460.12	1144.62
23	475.11	1145.17
24	490.08	1146.06
25	505.03	1147.30
26	519.95	1148.87
27	534.83	1150.78
28	549.66	1153.03
29	564.44	1155.61
30	579.15	1158.53
31	593.79	1161.78
32	608.36	1165.37
33	622.84	1169.28
34	637.22	1173.52
35	651.51	1178.09
36	665.69	1182.98
37	679.76	1188.19
38	693.70	1193.73
39	707.51	1199.57
40	721.19	1205.73
41	734.73	1212.20
42	748.11	1218.97
43	761.34	1226.05
44	774.40	1233.42
45	787.29	1241.09
46	800.00	1249.05
47	812.53	1257.30
48	824.87	1265.82
49	837.01	1274.63
50	848.95	1283.71
51	860.68	1293.06
52	872.20	1302.68
53	883.49	1312.55
54	894.56	1322.68
55	905.39	1333.05
56	915.98	1343.67
57	926.33	1354.53
58	936.43	1365.62
59	946.28	1376.93
60	955.87	1388.47
61	965.19	1400.22

62 969.27 1405.61
Circle Center At X = 443.3 ; Y = 1804.5 and Radius, 660.1
*** 2.882 ***
Individual data on the 73 slices

Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Tie Force Norm (lbs)	Tie Force Tan (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Surcharge Load (lbs)
1	0.2	2.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	1.6	146.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	3.7	1182.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	1.6	878.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	6.4	5185.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6	13.7	18884.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7	13.8	29358.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8	14.0	39488.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0
9	14.1	49241.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10	14.2	58581.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
11	14.3	67479.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0
12	8.2	42442.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
13	2.5	13343.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
14	3.7	20415.8	0.0	130.4	0.0	0.0	0.0	0.0	0.0
15	14.5	86871.5	0.0	2855.5	0.0	0.0	0.0	0.0	0.0
16	14.6	97602.0	0.0	6374.2	0.0	0.0	0.0	0.0	0.0
17	14.7	107831.6	0.0	9583.0	0.0	0.0	0.0	0.0	0.0
18	14.7	117531.7	0.0	12480.6	0.0	0.0	0.0	0.0	0.0
19	14.8	126674.5	0.0	15065.3	0.0	0.0	0.0	0.0	0.0
20	14.8	135236.0	0.0	17336.0	0.0	0.0	0.0	0.0	0.0
21	14.9	143191.4	0.0	19291.3	0.0	0.0	0.0	0.0	0.0
22	14.9	150520.8	0.0	20930.2	0.0	0.0	0.0	0.0	0.0
23	15.0	157204.2	0.0	22251.8	0.0	0.0	0.0	0.0	0.0
24	15.0	163225.4	0.0	23255.8	0.0	0.0	0.0	0.0	0.0
25	15.0	168569.3	0.0	23941.3	0.0	0.0	0.0	0.0	0.0
26	15.0	173223.2	0.0	24308.0	0.0	0.0	0.0	0.0	0.0
27	15.0	177176.9	0.0	24355.8	0.0	0.0	0.0	0.0	0.0
28	15.0	180422.4	0.0	24084.5	0.0	0.0	0.0	0.0	0.0
29	15.0	182954.2	0.0	23494.5	0.0	0.0	0.0	0.0	0.0
30	14.9	184768.3	0.0	22586.1	0.0	0.0	0.0	0.0	0.0
31	14.9	185863.8	0.0	21359.6	0.0	0.0	0.0	0.0	0.0
32	14.9	186241.7	0.0	19815.8	0.0	0.0	0.0	0.0	0.0
33	14.8	185905.5	0.0	17955.4	0.0	0.0	0.0	0.0	0.0
34	14.8	184860.3	0.0	15779.1	0.0	0.0	0.0	0.0	0.0
35	14.6	181274.5	0.0	13167.7	0.0	0.0	0.0	0.0	0.0
36	0.1	1840.3	0.0	120.8	0.0	0.0	0.0	0.0	0.0
37	14.6	180626.7	0.0	10484.4	0.0	0.0	0.0	0.0	0.0
38	14.6	177412.3	0.0	7368.8	0.0	0.0	0.0	0.0	0.0
39	14.5	173536.2	0.0	3942.9	0.0	0.0	0.0	0.0	0.0
40	8.0	94031.2	0.0	595.9	0.0	0.0	0.0	0.0	0.0
41	6.4	74984.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
42	14.3	163868.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
43	0.6	6264.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0
44	11.6	129412.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
45	2.0	22475.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
46	14.1	154111.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
47	13.9	150947.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
48	13.8	147402.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
49	13.7	143489.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0
50	13.5	139225.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0
51	13.4	134627.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0
52	13.2	129713.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
53	13.1	124501.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
54	12.9	119011.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0
55	12.7	113265.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0
56	12.5	107284.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
57	12.3	101092.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
58	12.1	94711.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0
59	11.9	88166.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0
60	11.7	81482.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0
61	11.5	74685.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
62	11.3	67800.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0

63	11.1	60854.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0
64	10.8	53875.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
65	10.6	46889.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0
66	10.4	39926.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
67	2.6	8966.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0
68	7.5	23629.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
69	9.8	24374.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0
70	9.6	16324.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
71	9.3	8522.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
72	1.7	761.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
73	2.3	421.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Failure Surface Specified By 61 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	155.15	1210.61
2	168.87	1204.54
3	182.71	1198.77
4	196.69	1193.32
5	210.78	1188.18
6	224.99	1183.37
7	239.30	1178.87
8	253.71	1174.70
9	268.20	1170.86
10	282.79	1167.34
11	297.44	1164.15
12	312.17	1161.29
13	326.96	1158.77
14	341.80	1156.58
15	356.68	1154.73
16	371.60	1153.21
17	386.56	1152.03
18	401.53	1151.18
19	416.52	1150.68
20	431.52	1150.51
21	446.52	1150.68
22	461.51	1151.19
23	476.49	1152.04
24	491.44	1153.22
25	506.37	1154.74
26	521.25	1156.60
27	536.09	1158.79
28	550.87	1161.32
29	565.60	1164.18
30	580.26	1167.37
31	594.84	1170.89
32	609.34	1174.74
33	623.74	1178.91
34	638.05	1183.41
35	652.26	1188.23
36	666.35	1193.37
37	680.32	1198.82
38	694.17	1204.59
39	707.88	1210.67
40	721.46	1217.06
41	734.88	1223.75
42	748.15	1230.74
43	761.26	1238.03
44	774.20	1245.61
45	786.97	1253.49
46	799.56	1261.65
47	811.96	1270.09
48	824.16	1278.80
49	836.17	1287.80
50	847.97	1297.06
51	859.56	1306.58
52	870.93	1316.36
53	882.08	1326.40
54	892.99	1336.68
55	903.68	1347.21
56	914.12	1357.98

57	924.32	1368.98
58	934.27	1380.21
59	943.96	1391.66
60	953.39	1403.32
61	954.71	1405.03

Circle Center At X = 431.5 ; Y = 1815.7 and Radius, 665.2
*** 2.884 ***
Failure Surface Specified By 63 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	150.91	1210.54
2	164.46	1204.10
3	178.15	1197.96
4	191.97	1192.13
5	205.91	1186.62
6	219.98	1181.41
7	234.16	1176.52
8	248.45	1171.95
9	262.83	1167.70
10	277.31	1163.76
11	291.87	1160.16
12	306.51	1156.88
13	321.21	1153.92
14	335.98	1151.30
15	350.80	1149.01
16	365.68	1147.04
17	380.59	1145.41
18	395.53	1144.12
19	410.50	1143.15
20	425.49	1142.52
21	440.48	1142.23
22	455.48	1142.27
23	470.48	1142.64
24	485.46	1143.35
25	500.43	1144.40
26	515.36	1145.78
27	530.26	1147.49
28	545.12	1149.53
29	559.94	1151.90
30	574.69	1154.61
31	589.38	1157.64
32	604.00	1161.00
33	618.54	1164.68
34	632.99	1168.69
35	647.36	1173.02
36	661.62	1177.67
37	675.77	1182.64
38	689.81	1187.92
39	703.73	1193.51
40	717.52	1199.42
41	731.17	1205.63
42	744.69	1212.14
43	758.05	1218.95
44	771.26	1226.06
45	784.30	1233.46
46	797.18	1241.15
47	809.89	1249.13
48	822.41	1257.39
49	834.74	1265.92
50	846.89	1274.73
51	858.83	1283.81
52	870.56	1293.15
53	882.09	1302.75
54	893.40	1312.60
55	904.48	1322.71
56	915.34	1333.06
57	925.96	1343.65
58	936.34	1354.48
59	946.48	1365.53
60	956.37	1376.81

61	966.01	1388.30
62	975.39	1400.01
63	980.00	1406.04

Circle Center At X = 446.2 ; Y = 1814.3 and Radius, 672.1
*** 2.885 ***
Failure Surface Specified By 63 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	155.15	1210.61
2	168.70	1204.17
3	182.38	1198.02
4	196.20	1192.19
5	210.14	1186.66
6	224.21	1181.45
7	238.39	1176.55
8	252.67	1171.97
9	267.05	1167.70
10	281.52	1163.76
11	296.08	1160.14
12	310.71	1156.85
13	325.42	1153.89
14	340.19	1151.25
15	355.01	1148.94
16	369.88	1146.97
17	384.79	1145.32
18	399.73	1144.01
19	414.70	1143.03
20	429.68	1142.39
21	444.68	1142.08
22	459.68	1142.10
23	474.67	1142.46
24	489.66	1143.15
25	504.62	1144.18
26	519.56	1145.54
27	534.47	1147.23
28	549.33	1149.26
29	564.14	1151.61
30	578.90	1154.30
31	593.59	1157.31
32	608.22	1160.65
33	622.76	1164.31
34	637.22	1168.30
35	651.59	1172.61
36	665.86	1177.24
37	680.02	1182.19
38	694.07	1187.45
39	707.99	1193.02
40	721.79	1198.90
41	735.46	1205.09
42	748.98	1211.58
43	762.36	1218.37
44	775.58	1225.45
45	788.64	1232.83
46	801.53	1240.50
47	814.25	1248.45
48	826.78	1256.69
49	839.13	1265.20
50	851.29	1273.99
51	863.25	1283.04
52	875.01	1292.36
53	886.55	1301.94
54	897.88	1311.77
55	908.98	1321.86
56	919.86	1332.18
57	930.50	1342.75
58	940.91	1353.56
59	951.07	1364.59
60	960.99	1375.84
61	970.65	1387.32
62	980.05	1399.01

63	985.63	1406.26

Circle Center At X = 451.1 ; Y = 1815.0 and Radius, 672.9
*** 2.885 ***
Failure Surface Specified By 60 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	155.15	1210.61
2	169.10	1205.09
3	183.16	1199.87
4	197.33	1194.94
5	211.60	1190.32
6	225.96	1186.00
7	240.42	1181.99
8	254.95	1178.28
9	269.56	1174.88
10	284.24	1171.80
11	298.98	1169.02
12	313.78	1166.56
13	328.62	1164.41
14	343.51	1162.58
15	358.43	1161.06
16	373.39	1159.86
17	388.36	1158.98
18	403.35	1158.41
19	418.35	1158.17
20	433.35	1158.24
21	448.34	1158.63
22	463.32	1159.33
23	478.29	1160.36
24	493.23	1161.70
25	508.14	1163.36
26	523.01	1165.33
27	537.83	1167.62
28	552.60	1170.22
29	567.32	1173.13
30	581.97	1176.36
31	596.55	1179.90
32	611.04	1183.74
33	625.46	1187.89
34	639.78	1192.35
35	654.01	1197.10
36	668.13	1202.16
37	682.14	1207.52
38	696.03	1213.17
39	709.80	1219.12
40	723.45	1225.35
41	736.95	1231.88
42	750.32	1238.69
43	763.54	1245.78
44	776.60	1253.15
45	789.51	1260.79
46	802.25	1268.71
47	814.82	1276.90
48	827.21	1285.35
49	839.42	1294.06
50	851.45	1303.02
51	863.28	1312.24
52	874.91	1321.71
53	886.34	1331.43
54	897.56	1341.38
55	908.57	1351.57
56	919.36	1361.99
57	929.93	1372.64
58	940.26	1383.51
59	950.37	1394.59
60	959.66	1405.23

Circle Center At X = 422.5 ; Y = 1865.6 and Radius, 707.5
*** 2.887 ***
Failure Surface Specified By 63 Coordinate Points

Point	X-Surf	Y-Surf

No.	(ft)	(ft)
1	161.52	1212.20
2	174.94	1205.51
3	188.51	1199.12
4	202.23	1193.05
5	216.08	1187.30
6	230.06	1181.87
7	244.17	1176.76
8	258.39	1171.98
9	272.71	1167.53
10	287.13	1163.41
11	301.65	1159.63
12	316.25	1156.18
13	330.92	1153.06
14	345.66	1150.29
15	360.46	1147.86
16	375.32	1145.77
17	390.21	1144.02
18	405.15	1142.62
19	420.11	1141.57
20	435.09	1140.85
21	450.09	1140.49
22	465.09	1140.47
23	480.09	1140.79
24	495.07	1141.47
25	510.04	1142.48
26	524.97	1143.85
27	539.88	1145.55
28	554.74	1147.60
29	569.54	1150.00
30	584.29	1152.73
31	598.98	1155.80
32	613.58	1159.21
33	628.11	1162.96
34	642.54	1167.04
35	656.88	1171.45
36	671.11	1176.20
37	685.22	1181.27
38	699.22	1186.66
39	713.09	1192.38
40	726.82	1198.41
41	740.41	1204.76
42	753.85	1211.42
43	767.14	1218.39
44	780.25	1225.66
45	793.20	1233.24
46	805.97	1241.11
47	818.55	1249.27
48	830.95	1257.72
49	843.14	1266.46
50	855.13	1275.47
51	866.91	1284.76
52	878.47	1294.32
53	889.80	1304.14
54	900.91	1314.22
55	911.78	1324.56
56	922.41	1335.14
57	932.80	1345.96
58	942.93	1357.03
59	952.80	1368.32
60	962.41	1379.84
61	971.75	1391.57
62	980.82	1403.52
63	982.72	1406.15

Circle Center At X = 458.5 ; Y = 1790.6 and Radius, 650.1

*** 2.889 ***

Failure Surface Specified By 64 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	142.42	1210.62

2	156.08	1204.40
3	169.86	1198.48
4	183.76	1192.85
5	197.78	1187.53
6	211.92	1182.50
7	226.16	1177.79
8	240.49	1173.37
9	254.92	1169.27
10	269.43	1165.48
11	284.03	1162.00
12	298.69	1158.84
13	313.42	1155.99
14	328.20	1153.46
15	343.04	1151.24
16	357.92	1149.35
17	372.83	1147.77
18	387.78	1146.52
19	402.75	1145.58
20	417.74	1144.97
21	432.74	1144.69
22	447.74	1144.72
23	462.73	1145.07
24	477.72	1145.75
25	492.68	1146.75
26	507.62	1148.07
27	522.53	1149.71
28	537.41	1151.67
29	552.23	1153.95
30	567.00	1156.55
31	581.72	1159.47
32	596.37	1162.69
33	610.94	1166.24
34	625.44	1170.09
35	639.85	1174.26
36	654.16	1178.74
37	668.38	1183.52
38	682.49	1188.60
39	696.49	1193.99
40	710.37	1199.68
41	724.13	1205.66
42	737.75	1211.94
43	751.24	1218.51
44	764.58	1225.37
45	777.77	1232.51
46	790.80	1239.93
47	803.67	1247.63
48	816.38	1255.61
49	828.90	1263.86
50	841.25	1272.37
51	853.42	1281.15
52	865.39	1290.19
53	877.16	1299.48
54	888.74	1309.03
55	900.10	1318.82
56	911.25	1328.85
57	922.19	1339.12
58	932.90	1349.62
59	943.38	1360.35
60	953.63	1371.30
61	963.64	1382.47
62	973.41	1393.85
63	982.94	1405.44
64	983.52	1406.18

Circle Center At X = 438.7 ; Y = 1843.0 and Radius, 698.3

*** 2.890 ***

Failure Surface Specified By 60 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	153.03	1210.52
2	167.02	1205.11

3	181.12	1199.99
4	195.33	1195.18
5	209.63	1190.66
6	224.03	1186.45
7	238.51	1182.53
8	253.07	1178.93
9	267.70	1175.63
10	282.40	1172.64
11	297.16	1169.96
12	311.97	1167.59
13	326.83	1165.53
14	341.73	1163.79
15	356.66	1162.36
16	371.62	1161.24
17	386.60	1160.44
18	401.59	1159.95
19	416.59	1159.78
20	431.59	1159.93
21	446.58	1160.39
22	461.56	1161.16
23	476.52	1162.25
24	491.45	1163.66
25	506.36	1165.37
26	521.22	1167.41
27	536.03	1169.75
28	550.80	1172.40
29	565.50	1175.37
30	580.14	1178.64
31	594.71	1182.22
32	609.19	1186.10
33	623.60	1190.29
34	637.91	1194.79
35	652.12	1199.58
36	666.23	1204.67
37	680.23	1210.05
38	694.12	1215.73
39	707.88	1221.70
40	721.51	1227.95
41	735.01	1234.50
42	748.37	1241.32
43	761.58	1248.42
44	774.64	1255.80
45	787.54	1263.46
46	800.28	1271.38
47	812.84	1279.57
48	825.23	1288.02
49	837.45	1296.73
50	849.47	1305.70
51	861.31	1314.91
52	872.95	1324.38
53	884.38	1334.08
54	895.61	1344.02
55	906.63	1354.20
56	917.43	1364.61
57	928.02	1375.24
58	938.37	1386.09
59	948.49	1397.16
60	955.42	1405.06

Circle Center At X = 417.2 ; Y = 1872.9 and Radius, 713.1

*** 2.890 ***

Failure Surface Specified By 61 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	146.67	1210.58
2	160.46	1204.68
3	174.38	1199.10
4	188.42	1193.81
5	202.57	1188.84
6	216.83	1184.18
7	231.19	1179.84

8	245.64	1175.81
9	260.17	1172.10
10	274.78	1168.71
11	289.46	1165.64
12	304.21	1162.89
13	319.01	1160.47
14	333.87	1158.37
15	348.76	1156.60
16	363.69	1155.16
17	378.65	1154.05
18	393.63	1153.26
19	408.62	1152.81
20	423.62	1152.68
21	438.62	1152.88
22	453.61	1153.41
23	468.59	1154.28
24	483.54	1155.47
25	498.46	1156.98
26	513.35	1158.83
27	528.19	1161.00
28	542.98	1163.50
29	557.71	1166.32
30	572.38	1169.46
31	586.97	1172.93
32	601.49	1176.71
33	615.92	1180.82
34	630.25	1185.24
35	644.49	1189.97
36	658.61	1195.01
37	672.62	1200.37
38	686.52	1206.03
39	700.28	1211.99
40	713.91	1218.25
41	727.40	1224.82
42	740.74	1231.67
43	753.93	1238.82
44	766.95	1246.26
45	779.81	1253.98
46	792.50	1261.98
47	805.01	1270.25
48	817.34	1278.80
49	829.47	1287.62
50	841.41	1296.70
51	853.14	1306.05
52	864.67	1315.65
53	875.98	1325.49
54	887.08	1335.59
55	897.95	1345.93
56	908.59	1356.50
57	918.99	1367.30
58	929.16	1378.33
59	939.08	1389.58
60	948.75	1401.05
61	951.88	1404.92

Circle Center At X = 421.9 ; Y = 1835.7 and Radius, 683.0

*** 2.891 ***

Failure Surface Specified By 64 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	148.79	1210.56
2	162.42	1204.29
3	176.18	1198.32
4	190.06	1192.65
5	204.06	1187.27
6	218.18	1182.19
7	232.40	1177.41
8	246.72	1172.94
9	261.12	1168.77
10	275.62	1164.91
11	290.19	1161.36

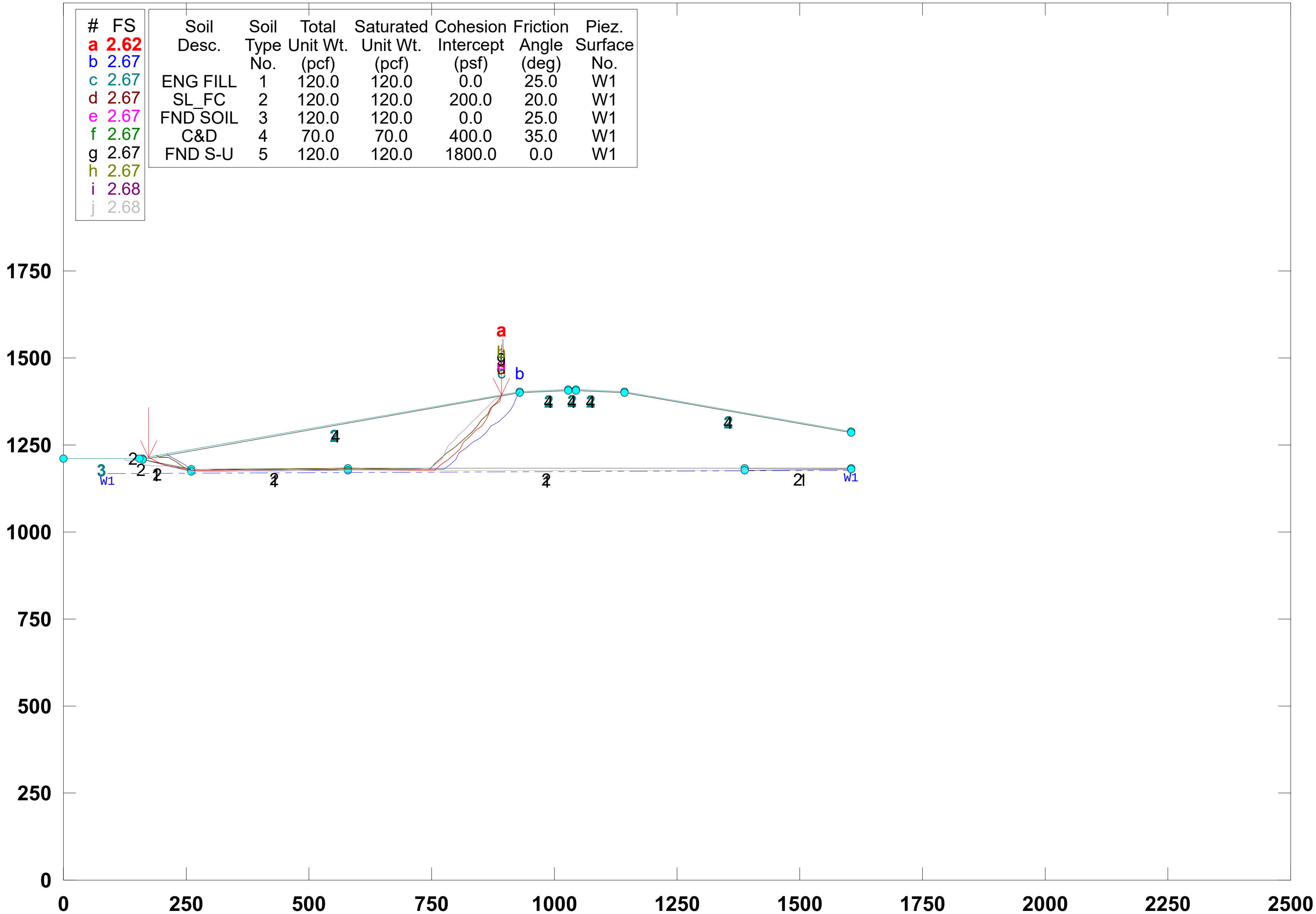
12	304.84	1158.13
13	319.55	1155.20
14	334.33	1152.60
15	349.15	1150.30
16	364.02	1148.33
17	378.93	1146.67
18	393.87	1145.33
19	408.83	1144.30
20	423.81	1143.60
21	438.81	1143.22
22	453.81	1143.16
23	468.81	1143.41
24	483.80	1143.99
25	498.77	1144.89
26	513.72	1146.10
27	528.64	1147.64
28	543.53	1149.49
29	558.37	1151.66
30	573.16	1154.15
31	587.90	1156.95
32	602.57	1160.06
33	617.17	1163.49
34	631.70	1167.22
35	646.15	1171.27
36	660.50	1175.62
37	674.76	1180.28
38	688.91	1185.24
39	702.96	1190.51
40	716.89	1196.07
41	730.70	1201.92
42	744.38	1208.07
43	757.93	1214.51
44	771.34	1221.24
45	784.60	1228.25
46	797.70	1235.55
47	810.65	1243.12
48	823.44	1250.96
49	836.05	1259.08
50	848.49	1267.46
51	860.75	1276.11
52	872.82	1285.02
53	884.69	1294.18
54	896.37	1303.59
55	907.85	1313.25
56	919.11	1323.16
57	930.17	1333.30
58	941.00	1343.67
59	951.61	1354.27
60	961.99	1365.10
61	972.14	1376.15
62	982.05	1387.41
63	991.72	1398.87
64	998.09	1406.76

Circle Center At X = 449.2 ; Y = 1846.3 and Radius, 703.2

*** 2.892 ***

Northeast Landfill Cross Section A-A', WB

m:\projects\16219107.00\task 3 - tier iii modification app\permit application\app c - liner and final cover system stability analysis\stabl files\nelf\2023.4.13 nelf_xs_a_wb.pl2 Run By: Username 5/11/2023 0



PCSTABL5M3 FSmin=2.62

Safety Factors Are Calculated By The Modified Janbu Method

**** PCSTABL5M3 ****

by Purdue University 1985
rev. for SCS Engineers HVA 2008
--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer`s Method of Slices

Run Date: 5/11/2023
Time of Run: 05:33PM
Run By: Username
Input Data Filename: M:2023.4.13 nelf_xs_a_wb.in
Output Filename: M:2023.4.13 nelf_xs_a_wb.OUT
Unit: ENGLISH
Plotted Output Filename: M:2023.4.13 nelf_xs_a_wb.PLT
PROBLEM DESCRIPTION Northeast Landfill
Cross Section A-A', WB

BOUNDARY COORDINATES
Note: User origin value specified.
Add 0.00 to X-values and 0.00 to Y-values listed.

6 Top Boundaries
21 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	0.00	1212.00	154.70	1210.50	3
2	154.70	1210.50	928.90	1404.00	2
3	928.90	1404.00	1029.10	1408.00	2
4	1029.10	1408.00	1043.80	1408.00	2
5	1043.80	1408.00	1144.10	1404.00	2
6	1144.10	1404.00	1603.40	1289.90	2
7	154.70	1210.50	160.70	1210.50	2
8	160.70	1210.50	162.30	1209.40	2
9	162.30	1209.40	928.90	1401.00	4
10	928.90	1401.00	1029.10	1405.00	4
11	1029.10	1405.00	1043.80	1405.00	4
12	1043.80	1405.00	1144.10	1401.00	4
13	1144.10	1401.00	1603.40	1286.90	4
14	162.30	1209.40	261.10	1179.40	2
15	261.10	1179.40	579.00	1182.30	2
16	579.00	1182.30	1386.40	1182.10	2
17	1386.40	1182.10	1603.40	1184.20	2
18	154.70	1210.50	261.10	1175.40	1
19	261.10	1175.40	579.00	1178.30	1
20	579.00	1178.30	1386.40	1178.10	1
21	1386.40	1178.10	1603.40	1180.20	1

ISOTROPIC SOIL PARAMETERS
5 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	120.0	120.0	0.0	25.0	0.00	0.0	1
2	120.0	120.0	200.0	20.0	0.00	0.0	1
3	120.0	120.0	0.0	25.0	0.00	0.0	1
4	70.0	70.0	400.0	35.0	0.00	0.0	1
5	120.0	120.0	1800.0	0.0	0.00	0.0	1

1 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED
Unit Weight of Water = 62.40
Piezometric Surface No. 1 Specified by 2 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	88.50	1168.30
2	1603.40	1177.60

A Critical Failure Surface Searching Method, Using A Random Technique For Generating Sliding Block Surfaces, Has Been Specified.
1000 Trial Surfaces Have Been Generated.
4 Boxes Specified For Generation Of Central Block Base
Length Of Line Segments For Active And Passive Portions Of Sliding Block Is 20.0

Box No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Height (ft)

1	261.10	1177.40	261.20	1177.40	4.00
2	261.70	1177.40	579.00	1180.30	4.00
3	579.50	1180.30	579.60	1180.30	4.00
4	580.10	1180.30	1386.40	1180.10	4.00

Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Examined. They Are Ordered - Most Critical
First.
* * Safety Factors Are Calculated By The Modified Janbu Method * *
Failure Surface Specified By 23 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	174.52	1215.45
2	187.03	1203.80
3	203.14	1191.94
4	221.93	1185.09
5	241.80	1182.84
6	261.14	1177.73
7	535.83	1179.10
8	579.55	1180.60
9	756.23	1178.26
10	768.63	1193.95
11	782.36	1208.50
12	794.99	1224.01
13	807.22	1239.84
14	814.92	1258.29
15	827.94	1273.48
16	838.85	1290.24
17	852.77	1304.60
18	861.84	1322.43
19	866.03	1341.98
20	874.71	1360.00
21	888.51	1374.48
22	890.88	1394.33
23	890.99	1394.53

*** 2.623 ***

Individual data on the 30 slices

Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Tie Force Norm (lbs)	Tie Force Tan (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Surcharge Load (lbs)
1	2.5	457.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	10.0	7706.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	4.4	5903.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	5.3	9264.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	6.3	14347.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6	18.8	56031.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7	14.9	52757.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8	4.9	18252.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
9	19.3	78330.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10	0.0	185.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
11	274.7	1860341.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
12	43.2	408143.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
13	0.5	5340.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
14	176.7	2022270.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15	3.2	40755.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
16	9.2	114458.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
17	13.7	160001.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
18	12.6	136980.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
19	12.2	121739.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
20	7.7	68849.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
21	13.0	103285.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
22	10.9	76737.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
23	13.9	85708.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
24	9.1	47429.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
25	4.2	16921.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
26	8.7	24638.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
27	13.8	26163.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
28	2.0	1888.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
29	0.3	66.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
30	0.1	1.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Failure Surface Specified By 22 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	209.10	1224.10
2	216.28	1217.10
3	231.72	1204.40
4	246.95	1191.43
5	261.18	1177.37
6	475.56	1177.86
7	579.56	1179.46
8	773.16	1179.54
9	787.30	1193.68
10	800.15	1209.01
11	806.65	1227.92
12	819.84	1242.96
13	833.88	1257.20
14	847.95	1271.41
15	861.56	1286.07
16	871.81	1303.24
17	885.83	1317.50
18	898.82	1332.71
19	910.31	1349.08
20	918.25	1367.44
21	924.17	1386.54
22	929.63	1404.03

*** 2.667 ***

Failure Surface Specified By 23 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	190.29	1219.39
2	194.14	1215.72
3	214.13	1214.99
4	228.28	1200.86
5	243.48	1187.86
6	261.11	1178.42
7	358.28	1179.76
8	579.58	1182.22
9	746.00	1178.98
10	756.99	1195.69
11	767.77	1212.53
12	781.91	1226.68
13	795.10	1241.72
14	808.11	1256.90
15	819.94	1273.03
16	834.07	1287.18
17	841.90	1305.58
18	853.32	1322.01
19	864.02	1338.90
20	870.30	1357.89
21	884.17	1372.29
22	890.95	1391.11
23	893.45	1395.14

*** 2.673 ***

Failure Surface Specified By 23 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	190.29	1219.39
2	194.14	1215.72
3	214.13	1214.99
4	228.28	1200.86
5	243.48	1187.86
6	261.11	1178.42
7	358.28	1179.76
8	579.58	1182.22
9	746.00	1178.98
10	756.99	1195.69
11	767.77	1212.53
12	781.91	1226.68
13	795.10	1241.72
14	808.11	1256.90

15	819.94	1273.03
16	834.07	1287.18
17	841.90	1305.58
18	853.32	1322.01
19	864.02	1338.90
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21	884.17	1372.29
22	890.95	1391.11
23	893.45	1395.14

*** 2.673 ***

Failure Surface Specified By 23 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	190.29	1219.39
2	194.14	1215.72
3	214.13	1214.99
4	228.28	1200.86
5	243.48	1187.86
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11	767.77	1212.53
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*** 2.673 ***

Failure Surface Specified By 23 Coordinate Points

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19	864.02	1338.90
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21	884.17	1372.29
22	890.95	1391.11
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*** 2.673 ***

Failure Surface Specified By 23 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	190.29	1219.39
2	194.14	1215.72
3	214.13	1214.99

4	228.28	1200.86
5	243.48	1187.86
6	261.11	1178.42
7	358.28	1179.76
8	579.58	1182.22
9	746.00	1178.98
10	756.99	1195.69
11	767.77	1212.53
12	781.91	1226.68
13	795.10	1241.72
14	808.11	1256.90
15	819.94	1273.03
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17	841.90	1305.58
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19	864.02	1338.90
20	870.30	1357.89
21	884.17	1372.29
22	890.95	1391.11
23	893.45	1395.14

*** 2.673 ***

Failure Surface Specified By 23 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	190.29	1219.39
2	194.14	1215.72
3	214.13	1214.99
4	228.28	1200.86
5	243.48	1187.86
6	261.11	1178.42
7	358.28	1179.76
8	579.58	1182.22
9	746.00	1178.98
10	756.99	1195.69
11	767.77	1212.53
12	781.91	1226.68
13	795.10	1241.72
14	808.11	1256.90
15	819.94	1273.03
16	834.07	1287.18
17	841.90	1305.58
18	853.32	1322.01
19	864.02	1338.90
20	870.30	1357.89
21	884.17	1372.29
22	890.95	1391.11
23	893.45	1395.14

*** 2.673 ***

Failure Surface Specified By 26 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	122.56	1210.81
2	128.16	1205.31
3	148.12	1204.07
4	163.73	1191.56
5	183.65	1189.76
6	203.64	1189.21
7	223.64	1189.07
8	243.09	1184.40
9	261.12	1175.75
10	526.23	1178.57
11	579.57	1180.93
12	744.42	1180.63
13	757.72	1195.57
14	771.86	1209.72
15	776.30	1229.22
16	783.80	1247.76
17	796.06	1263.56
18	806.78	1280.44
19	819.01	1296.27

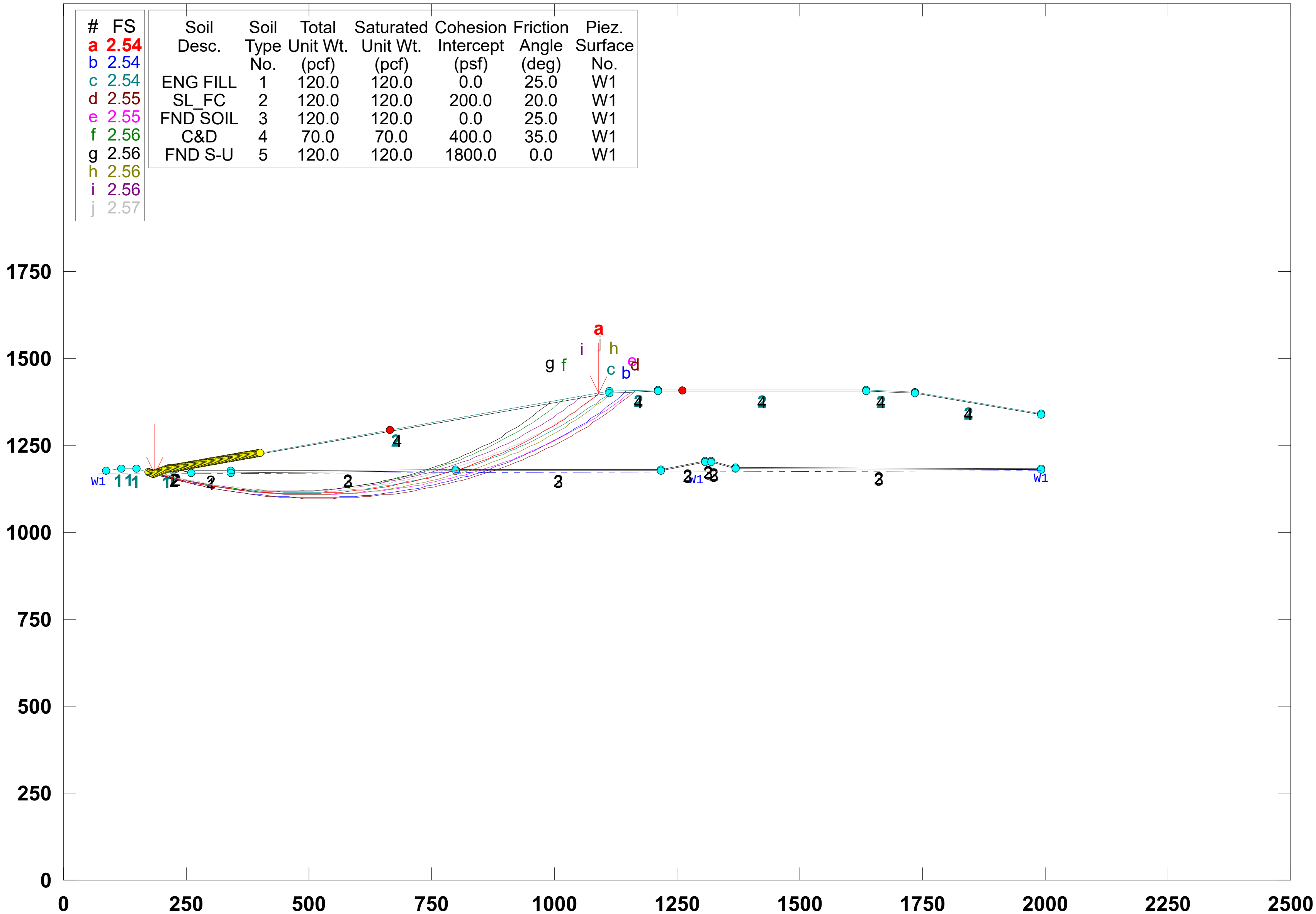
20	829.31	1313.41
21	843.39	1327.61
22	852.25	1345.54
23	864.68	1361.21
24	877.08	1376.90
25	891.20	1391.07
26	895.74	1395.71
***	2.676	***

Failure Surface Specified By 26 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	122.56	1210.81
2	128.16	1205.31
3	148.12	1204.07
4	163.73	1191.56
5	183.65	1189.76
6	203.64	1189.21
7	223.64	1189.07
8	243.09	1184.40
9	261.12	1175.75
10	526.23	1178.57
11	579.57	1180.93
12	744.42	1180.63
13	757.72	1195.57
14	771.86	1209.72
15	776.30	1229.22
16	783.80	1247.76
17	796.06	1263.56
18	806.78	1280.44
19	819.01	1296.27
20	829.31	1313.41
21	843.39	1327.61
22	852.25	1345.54
23	864.68	1361.21
24	877.08	1376.90
25	891.20	1391.07
26	895.74	1395.71
***	2.676	***

Northeast Landfill Cross Section B, Circular

m:\projects\16219107.00\task 3 - tier iii modification app\permit application\app c - liner and final cover system stability analysis\stabl files\nelf\2023.4.13 nelf_xs_b_circ.pl2 Run By: Username 5/11/2023 0



PCSTABL5M3 FSmin=2.54

Safety Factors Are Calculated By The Modified Bishop Method

**** PCSTABL5M3 ****
by Purdue University 1985
rev. for SCS Engineers HVA 2008
--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer`s Method of Slices

Run Date: 5/11/2023
Time of Run: 05:37PM
Run By: Username
Input Data Filename: M:2023.4.13 nelf_xs_b_circ.in
Output Filename: M:2023.4.13 nelf_xs_b_circ.OUT
Unit: ENGLISH
Plotted Output Filename: M:2023.4.13 nelf_xs_b_circ.PLT
PROBLEM DESCRIPTION Northeast Landfill
Cross Section B, Circular

BOUNDARY COORDINATES
Note: User origin value specified.
Add 0.00 to X-values and 0.00 to Y-values listed.

10 Top Boundaries
33 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	87.00	1176.00	118.70	1184.50	1
2	118.70	1184.50	149.60	1184.50	1
3	149.60	1184.50	183.40	1168.50	1
4	183.40	1168.50	215.50	1184.50	1
5	215.50	1184.50	223.10	1184.50	1
6	223.10	1184.50	1110.60	1405.50	2
7	1110.60	1405.50	1211.80	1408.00	2
8	1211.80	1408.00	1635.60	1408.00	2
9	1635.60	1408.00	1735.70	1404.00	2
10	1735.70	1404.00	1991.20	1340.20	2
11	223.10	1184.50	229.10	1184.50	2
12	229.10	1184.50	230.70	1182.90	2
13	230.70	1182.90	1110.60	1401.00	4
14	1110.60	1401.00	1211.80	1405.00	4
15	1211.80	1405.00	1635.60	1405.00	4
16	1635.60	1405.00	1735.70	1401.00	4
17	1735.70	1401.00	1991.20	1337.20	4
18	230.70	1182.90	261.10	1171.80	2
19	261.10	1175.90	341.50	1175.90	2
20	341.50	1175.90	800.00	1179.90	2
21	800.00	1179.90	1218.60	1181.00	2
22	1218.60	1181.00	1305.70	1206.00	2
23	1305.70	1206.00	1320.70	1206.00	2
24	1320.70	1206.00	1369.90	1186.00	2
25	1369.90	1186.00	1991.20	1184.40	2
26	223.10	1184.40	261.10	1171.80	1
27	261.10	1171.80	341.50	1171.90	1
28	341.50	1171.90	800.00	1175.90	3
29	800.00	1175.90	1218.60	1177.00	3
30	1218.60	1177.00	1305.70	1202.00	3
31	1305.70	1202.00	1320.70	1202.00	3
32	1320.70	1202.00	1369.90	1182.00	3
33	1369.90	1182.00	1991.20	1180.40	3

ISOTROPIC SOIL PARAMETERS
5 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	120.0	120.0	0.0	25.0	0.00	0.0	1
2	120.0	120.0	200.0	20.0	0.00	0.0	1
3	120.0	120.0	0.0	25.0	0.00	0.0	1
4	70.0	70.0	400.0	35.0	0.00	0.0	1
5	120.0	120.0	1800.0	0.0	0.00	0.0	1

1 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED
Unit Weight of Water = 62.40
Piezometric Surface No. 1 Specified by 3 Coordinate Points

Point X-Water Y-Water

No.	(ft)	(ft)
1	70.80	1167.90
2	1287.50	1174.20
3	1991.20	1176.50

A Critical Failure Surface Searching Method, Using A Random Technique For Generating Circular Surfaces, Has Been Specified.
10000 Trial Surfaces Have Been Generated.
100 Surfaces Initiate From Each Of100 Points Equally Spaced Along The Ground Surface Between X = 173.10 ft. and X = 400.60 ft.
Each Surface Terminates Between X = 665.00 ft. and X =1260.60 ft.
Unless Further Limitations Were Imposed, The Minimum Elevation At Which A Surface Extends Is Y = 0.00 ft.
15.00 ft. Line Segments Define Each Trial Failure Surface.
Following Are Displayed The Ten Most Critical Of The Trial Failure Surfaces Examined. They Are Ordered - Most Critical First.
* * Safety Factors Are Calculated By The Modified Bishop Method * *
Failure Surface Specified By 68 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	184.59	1169.09
2	198.55	1163.61
3	212.62	1158.39
4	226.78	1153.44
5	241.03	1148.76
6	255.36	1144.36
7	269.78	1140.22
8	284.28	1136.36
9	298.84	1132.78
10	313.48	1129.47
11	328.17	1126.44
12	342.91	1123.69
13	357.71	1121.23
14	372.55	1119.04
15	387.43	1117.14
16	402.34	1115.51
17	417.28	1114.18
18	432.24	1113.12
19	447.22	1112.35
20	462.21	1111.87
21	477.21	1111.67
22	492.21	1111.76
23	507.21	1112.13
24	522.19	1112.78
25	537.16	1113.72
26	552.11	1114.94
27	567.04	1116.45
28	581.93	1118.24
29	596.79	1120.32
30	611.60	1122.67
31	626.37	1125.31
32	641.08	1128.22
33	655.74	1131.42
34	670.33	1134.89
35	684.85	1138.64
36	699.30	1142.67
37	713.67	1146.96
38	727.96	1151.54
39	742.16	1156.38
40	756.26	1161.49
41	770.26	1166.86
42	784.16	1172.51
43	797.95	1178.41
44	811.63	1184.58
45	825.18	1191.00
46	838.61	1197.68
47	851.91	1204.62
48	865.08	1211.80

49	878.10	1219.24
50	890.99	1226.92
51	903.72	1234.84
52	916.31	1243.01
53	928.73	1251.41
54	941.00	1260.05
55	953.09	1268.92
56	965.02	1278.01
57	976.77	1287.34
58	988.35	1296.88
59	999.74	1306.64
60	1010.94	1316.62
61	1021.95	1326.80
62	1032.76	1337.20
63	1043.38	1347.79
64	1053.79	1358.59
65	1064.00	1369.59
66	1073.99	1380.77
67	1083.77	1392.14
68	1090.73	1400.55

Circle Center At X = 480.2 ; Y = 1901.2 and Radius, 789.5

*** 2.541 ***

Individual data on the 79 slices

Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Tie Force Norm (lbs)	Tie Force Tan (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Surcharge Load (lbs)
1	1.5	123.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	12.4	10300.0	0.0	2065.4	0.0	0.0	0.0	0.0	0.0
3	14.1	31315.5	0.0	7110.4	0.0	0.0	0.0	0.0	0.0
4	2.9	8962.2	0.0	2050.3	0.0	0.0	0.0	0.0	0.0
5	7.6	25940.7	0.0	6336.2	0.0	0.0	0.0	0.0	0.0
6	3.7	13616.6	0.0	3550.2	0.0	0.0	0.0	0.0	0.0
7	2.3	9105.2	0.0	2389.4	0.0	0.0	0.0	0.0	0.0
8	1.6	6484.9	0.0	1713.5	0.0	0.0	0.0	0.0	0.0
9	10.3	44488.8	0.0	12408.7	0.0	0.0	0.0	0.0	0.0
10	14.3	68340.3	0.0	20833.7	0.0	0.0	0.0	0.0	0.0
11	5.7	29375.2	0.0	9432.7	0.0	0.0	0.0	0.0	0.0
12	8.7	49051.2	0.0	15468.4	0.0	0.0	0.0	0.0	0.0
13	14.5	90337.0	0.0	28712.6	0.0	0.0	0.0	0.0	0.0
14	14.6	100984.6	0.0	32266.8	0.0	0.0	0.0	0.0	0.0
15	14.6	111222.6	0.0	35562.3	0.0	0.0	0.0	0.0	0.0
16	14.7	121030.6	0.0	38598.0	0.0	0.0	0.0	0.0	0.0
17	13.3	117526.3	0.0	37295.9	0.0	0.0	0.0	0.0	0.0
18	1.4	12863.4	0.0	4076.8	0.0	0.0	0.0	0.0	0.0
19	14.8	139337.0	0.0	43885.5	0.0	0.0	0.0	0.0	0.0
20	14.8	147839.0	0.0	46135.5	0.0	0.0	0.0	0.0	0.0
21	14.9	155840.6	0.0	48122.0	0.0	0.0	0.0	0.0	0.0
22	14.9	163326.9	0.0	49843.9	0.0	0.0	0.0	0.0	0.0
23	14.9	170284.1	0.0	51301.0	0.0	0.0	0.0	0.0	0.0
24	15.0	176699.5	0.0	52492.4	0.0	0.0	0.0	0.0	0.0
25	15.0	182562.5	0.0	53418.1	0.0	0.0	0.0	0.0	0.0
26	15.0	187862.7	0.0	54077.5	0.0	0.0	0.0	0.0	0.0
27	15.0	192591.1	0.0	54470.2	0.0	0.0	0.0	0.0	0.0
28	15.0	196740.2	0.0	54596.3	0.0	0.0	0.0	0.0	0.0
29	15.0	200304.7	0.0	54455.7	0.0	0.0	0.0	0.0	0.0
30	15.0	203279.3	0.0	54048.6	0.0	0.0	0.0	0.0	0.0
31	15.0	205660.6	0.0	53374.8	0.0	0.0	0.0	0.0	0.0
32	15.0	207447.1	0.0	52435.1	0.0	0.0	0.0	0.0	0.0
33	14.9	208637.2	0.0	51229.2	0.0	0.0	0.0	0.0	0.0
34	14.9	209231.0	0.0	49757.6	0.0	0.0	0.0	0.0	0.0
35	14.9	209231.9	0.0	48021.3	0.0	0.0	0.0	0.0	0.0
36	14.8	208642.7	0.0	46020.8	0.0	0.0	0.0	0.0	0.0
37	14.8	207467.1	0.0	43756.4	0.0	0.0	0.0	0.0	0.0
38	14.7	205711.8	0.0	41229.4	0.0	0.0	0.0	0.0	0.0
39	14.7	203383.6	0.0	38440.4	0.0	0.0	0.0	0.0	0.0
40	14.6	200491.5	0.0	35390.7	0.0	0.0	0.0	0.0	0.0
41	14.5	197045.0	0.0	32080.9	0.0	0.0	0.0	0.0	0.0
42	14.4	193054.7	0.0	28512.9	0.0	0.0	0.0	0.0	0.0
43	14.4	188534.0	0.0	24687.5	0.0	0.0	0.0	0.0	0.0

44	14.3	183494.7	0.0	20606.2	0.0	0.0	0.0	0.0	0.0
45	14.2	177953.8	0.0	16270.4	0.0	0.0	0.0	0.0	0.0
46	14.1	171925.2	0.0	11681.8	0.0	0.0	0.0	0.0	0.0
47	14.0	165426.8	0.0	6841.9	0.0	0.0	0.0	0.0	0.0
48	11.6	132922.3	0.0	1822.7	0.0	0.0	0.0	0.0	0.0
49	2.3	25554.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
50	7.8	85816.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0
51	6.0	65277.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
52	2.0	21903.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
53	1.3	13391.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
54	10.4	109188.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
55	13.6	140352.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
56	13.4	136072.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
57	13.3	131533.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
58	13.2	126746.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
59	13.0	121726.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
60	12.9	116487.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0
61	12.7	111043.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0
62	12.6	105411.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
63	12.4	99604.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
64	12.3	93640.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0
65	12.1	87536.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0
66	11.9	81307.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0
67	11.8	74972.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0
68	11.6	68548.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0
69	11.4	62054.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
70	11.2	55507.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
71	11.0	48926.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0
72	10.8	42332.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
73	10.6	35741.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
74	10.4	29174.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
75	10.2	22651.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
76	10.0	16190.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
77	9.8	9812.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0
78	2.3	1409.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0
79	4.7	1250.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Failure Surface Specified By 73 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	184.59	1169.09
2	198.36	1163.14
3	212.23	1157.43
4	226.21	1151.99
5	240.28	1146.81
6	254.45	1141.89
7	268.71	1137.23
8	283.06	1132.84
9	297.48	1128.71
10	311.97	1124.86
11	326.54	1121.27
12	341.17	1117.95
13	355.85	1114.91
14	370.60	1112.14
15	385.39	1109.64
16	400.22	1107.42
17	415.09	1105.47
18	430.00	1103.80
19	444.94	1102.40
20	459.89	1101.29
21	474.87	1100.45
22	489.86	1099.88
23	504.86	1099.60
24	519.86	1099.60
25	534.85	1099.87
26	549.84	1100.42
27	564.82	1101.25
28	579.78	1102.36
29	594.72	1103.74
30	609.62	1105.40
31	624.50	1107.34

32	639.33	1109.55
33	654.13	1112.04
34	668.87	1114.80
35	683.56	1117.84
36	698.19	1121.14
37	712.76	1124.72
38	727.26	1128.57
39	741.68	1132.68
40	756.03	1137.07
41	770.29	1141.71
42	784.46	1146.63
43	798.54	1151.80
44	812.52	1157.23
45	826.40	1162.92
46	840.17	1168.87
47	853.83	1175.08
48	867.37	1181.53
49	880.79	1188.24
50	894.08	1195.19
51	907.24	1202.39
52	920.26	1209.83
53	933.14	1217.51
54	945.88	1225.43
55	958.47	1233.58
56	970.91	1241.97
57	983.19	1250.59
58	995.31	1259.43
59	1007.26	1268.49
60	1019.04	1277.78
61	1030.64	1287.28
62	1042.07	1297.00
63	1053.32	1306.92
64	1064.38	1317.06
65	1075.25	1327.39
66	1085.92	1337.93
67	1096.40	1348.66
68	1106.68	1359.59
69	1116.76	1370.70
70	1126.62	1382.00
71	1136.28	1393.48
72	1145.72	1405.14
73	1146.69	1406.39

Circle Center At X = 512.6 ; Y = 1908.2 and Radius, 808.6

*** 2.542 ***

Failure Surface Specified By 70 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	184.59	1169.09
2	198.68	1163.95
3	212.86	1159.06
4	227.12	1154.42
5	241.47	1150.03
6	255.89	1145.90
7	270.38	1142.03
8	284.94	1138.42
9	299.56	1135.07
10	314.24	1131.98
11	328.97	1129.15
12	343.75	1126.58
13	358.57	1124.28
14	373.43	1122.24
15	388.33	1120.47
16	403.25	1118.96
17	418.20	1117.72
18	433.17	1116.74
19	448.15	1116.04
20	463.14	1115.60
21	478.14	1115.42
22	493.14	1115.52
23	508.14	1115.88

24	523.13	1116.50
25	538.10	1117.40
26	553.05	1118.56
27	567.99	1119.99
28	582.89	1121.68
29	597.76	1123.64
30	612.60	1125.86
31	627.39	1128.35
32	642.13	1131.10
33	656.83	1134.11
34	671.47	1137.38
35	686.05	1140.92
36	700.56	1144.71
37	715.00	1148.76
38	729.37	1153.07
39	743.66	1157.63
40	757.86	1162.45
41	771.98	1167.51
42	786.01	1172.83
43	799.94	1178.40
44	813.76	1184.22
45	827.48	1190.28
46	841.09	1196.58
47	854.59	1203.13
48	867.97	1209.91
49	881.22	1216.94
50	894.35	1224.19
51	907.35	1231.68
52	920.21	1239.40
53	932.93	1247.35
54	945.50	1255.53
55	957.93	1263.92
56	970.21	1272.54
57	982.33	1281.37
58	994.30	1290.42
59	1006.10	1299.68
60	1017.73	1309.15
61	1029.20	1318.83
62	1040.48	1328.70
63	1051.60	1338.78
64	1062.53	1349.05
65	1073.27	1359.52
66	1083.83	1370.18
67	1094.19	1381.02
68	1104.36	1392.04
69	1114.34	1403.25
70	1116.39	1405.64

Circle Center At X = 480.4 ; Y = 1957.4 and Radius, 841.9

*** 2.542 ***

Failure Surface Specified By 74 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	184.59	1169.09
2	198.33	1163.08
3	212.18	1157.31
4	226.13	1151.80
5	240.18	1146.55
6	254.32	1141.55
7	268.55	1136.81
8	282.87	1132.33
9	297.27	1128.12
10	311.74	1124.16
11	326.27	1120.47
12	340.88	1117.05
13	355.54	1113.90
14	370.26	1111.01
15	385.03	1108.39
16	399.85	1106.05
17	414.70	1103.97
18	429.59	1102.16

19	444.52	1100.63
20	459.46	1099.37
21	474.43	1098.38
22	489.41	1097.67
23	504.41	1097.23
24	519.41	1097.06
25	534.41	1097.17
26	549.40	1097.55
27	564.39	1098.20
28	579.36	1099.13
29	594.31	1100.33
30	609.24	1101.81
31	624.14	1103.55
32	639.00	1105.57
33	653.82	1107.86
34	668.60	1110.42
35	683.33	1113.25
36	698.01	1116.34
37	712.63	1119.71
38	727.18	1123.34
39	741.67	1127.23
40	756.08	1131.39
41	770.41	1135.81
42	784.66	1140.49
43	798.83	1145.44
44	812.90	1150.64
45	826.87	1156.09
46	840.74	1161.80
47	854.51	1167.76
48	868.16	1173.97
49	881.70	1180.43
50	895.11	1187.14
51	908.41	1194.09
52	921.57	1201.28
53	934.60	1208.71
54	947.49	1216.38
55	960.24	1224.28
56	972.85	1232.41
57	985.30	1240.77
58	997.60	1249.36
59	1009.74	1258.17
60	1021.72	1267.20
61	1033.53	1276.45
62	1045.17	1285.91
63	1056.63	1295.58
64	1067.92	1305.46
65	1079.02	1315.55
66	1089.94	1325.83
67	1100.67	1336.32
68	1111.21	1346.99
69	1121.55	1357.86
70	1131.68	1368.91
71	1141.62	1380.15
72	1151.35	1391.57
73	1160.87	1403.16
74	1163.75	1406.81

Circle Center At X = 521.0 ; Y = 1918.7 and Radius, 821.7

*** 2.548 ***

Failure Surface Specified By 73 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	186.89	1170.24
2	200.86	1164.77
3	214.92	1159.55
4	229.07	1154.58
5	243.31	1149.85
6	257.62	1145.37
7	272.01	1141.14
8	286.48	1137.16
9	301.01	1133.44

10	315.60	1129.97
11	330.25	1126.75
12	344.95	1123.79
13	359.71	1121.09
14	374.51	1118.64
15	389.35	1116.45
16	404.22	1114.52
17	419.13	1112.86
18	434.06	1111.45
19	449.02	1110.30
20	463.99	1109.41
21	478.98	1108.78
22	493.98	1108.42
23	508.98	1108.31
24	523.97	1108.47
25	538.97	1108.89
26	553.95	1109.57
27	568.92	1110.51
28	583.88	1111.72
29	598.80	1113.18
30	613.70	1114.90
31	628.57	1116.88
32	643.40	1119.13
33	658.20	1121.63
34	672.94	1124.38
35	687.63	1127.40
36	702.27	1130.66
37	716.85	1134.19
38	731.37	1137.97
39	745.82	1141.99
40	760.19	1146.28
41	774.49	1150.81
42	788.71	1155.59
43	802.84	1160.61
44	816.89	1165.89
45	830.84	1171.40
46	844.69	1177.16
47	858.44	1183.16
48	872.08	1189.40
49	885.61	1195.87
50	899.02	1202.58
51	912.32	1209.52
52	925.49	1216.70
53	938.54	1224.10
54	951.46	1231.72
55	964.24	1239.58
56	976.88	1247.65
57	989.38	1255.94
58	1001.73	1264.45
59	1013.93	1273.17
60	1025.98	1282.11
61	1037.88	1291.25
62	1049.61	1300.60
63	1061.17	1310.15
64	1072.57	1319.90
65	1083.79	1329.85
66	1094.84	1340.00
67	1105.72	1350.33
68	1116.41	1360.85
69	1126.91	1371.56
70	1137.23	1382.45
71	1147.35	1393.52
72	1157.28	1404.76
73	1158.93	1406.69

Circle Center At X = 507.4 ; Y = 1968.8 and Radius, 860.5

*** 2.554 ***

Failure Surface Specified By 63 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	184.59	1169.09

2	198.62	1163.80
3	212.76	1158.79
4	227.00	1154.07
5	241.33	1149.63
6	255.75	1145.49
7	270.25	1141.64
8	284.82	1138.09
9	299.46	1134.83
10	314.17	1131.87
11	328.93	1129.21
12	343.74	1126.85
13	358.60	1124.79
14	373.49	1123.03
15	388.42	1121.57
16	403.38	1120.42
17	418.36	1119.56
18	433.35	1119.02
19	448.34	1118.77
20	463.34	1118.83
21	478.34	1119.20
22	493.32	1119.87
23	508.29	1120.84
24	523.24	1122.11
25	538.15	1123.69
26	553.04	1125.57
27	567.88	1127.75
28	582.67	1130.23
29	597.41	1133.01
30	612.09	1136.09
31	626.71	1139.46
32	641.25	1143.13
33	655.72	1147.10
34	670.10	1151.35
35	684.39	1155.90
36	698.59	1160.74
37	712.69	1165.86
38	726.68	1171.27
39	740.56	1176.96
40	754.32	1182.93
41	767.96	1189.18
42	781.47	1195.70
43	794.84	1202.50
44	808.07	1209.56
45	821.16	1216.89
46	834.09	1224.49
47	846.87	1232.34
48	859.49	1240.46
49	871.94	1248.82
50	884.21	1257.44
51	896.31	1266.31
52	908.23	1275.41
53	919.96	1284.76
54	931.50	1294.35
55	942.85	1304.16
56	953.99	1314.21
57	964.92	1324.47
58	975.65	1334.96
59	986.16	1345.66
60	996.45	1356.57
61	1006.52	1367.69
62	1016.36	1379.01
63	1019.54	1382.82

Circle Center At X = 452.9 ; Y = 1858.9 and Radius, 740.1

*** 2.555 ***

Failure Surface Specified By 61 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	184.59	1169.09
2	198.53	1163.56
3	212.59	1158.32

4	226.75	1153.39
5	241.02	1148.76
6	255.39	1144.44
7	269.84	1140.43
8	284.38	1136.73
9	298.99	1133.34
10	313.67	1130.27
11	328.42	1127.51
12	343.22	1125.07
13	358.07	1122.95
14	372.96	1121.15
15	387.88	1119.67
16	402.84	1118.51
17	417.81	1117.67
18	432.81	1117.15
19	447.80	1116.96
20	462.80	1117.08
21	477.80	1117.53
22	492.78	1118.30
23	507.74	1119.39
24	522.67	1120.81
25	537.57	1122.54
26	552.43	1124.59
27	567.24	1126.96
28	582.00	1129.65
29	596.69	1132.65
30	611.32	1135.97
31	625.88	1139.61
32	640.35	1143.55
33	654.73	1147.80
34	669.02	1152.37
35	683.21	1157.23
36	697.29	1162.41
37	711.26	1167.88
38	725.10	1173.65
39	738.82	1179.71
40	752.41	1186.07
41	765.85	1192.72
42	779.15	1199.66
43	792.30	1206.88
44	805.29	1214.38
45	818.11	1222.16
46	830.77	1230.22
47	843.25	1238.54
48	855.55	1247.13
49	867.66	1255.98
50	879.58	1265.08
51	891.29	1274.45
52	902.81	1284.06
53	914.12	1293.91
54	925.21	1304.01
55	936.08	1314.34
56	946.73	1324.91
57	957.15	1335.70
58	967.34	1346.71
59	977.29	1357.94
60	986.99	1369.37
61	992.43	1376.07

Circle Center At X = 449.4 ; Y = 1815.6 and Radius, 698.6

*** 2.558 ***

Failure Surface Specified By 70 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	191.48	1172.53
2	205.33	1166.77
3	219.29	1161.27
4	233.35	1156.04
5	247.50	1151.07
6	261.75	1146.38
7	276.08	1141.95

8	290.50	1137.80
9	304.98	1133.92
10	319.55	1130.32
11	334.17	1126.99
12	348.86	1123.94
13	363.60	1121.17
14	378.39	1118.68
15	393.23	1116.47
16	408.10	1114.54
17	423.01	1112.90
18	437.95	1111.53
19	452.91	1110.45
20	467.89	1109.66
21	482.88	1109.15
22	497.88	1108.92
23	512.88	1108.97
24	527.88	1109.31
25	542.86	1109.94
26	557.84	1110.84
27	572.79	1112.04
28	587.72	1113.51
29	602.61	1115.27
30	617.47	1117.31
31	632.29	1119.63
32	647.07	1122.23
33	661.79	1125.11
34	676.45	1128.27
35	691.05	1131.70
36	705.59	1135.41
37	720.05	1139.40
38	734.43	1143.66
39	748.73	1148.19
40	762.94	1152.99
41	777.06	1158.06
42	791.07	1163.40
43	804.99	1169.00
44	818.80	1174.86
45	832.49	1180.99
46	846.06	1187.37
47	859.51	1194.01
48	872.84	1200.90
49	886.03	1208.05
50	899.08	1215.44
51	911.99	1223.08
52	924.75	1230.96
53	937.36	1239.08
54	949.82	1247.44
55	962.11	1256.03
56	974.24	1264.86
57	986.20	1273.91
58	997.99	1283.19
59	1009.59	1292.69
60	1021.02	1302.41
61	1032.26	1312.34
62	1043.31	1322.48
63	1054.17	1332.83
64	1064.82	1343.39
65	1075.28	1354.15
66	1085.53	1365.10
67	1095.57	1376.24
68	1105.40	1387.57
69	1115.01	1399.09
70	1120.35	1405.74

Circle Center At X = 502.4 ; Y = 1900.5 and Radius, 791.6

***   2.560   ***

Failure Surface Specified By 65 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	186.89	1170.24
2	200.98	1165.09

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     3        215.16     1160.22
     4        229.44     1155.61
     5        243.80     1151.28
     6        258.24     1147.23
     7        272.76     1143.45
     8        287.34     1139.95
     9        301.99     1136.73
    10        316.70     1133.79
    11        331.47     1131.13
    12        346.28     1128.76
    13        361.13     1126.66
    14        376.02     1124.86
    15        390.94     1123.34
    16        405.89     1122.10
    17        420.86     1121.15
    18        435.85     1120.49
    19        450.84     1120.11
    20        465.84     1120.02
    21        480.84     1120.21
    22        495.83     1120.70
    23        510.81     1121.47
    24        525.78     1122.52
    25        540.72     1123.86
    26        555.63     1125.49
    27        570.51     1127.40
    28        585.34     1129.60
    29        600.14     1132.08
    30        614.88     1134.84
    31        629.57     1137.89
    32        644.20     1141.21
    33        658.76     1144.81
    34        673.25     1148.69
    35        687.66     1152.85
    36        701.99     1157.28
    37        716.23     1161.99
    38        730.38     1166.96
    39        744.44     1172.21
    40        758.39     1177.72
    41        772.23     1183.50
    42        785.96     1189.54
    43        799.57     1195.85
    44        813.06     1202.41
    45        826.42     1209.23
    46        839.64     1216.31
    47        852.73     1223.63
    48        865.68     1231.21
    49        878.48     1239.03
    50        891.13     1247.09
    51        903.62     1255.40
    52        915.95     1263.94
    53        928.11     1272.72
    54        940.11     1281.72
    55        951.93     1290.96
    56        963.57     1300.42
    57        975.03     1310.10
    58        986.30     1320.00
    59        997.38     1330.11
    60       1008.26     1340.43
    61       1018.95     1350.96
    62       1029.43     1361.69
    63       1039.70     1372.61
    64       1049.77     1383.74
    65       1057.12     1392.18
Circle Center At X =  463.1 ; Y = 1904.5  and Radius,  784.5
      ***     2.561    ***
Failure Surface Specified By 68 Coordinate Points
  Point      X-Surf      Y-Surf
   No.        (ft)        (ft)
     1        189.19     1171.38
     2        203.30     1166.29
```

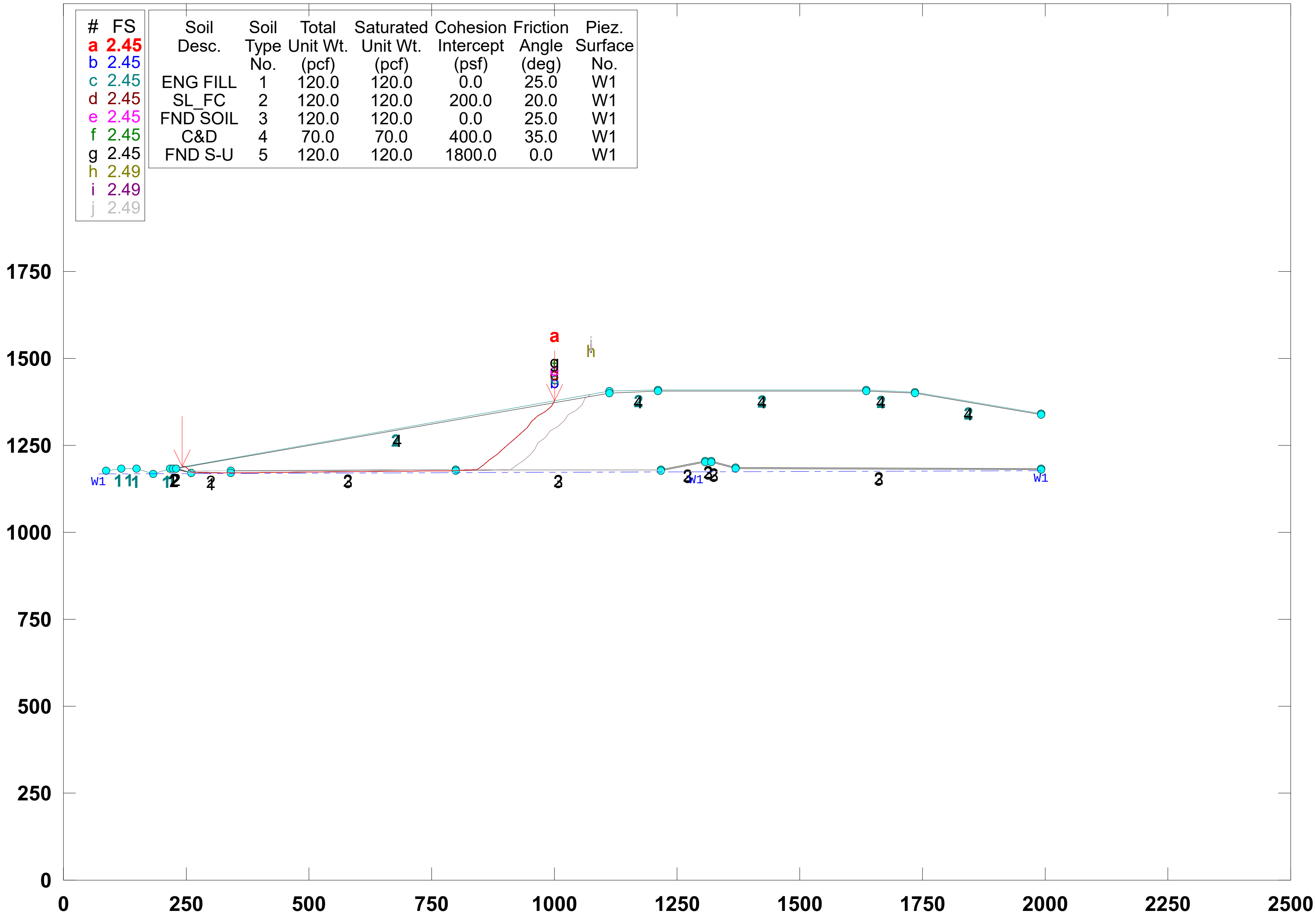
3	217.49	1161.46
4	231.78	1156.88
5	246.15	1152.57
6	260.59	1148.52
7	275.10	1144.73
8	289.69	1141.21
9	304.33	1137.96
10	319.03	1134.98
11	333.78	1132.26
12	348.58	1129.81
13	363.42	1127.64
14	378.30	1125.73
15	393.21	1124.10
16	408.15	1122.74
17	423.11	1121.65
18	438.09	1120.84
19	453.08	1120.30
20	468.08	1120.03
21	483.08	1120.04
22	498.07	1120.32
23	513.06	1120.88
24	528.04	1121.71
25	543.00	1122.81
26	557.94	1124.18
27	572.85	1125.83
28	587.72	1127.75
29	602.56	1129.94
30	617.36	1132.40
31	632.11	1135.13
32	646.80	1138.13
33	661.44	1141.40
34	676.02	1144.94
35	690.53	1148.74
36	704.97	1152.80
37	719.33	1157.13
38	733.61	1161.72
39	747.81	1166.56
40	761.91	1171.67
41	775.92	1177.04
42	789.83	1182.65
43	803.63	1188.53
44	817.33	1194.65
45	830.90	1201.02
46	844.37	1207.64
47	857.70	1214.50
48	870.91	1221.61
49	883.99	1228.95
50	896.93	1236.53
51	909.74	1244.35
52	922.39	1252.40
53	934.90	1260.68
54	947.25	1269.19
55	959.45	1277.92
56	971.49	1286.87
57	983.36	1296.05
58	995.06	1305.43
59	1006.58	1315.03
60	1017.93	1324.84
61	1029.10	1334.85
62	1040.09	1345.06
63	1050.88	1355.48
64	1061.49	1366.09
65	1071.90	1376.89
66	1082.11	1387.88
67	1092.11	1399.05
68	1094.15	1401.40

Circle Center At X = 475.2 ; Y = 1941.5 and Radius, 821.5

*** 2.565 ***

Northeast Landfill Cross Section B-B', WB

m:\projects\16219107.00\task 3 - tier iii modification app\permit application\app c - liner and final cover system stability analysis\stabl files\nelf\2023.4.13 nelf_xs_b_block.pl2 Run By: Username 5/11/2023



PCSTABL5M3 FSmin=2.45

Safety Factors Are Calculated By The Modified Janbu Method

**** PCSTABL5M3 ****

by Purdue University 1985
rev. for SCS Engineers HVA 2008
--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer`s Method of Slices

Run Date: 5/11/2023
Time of Run: 05:40PM
Run By: Username
Input Data Filename: M:2023.4.13 nelf_xs_b_block.in
Output Filename: M:2023.4.13 nelf_xs_b_block.OUT
Unit: ENGLISH
Plotted Output Filename: M:2023.4.13 nelf_xs_b_block.PLT
PROBLEM DESCRIPTION Northeast Landfill
Cross Section B-B', WB

BOUNDARY COORDINATES
Note: User origin value specified.
Add 0.00 to X-values and 0.00 to Y-values listed.

10 Top Boundaries
33 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	87.00	1176.00	118.70	1184.50	1
2	118.70	1184.50	149.60	1184.50	1
3	149.60	1184.50	183.40	1168.50	1
4	183.40	1168.50	215.50	1184.50	1
5	215.50	1184.50	223.10	1184.50	1
6	223.10	1184.50	1110.60	1405.50	2
7	1110.60	1405.50	1211.80	1408.00	2
8	1211.80	1408.00	1635.60	1408.00	2
9	1635.60	1408.00	1735.70	1404.00	2
10	1735.70	1404.00	1991.20	1340.20	2
11	223.10	1184.50	229.10	1184.50	2
12	229.10	1184.50	230.70	1182.90	2
13	230.70	1182.90	1110.60	1401.00	4
14	1110.60	1401.00	1211.80	1405.00	4
15	1211.80	1405.00	1635.60	1405.00	4
16	1635.60	1405.00	1735.70	1401.00	4
17	1735.70	1401.00	1991.20	1337.20	4
18	230.70	1182.90	261.10	1171.80	2
19	261.10	1175.90	341.50	1175.90	2
20	341.50	1175.90	800.00	1179.90	2
21	800.00	1179.90	1218.60	1181.00	2
22	1218.60	1181.00	1305.70	1206.00	2
23	1305.70	1206.00	1320.70	1206.00	2
24	1320.70	1206.00	1369.90	1186.00	2
25	1369.90	1186.00	1991.20	1184.40	2
26	223.10	1184.40	261.10	1171.80	1
27	261.10	1171.80	341.50	1171.90	1
28	341.50	1171.90	800.00	1175.90	3
29	800.00	1175.90	1218.60	1177.00	3
30	1218.60	1177.00	1305.70	1202.00	3
31	1305.70	1202.00	1320.70	1202.00	3
32	1320.70	1202.00	1369.90	1182.00	3
33	1369.90	1182.00	1991.20	1180.40	3

ISOTROPIC SOIL PARAMETERS
5 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	120.0	120.0	0.0	25.0	0.00	0.0	1
2	120.0	120.0	200.0	20.0	0.00	0.0	1
3	120.0	120.0	0.0	25.0	0.00	0.0	1
4	70.0	70.0	400.0	35.0	0.00	0.0	1
5	120.0	120.0	1800.0	0.0	0.00	0.0	1

1 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED
Unit Weight of Water = 62.40
Piezometric Surface No. 1 Specified by 3 Coordinate Points

Point X-Water Y-Water

No.	(ft)	(ft)
1	70.80	1167.90
2	1287.50	1174.20
3	1991.20	1176.50

A Critical Failure Surface Searching Method, Using A Random Technique For Generating Sliding Block Surfaces, Has Been Specified.

1000 Trial Surfaces Have Been Generated.

6 Boxes Specified For Generation Of Central Block Base

Length Of Line Segments For Active And Passive Portions Of Sliding Block Is 20.0

Box No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Height (ft)
1	261.10	1173.80	261.20	1173.80	4.00
2	261.70	1173.80	341.00	1173.90	4.00
3	341.50	1173.90	341.60	1173.90	4.00
4	342.10	1173.00	800.00	1177.90	4.00
5	800.50	1177.90	800.60	1177.90	4.00
6	801.10	1177.90	1216.60	1179.00	4.00

Following Are Displayed The Ten Most Critical Of The Trial Failure Surfaces Examined. They Are Ordered - Most Critical First.

* * Safety Factors Are Calculated By The Modified Janbu Method * *

Failure Surface Specified By 21 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	242.36	1189.30
2	246.94	1189.27
3	261.16	1175.20
4	293.81	1172.42
5	341.50	1172.39
6	532.45	1174.55
7	800.53	1176.92
8	841.96	1179.39
9	855.63	1193.99
10	868.75	1209.08
11	882.53	1223.58
12	896.57	1237.82
13	907.95	1254.27
14	919.25	1270.78
15	932.19	1286.02
16	945.24	1301.17
17	953.49	1319.39
18	967.36	1333.80
19	980.71	1348.69
20	993.20	1364.32
21	1001.84	1378.42

***   2.446   ***

Individual data on the   25 slices

Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Tie Force Norm (lbs)	Tie Force Tan (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Surcharge Load (lbs)
1	4.6	320.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	1.9	532.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	12.3	11779.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	32.7	64585.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	47.7	135849.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6	0.0	9.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7	191.0	926002.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8	267.5	2324230.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
9	0.5	5783.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10	41.4	462674.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
11	0.6	6567.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0
12	13.1	143394.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
13	13.1	133244.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
14	13.8	128971.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15	14.0	120650.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0
16	11.4	88086.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
17	11.3	76704.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0

18	12.9	76209.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
19	13.1	65966.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
20	8.2	33564.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0
21	13.9	43293.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
22	13.4	31172.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
23	12.5	18629.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
24	5.5	4326.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
25	3.2	829.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Failure Surface Specified By 21 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	242.36	1189.30
2	246.94	1189.27
3	261.16	1175.20
4	293.81	1172.42
5	341.50	1172.39
6	532.45	1174.55
7	800.53	1176.92
8	841.96	1179.39
9	855.63	1193.99
10	868.75	1209.08
11	882.53	1223.58
12	896.57	1237.82
13	907.95	1254.27
14	919.25	1270.78
15	932.19	1286.02
16	945.24	1301.17
17	953.49	1319.39
18	967.36	1333.80
19	980.71	1348.69
20	993.20	1364.32
21	1001.84	1378.42

*** 2.446 ***

Failure Surface Specified By 21 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	242.36	1189.30
2	246.94	1189.27
3	261.16	1175.20
4	293.81	1172.42
5	341.50	1172.39
6	532.45	1174.55
7	800.53	1176.92
8	841.96	1179.39
9	855.63	1193.99
10	868.75	1209.08
11	882.53	1223.58
12	896.57	1237.82
13	907.95	1254.27
14	919.25	1270.78
15	932.19	1286.02
16	945.24	1301.17
17	953.49	1319.39
18	967.36	1333.80
19	980.71	1348.69
20	993.20	1364.32
21	1001.84	1378.42

*** 2.446 ***

Failure Surface Specified By 21 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	242.36	1189.30
2	246.94	1189.27
3	261.16	1175.20
4	293.81	1172.42
5	341.50	1172.39
6	532.45	1174.55
7	800.53	1176.92
8	841.96	1179.39
9	855.63	1193.99

10	868.75	1209.08
11	882.53	1223.58
12	896.57	1237.82
13	907.95	1254.27
14	919.25	1270.78
15	932.19	1286.02
16	945.24	1301.17
17	953.49	1319.39
18	967.36	1333.80
19	980.71	1348.69
20	993.20	1364.32
21	1001.84	1378.42

*** 2.446 ***

Failure Surface Specified By 21 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	242.36	1189.30
2	246.94	1189.27
3	261.16	1175.20
4	293.81	1172.42
5	341.50	1172.39
6	532.45	1174.55
7	800.53	1176.92
8	841.96	1179.39
9	855.63	1193.99
10	868.75	1209.08
11	882.53	1223.58
12	896.57	1237.82
13	907.95	1254.27
14	919.25	1270.78
15	932.19	1286.02
16	945.24	1301.17
17	953.49	1319.39
18	967.36	1333.80
19	980.71	1348.69
20	993.20	1364.32
21	1001.84	1378.42

*** 2.446 ***

Failure Surface Specified By 21 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	242.36	1189.30
2	246.94	1189.27
3	261.16	1175.20
4	293.81	1172.42
5	341.50	1172.39
6	532.45	1174.55
7	800.53	1176.92
8	841.96	1179.39
9	855.63	1193.99
10	868.75	1209.08
11	882.53	1223.58
12	896.57	1237.82
13	907.95	1254.27
14	919.25	1270.78
15	932.19	1286.02
16	945.24	1301.17
17	953.49	1319.39
18	967.36	1333.80
19	980.71	1348.69
20	993.20	1364.32
21	1001.84	1378.42

*** 2.446 ***

Failure Surface Specified By 21 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	242.36	1189.30
2	246.94	1189.27
3	261.16	1175.20
4	293.81	1172.42

5	341.50	1172.39
6	532.45	1174.55
7	800.53	1176.92
8	841.96	1179.39
9	855.63	1193.99
10	868.75	1209.08
11	882.53	1223.58
12	896.57	1237.82
13	907.95	1254.27
14	919.25	1270.78
15	932.19	1286.02
16	945.24	1301.17
17	953.49	1319.39
18	967.36	1333.80
19	980.71	1348.69
20	993.20	1364.32
21	1001.84	1378.42

*** 2.446 ***

Failure Surface Specified By 22 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	231.95	1186.70
2	242.66	1179.77
3	261.17	1172.21
4	275.13	1172.74
5	341.58	1172.01
6	587.34	1175.47
7	800.59	1176.90
8	909.62	1179.64
9	923.65	1193.88
10	937.41	1208.40
11	951.55	1222.54
12	961.46	1239.91
13	967.27	1259.05
14	981.04	1273.55
15	991.64	1290.52
16	1005.35	1305.08
17	1019.39	1319.32
18	1029.07	1336.82
19	1043.18	1350.99
20	1057.20	1365.26
21	1063.78	1384.14
22	1075.79	1396.83

*** 2.485 ***

Failure Surface Specified By 22 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	231.95	1186.70
2	242.66	1179.77
3	261.17	1172.21
4	275.13	1172.74
5	341.58	1172.01
6	587.34	1175.47
7	800.59	1176.90
8	909.62	1179.64
9	923.65	1193.88
10	937.41	1208.40
11	951.55	1222.54
12	961.46	1239.91
13	967.27	1259.05
14	981.04	1273.55
15	991.64	1290.52
16	1005.35	1305.08
17	1019.39	1319.32
18	1029.07	1336.82
19	1043.18	1350.99
20	1057.20	1365.26
21	1063.78	1384.14
22	1075.79	1396.83

*** 2.485 ***

Failure Surface Specified By 22 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	231.95	1186.70
2	242.66	1179.77
3	261.17	1172.21
4	275.13	1172.74
5	341.58	1172.01
6	587.34	1175.47
7	800.59	1176.90
8	909.62	1179.64
9	923.65	1193.88
10	937.41	1208.40
11	951.55	1222.54
12	961.46	1239.91
13	967.27	1259.05
14	981.04	1273.55
15	991.64	1290.52
16	1005.35	1305.08
17	1019.39	1319.32
18	1029.07	1336.82
19	1043.18	1350.99
20	1057.20	1365.26
21	1063.78	1384.14
22	1075.79	1396.83

*** 2.485 ***

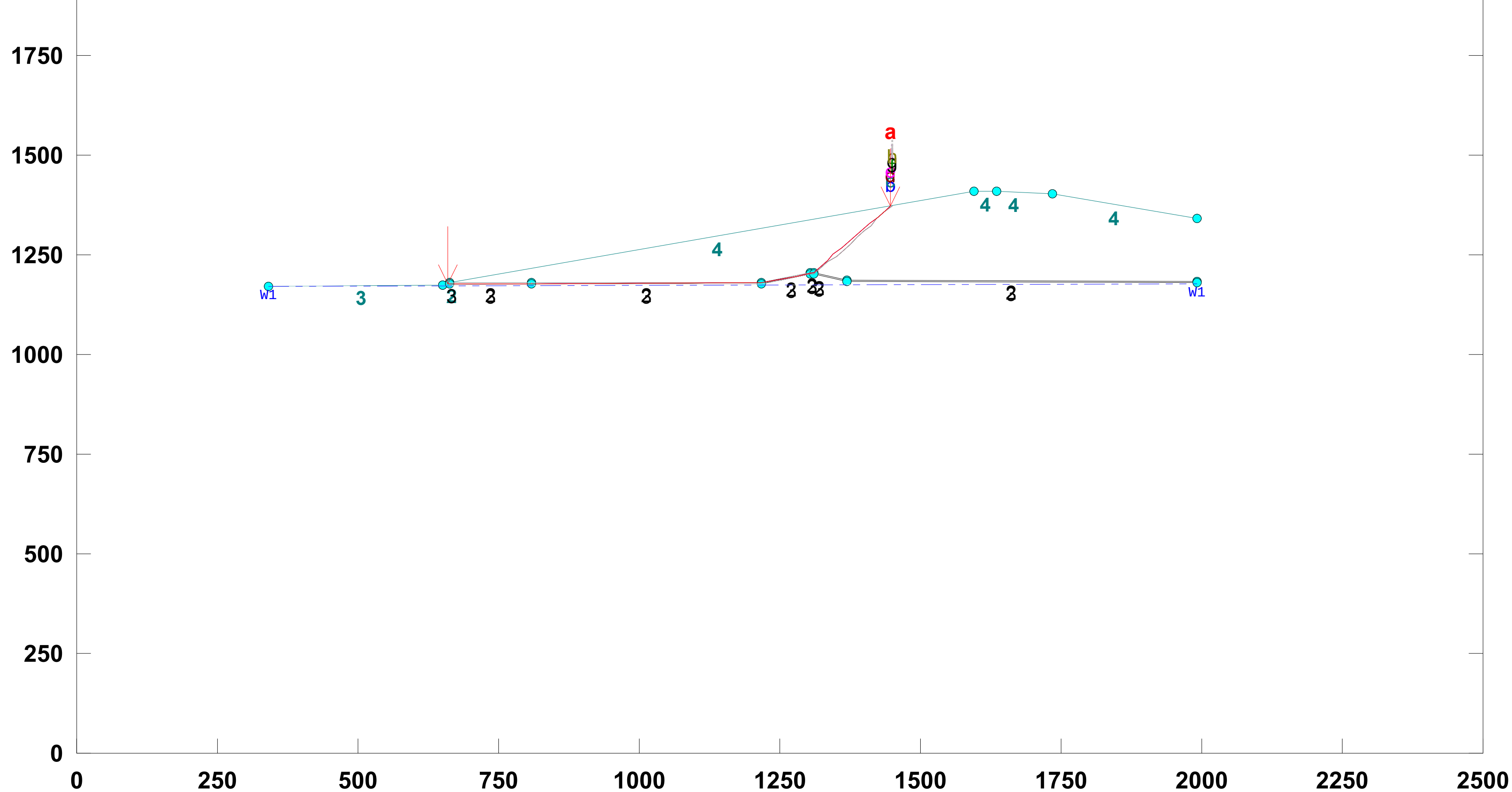
Northeast Landfill Cross Section B-B', PH12 WB (Seismic)

m:\projects\16219107.00\task 3 - tier iii modification app\permit application\app c - liner and final cover system stability analysis\stabl files\nelf\2023.4.13 nelf_xs_b_ph12 wb (seismic).pl2 Run By: Username 5/11/2023

#	FS
a	1.01
b	1.01
c	1.01
d	1.01
e	1.01
f	1.01
g	1.01
h	1.01
i	1.01
j	1.01

Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Piez. Surface No.
ENG FILL	1	120.0	120.0	0.0	25.0	W1
SL_FC	2	120.0	120.0	200.0	20.0	W1
FND SOIL	3	120.0	120.0	0.0	25.0	W1
C&D	4	70.0	70.0	400.0	35.0	W1
FND S-U	5	120.0	120.0	1800.0	0.0	W1

Load	Value
Horiz Eqk	0.250 g<



PCSTABL5M3 FSmin=1.01
Safety Factors Are Calculated By The Modified Janbu Method

**** PCSTABL5M3 ****

by Purdue University 1985
rev. for SCS Engineers HVA 2008
--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer`s Method of Slices

```
Run Date:                  5/11/2023
Time of Run:               05:46PM
Run By:                    Username
Input Data Filename:       M:2023.4.13 nelf_xs_b_ph12 wb (seismic).in
Output Filename:           M:2023.4.13 nelf_xs_b_ph12 wb (seismic).OUT
Unit:                      ENGLISH
Plotted Output Filename:   M:2023.4.13 nelf_xs_b_ph12 wb (seismic).PLT
PROBLEM DESCRIPTION   Northeast Landfill
                      Cross Section B-B', PH12 WB (Seismic)
BOUNDARY COORDINATES
     Note: User origin value specified.
     Add 0.00 to X-values and 0.00 to Y-values listed.

    6 Top   Boundaries
   19 Total Boundaries
```

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	341.50	1171.90	651.40	1174.70	3
2	651.40	1174.70	663.40	1178.70	2
3	663.40	1178.70	1596.50	1408.00	4
4	1596.50	1408.00	1635.60	1408.00	4
5	1635.60	1408.00	1735.70	1404.00	4
6	1735.70	1404.00	1991.20	1340.20	4
7	663.40	1178.70	807.10	1180.00	2
8	807.10	1180.00	1218.60	1181.00	2
9	1218.60	1181.00	1305.60	1206.00	2
10	1305.60	1206.00	1310.60	1206.00	2
11	1310.60	1206.00	1369.90	1186.00	2
12	1369.90	1186.00	1991.20	1184.40	2
13	651.40	1174.70	663.40	1178.40	3
14	663.40	1178.40	807.10	1176.00	3
15	807.10	1176.00	1218.60	1177.00	3
16	1218.60	1177.00	1305.60	1202.00	3
17	1305.60	1202.00	1310.60	1202.00	3
18	1310.60	1202.00	1369.90	1182.00	3
19	1369.90	1182.00	1991.20	1180.40	3

ISOTROPIC SOIL PARAMETERS
5 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	120.0	120.0	0.0	25.0	0.00	0.0	1
2	120.0	120.0	200.0	20.0	0.00	0.0	1
3	120.0	120.0	0.0	25.0	0.00	0.0	1
4	70.0	70.0	400.0	35.0	0.00	0.0	1
5	120.0	120.0	1800.0	0.0	0.00	0.0	1

1 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED
Unit Weight of Water = 62.40
Piezometric Surface No. 1 Specified by 2 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	340.80	1170.40
2	1991.20	1176.50

A Horizontal Earthquake Loading Coefficient
Of0.250 Has Been Assigned
A Vertical Earthquake Loading Coefficient
Of0.000 Has Been Assigned
Cavitation Pressure = 0.0 (psf)
A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Sliding Block Surfaces, Has Been
Specified.
1000 Trial Surfaces Have Been Generated.
8 Boxes Specified For Generation Of Central Block Base
Length Of Line Segments For Active And Passive Portions Of

Sliding Block Is 20.0

Box No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Height (ft)
1	663.40	1176.70	663.50	1176.70	4.00
2	664.00	1176.70	806.50	1178.00	4.00
3	807.00	1178.00	807.10	1178.00	4.00
4	807.60	1178.00	1218.10	1179.00	4.00
5	1218.60	1179.00	1218.70	1179.00	4.00
6	1219.20	1179.00	1305.10	1204.00	4.00
7	1305.60	1204.00	1305.70	1204.00	4.00
8	1306.10	1204.00	1310.10	1204.00	4.00

The Factor Of Safety For The Trial Failure Surface Defined
By The Coordinates Listed Below Is Misleading.
Failure Surface Defined By 19 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	662.20	1178.30
2	663.41	1178.06
3	799.53	1178.07
4	807.01	1177.21
5	1043.69	1178.04
6	1218.62	1179.76
7	1277.92	1198.06
8	1305.62	1204.99
9	1306.21	1202.67
10	1319.77	1217.37
11	1332.46	1232.83
12	1341.40	1250.72
13	1346.01	1270.18
14	1349.60	1289.86
15	1361.70	1305.78
16	1375.56	1320.19
17	1377.85	1340.06
18	1389.56	1356.27
19	1389.61	1357.16

Factor Of Safety For The Preceding Specified Surface = 1.005
The Factor Of Safety For The Trial Failure Surface Defined
By The Coordinates Listed Below Is Misleading.
Failure Surface Defined By 19 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	660.40	1177.70
2	663.49	1174.84
3	759.00	1179.26
4	807.00	1176.98
5	1162.65	1179.24
6	1218.69	1178.26
7	1282.34	1197.37
8	1305.64	1205.97
9	1306.21	1203.55
10	1320.34	1217.71
11	1331.57	1234.26
12	1345.71	1248.40
13	1359.82	1262.57
14	1373.61	1277.06
15	1377.22	1296.74
16	1391.20	1311.04
17	1399.38	1329.29
18	1413.14	1343.81
19	1415.10	1363.42

Factor Of Safety For The Preceding Specified Surface = 0.985
The Factor Of Safety For The Trial Failure Surface Defined
By The Coordinates Listed Below Is Misleading.
Failure Surface Defined By 19 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	659.49	1177.40
2	663.41	1174.94
3	708.07	1176.46
4	807.02	1178.70

5	1131.38	1179.45
6	1218.67	1179.61
7	1257.01	1190.91
8	1305.62	1204.95
9	1306.15	1203.09
10	1314.33	1221.35
11	1327.71	1236.21
12	1341.82	1250.39
13	1354.09	1266.18
14	1367.61	1280.92
15	1369.86	1300.79
16	1374.99	1320.12
17	1385.29	1337.27
18	1399.19	1351.65
19	1402.09	1360.23

Factor Of Safety For The Preceding Specified Surface = 0.987
The Factor Of Safety For The Trial Failure Surface Defined
By The Coordinates Listed Below Is Misleading.
Failure Surface Defined By 19 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	662.79	1178.50
2	663.41	1178.05
3	673.87	1175.20
4	807.09	1179.01
5	842.05	1178.13
6	1218.60	1180.37
7	1290.75	1201.69
8	1305.63	1205.41
9	1306.37	1202.88
10	1316.99	1219.83
11	1327.63	1236.76
12	1341.77	1250.90
13	1355.53	1265.42
14	1364.47	1283.31
15	1364.90	1303.30
16	1378.89	1317.59
17	1392.11	1332.61
18	1394.61	1352.45
19	1402.01	1360.21

Factor Of Safety For The Preceding Specified Surface = 0.972
Factor Of Safety Calculation Has Gone Through Ten Iterations
The Trial Failure Surface In Question Is Defined
By The Following 19 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	662.07	1178.26
2	663.41	1177.15
3	782.17	1179.24
4	807.05	1179.32
5	963.22	1177.80
6	1218.64	1177.13
7	1238.59	1183.47
8	1305.64	1205.88
9	1306.58	1202.67
10	1318.93	1218.40
11	1324.27	1237.67
12	1324.71	1257.67
13	1325.66	1277.64
14	1339.78	1291.81
15	1353.90	1305.97
16	1366.01	1321.89
17	1380.15	1336.03
18	1388.24	1354.33
19	1389.90	1357.23

Factor Of Safety For The Preceding Specified Surface = 1.576
Factor Of Safety Calculation Has Gone Through Ten Iterations
The Trial Failure Surface In Question Is Defined
By The Following 19 Coordinate Points

Point	X-Surf	Y-Surf

No.	(ft)	(ft)
1	662.07	1178.26
2	663.41	1177.15
3	782.17	1179.24
4	807.05	1179.32
5	963.22	1177.80
6	1218.64	1177.13
7	1238.59	1183.47
8	1305.64	1205.88
9	1306.58	1202.67
10	1318.93	1218.40
11	1324.27	1237.67
12	1324.71	1257.67
13	1325.66	1277.64
14	1339.78	1291.81
15	1353.90	1305.97
16	1366.01	1321.89
17	1380.15	1336.03
18	1388.24	1354.33
19	1389.90	1357.23

Factor Of Safety For The Preceding Specified Surface = 1.576
Factor Of Safety Calculation Has Gone Through Ten Iterations
The Trial Failure Surface In Question Is Defined
By The Following 19 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	662.07	1178.26
2	663.41	1177.15
3	782.17	1179.24
4	807.05	1179.32
5	963.22	1177.80
6	1218.64	1177.13
7	1238.59	1183.47
8	1305.64	1205.88
9	1306.58	1202.67
10	1318.93	1218.40
11	1324.27	1237.67
12	1324.71	1257.67
13	1325.66	1277.64
14	1339.78	1291.81
15	1353.90	1305.97
16	1366.01	1321.89
17	1380.15	1336.03
18	1388.24	1354.33
19	1389.90	1357.23

Factor Of Safety For The Preceding Specified Surface = 1.576
Factor Of Safety Calculation Has Gone Through Ten Iterations
The Trial Failure Surface In Question Is Defined
By The Following 19 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	662.07	1178.26
2	663.41	1177.15
3	782.17	1179.24
4	807.05	1179.32
5	963.22	1177.80
6	1218.64	1177.13
7	1238.59	1183.47
8	1305.64	1205.88
9	1306.58	1202.67
10	1318.93	1218.40
11	1324.27	1237.67
12	1324.71	1257.67
13	1325.66	1277.64
14	1339.78	1291.81
15	1353.90	1305.97
16	1366.01	1321.89
17	1380.15	1336.03
18	1388.24	1354.33
19	1389.90	1357.23

Factor Of Safety For The Preceding Specified Surface = 1.576
Factor Of Safety Calculation Has Gone Through Ten Iterations
The Trial Failure Surface In Question Is Defined
By The Following 19 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	662.07	1178.26
2	663.41	1177.15
3	782.17	1179.24
4	807.05	1179.32
5	963.22	1177.80
6	1218.64	1177.13
7	1238.59	1183.47
8	1305.64	1205.88
9	1306.58	1202.67
10	1318.93	1218.40
11	1324.27	1237.67
12	1324.71	1257.67
13	1325.66	1277.64
14	1339.78	1291.81
15	1353.90	1305.97
16	1366.01	1321.89
17	1380.15	1336.03
18	1388.24	1354.33
19	1389.90	1357.23

Factor Of Safety For The Preceding Specified Surface = 1.576
Following Are Displayed The Ten Most Critical Of The Trial Failure Surfaces Examined. They Are Ordered - Most Critical First.

* * Safety Factors Are Calculated By The Modified Janbu Method * *

Failure Surface Specified By 20 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	658.70	1177.13
2	663.42	1176.33
3	678.36	1177.16
4	807.03	1177.38
5	1215.77	1179.16
6	1218.62	1180.06
7	1278.02	1195.56
8	1305.68	1203.68
9	1309.79	1205.16
10	1323.89	1219.34
11	1335.54	1235.60
12	1345.54	1252.92
13	1359.57	1267.17
14	1371.47	1283.25
15	1385.59	1297.41
16	1397.02	1313.82
17	1410.53	1328.57
18	1423.69	1343.63
19	1435.79	1359.55
20	1446.42	1371.12

*** 1.005 ***

Individual data on the 27 slices

Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Tie Force Norm (lbs)	Tie Force Tan (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Surcharge Load (lbs)
1	0.4	4.4	0.0	0.0	0.0	0.0	1.1	0.0	0.0
2	4.3	661.5	0.0	0.0	0.0	0.0	165.4	0.0	0.0
3	0.0	7.1	0.0	0.0	0.0	0.0	1.8	0.0	0.0
4	14.9	5479.4	0.0	0.0	0.0	0.0	1369.9	0.0	0.0
5	53.9	49572.8	0.0	0.0	0.0	0.0	12393.2	0.0	0.0
6	74.8	152657.0	0.0	0.0	0.0	0.0	38164.3	0.0	0.0
7	0.1	195.1	0.0	0.0	0.0	0.0	48.8	0.0	0.0
8	408.7	2504456.2	0.0	0.0	0.0	0.0	*******	0.0	0.0
9	2.8	26976.3	0.0	0.0	0.0	0.0	6744.1	0.0	0.0
10	0.0	213.4	0.0	0.0	0.0	0.0	53.4	0.0	0.0
11	59.4	564889.9	0.0	0.0	0.0	0.0	*******	0.0	0.0

12	27.6	261108.8	0.0	0.0	0.0	0.0	65277.2	0.0	0.0
13	0.1	795.4	0.0	0.0	0.0	0.0	198.9	0.0	0.0
14	4.1	38420.5	0.0	0.0	0.0	0.0	9605.1	0.0	0.0
15	0.8	7522.7	0.0	0.0	0.0	0.0	1880.7	0.0	0.0
16	0.0	175.7	0.0	0.0	0.0	0.0	43.9	0.0	0.0
17	13.3	117707.4	0.0	0.0	0.0	0.0	29426.8	0.0	0.0
18	11.7	93774.7	0.0	0.0	0.0	0.0	23443.7	0.0	0.0
19	10.0	70565.1	0.0	0.0	0.0	0.0	17641.3	0.0	0.0
20	14.0	86432.2	0.0	0.0	0.0	0.0	21608.0	0.0	0.0
21	11.9	63318.5	0.0	0.0	0.0	0.0	15829.6	0.0	0.0
22	14.1	63395.3	0.0	0.0	0.0	0.0	15848.8	0.0	0.0
23	11.4	41565.4	0.0	0.0	0.0	0.0	10391.3	0.0	0.0
24	13.5	37304.4	0.0	0.0	0.0	0.0	9326.1	0.0	0.0
25	13.2	25622.1	0.0	0.0	0.0	0.0	6405.5	0.0	0.0
26	12.1	13073.1	0.0	0.0	0.0	0.0	3268.3	0.0	0.0
27	10.6	3332.3	0.0	0.0	0.0	0.0	833.1	0.0	0.0

Failure Surface Specified By 20 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	658.70	1177.13
2	663.42	1176.33
3	678.36	1177.16
4	807.03	1177.38
5	1215.77	1179.16
6	1218.62	1180.06
7	1278.02	1195.56
8	1305.68	1203.68
9	1309.79	1205.16
10	1323.89	1219.34
11	1335.54	1235.60
12	1345.54	1252.92
13	1359.57	1267.17
14	1371.47	1283.25
15	1385.59	1297.41
16	1397.02	1313.82
17	1410.53	1328.57
18	1423.69	1343.63
19	1435.79	1359.55
20	1446.42	1371.12

*** 1.005 ***

Failure Surface Specified By 20 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	658.70	1177.13
2	663.42	1176.33
3	678.36	1177.16
4	807.03	1177.38
5	1215.77	1179.16
6	1218.62	1180.06
7	1278.02	1195.56
8	1305.68	1203.68
9	1309.79	1205.16
10	1323.89	1219.34
11	1335.54	1235.60
12	1345.54	1252.92
13	1359.57	1267.17
14	1371.47	1283.25
15	1385.59	1297.41
16	1397.02	1313.82
17	1410.53	1328.57
18	1423.69	1343.63
19	1435.79	1359.55
20	1446.42	1371.12

*** 1.005 ***

Failure Surface Specified By 20 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	658.70	1177.13
2	663.42	1176.33
3	678.36	1177.16

4	807.03	1177.38
5	1215.77	1179.16
6	1218.62	1180.06
7	1278.02	1195.56
8	1305.68	1203.68
9	1309.79	1205.16
10	1323.89	1219.34
11	1335.54	1235.60
12	1345.54	1252.92
13	1359.57	1267.17
14	1371.47	1283.25
15	1385.59	1297.41
16	1397.02	1313.82
17	1410.53	1328.57
18	1423.69	1343.63
19	1435.79	1359.55
20	1446.42	1371.12

*** 1.005 ***

Failure Surface Specified By 20 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	658.70	1177.13
2	663.42	1176.33
3	678.36	1177.16
4	807.03	1177.38
5	1215.77	1179.16
6	1218.62	1180.06
7	1278.02	1195.56
8	1305.68	1203.68
9	1309.79	1205.16
10	1323.89	1219.34
11	1335.54	1235.60
12	1345.54	1252.92
13	1359.57	1267.17
14	1371.47	1283.25
15	1385.59	1297.41
16	1397.02	1313.82
17	1410.53	1328.57
18	1423.69	1343.63
19	1435.79	1359.55
20	1446.42	1371.12

*** 1.005 ***

Failure Surface Specified By 20 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	655.33	1176.01
2	663.47	1175.96
3	720.49	1177.51
4	807.09	1177.62
5	867.31	1176.26
6	1218.61	1178.66
7	1251.74	1187.60
8	1305.63	1202.39
9	1309.49	1202.33
10	1323.16	1216.92
11	1336.28	1232.02
12	1350.06	1246.51
13	1364.10	1260.76
14	1375.48	1277.21
15	1386.78	1293.71
16	1399.72	1308.96
17	1412.77	1324.11
18	1421.02	1342.33
19	1434.89	1356.74
20	1448.17	1371.55

*** 1.006 ***

Failure Surface Specified By 20 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	655.33	1176.01

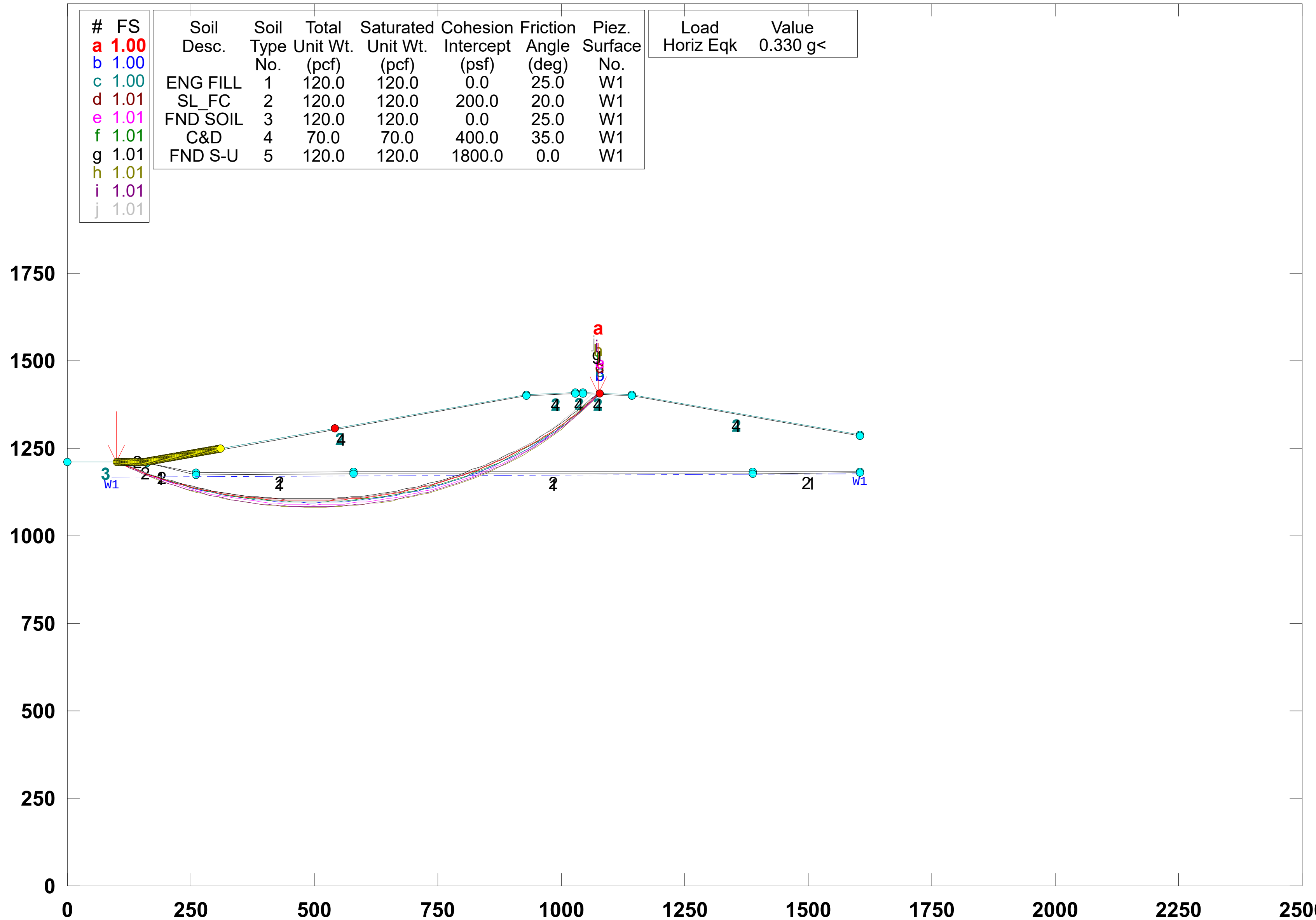
```
     2        663.47     1175.96
     3        720.49     1177.51
     4        807.09     1177.62
     5        867.31     1176.26
     6       1218.61     1178.66
     7       1251.74     1187.60
     8       1305.63     1202.39
     9       1309.49     1202.33
    10       1323.16     1216.92
    11       1336.28     1232.02
    12       1350.06     1246.51
    13       1364.10     1260.76
    14       1375.48     1277.21
    15       1386.78     1293.71
    16       1399.72     1308.96
    17       1412.77     1324.11
    18       1421.02     1342.33
    19       1434.89     1356.74
    20       1448.17     1371.55
        ***      1.006   ***
Failure Surface Specified By 20 Coordinate Points
  Point      X-Surf      Y-Surf
   No.        (ft)        (ft)
     1        655.33     1176.01
     2        663.47     1175.96
     3        720.49     1177.51
     4        807.09     1177.62
     5        867.31     1176.26
     6       1218.61     1178.66
     7       1251.74     1187.60
     8       1305.63     1202.39
     9       1309.49     1202.33
    10       1323.16     1216.92
    11       1336.28     1232.02
    12       1350.06     1246.51
    13       1364.10     1260.76
    14       1375.48     1277.21
    15       1386.78     1293.71
    16       1399.72     1308.96
    17       1412.77     1324.11
    18       1421.02     1342.33
    19       1434.89     1356.74
    20       1448.17     1371.55
        ***      1.006   ***
Failure Surface Specified By 20 Coordinate Points
  Point      X-Surf      Y-Surf
   No.        (ft)        (ft)
     1        655.33     1176.01
     2        663.47     1175.96
     3        720.49     1177.51
     4        807.09     1177.62
     5        867.31     1176.26
     6       1218.61     1178.66
     7       1251.74     1187.60
     8       1305.63     1202.39
     9       1309.49     1202.33
    10       1323.16     1216.92
    11       1336.28     1232.02
    12       1350.06     1246.51
    13       1364.10     1260.76
    14       1375.48     1277.21
    15       1386.78     1293.71
    16       1399.72     1308.96
    17       1412.77     1324.11
    18       1421.02     1342.33
    19       1434.89     1356.74
    20       1448.17     1371.55
        ***      1.006   ***
Failure Surface Specified By 20 Coordinate Points
  Point      X-Surf      Y-Surf
```

No.	(ft)	(ft)
1	655.33	1176.01
2	663.47	1175.96
3	720.49	1177.51
4	807.09	1177.62
5	867.31	1176.26
6	1218.61	1178.66
7	1251.74	1187.60
8	1305.63	1202.39
9	1309.49	1202.33
10	1323.16	1216.92
11	1336.28	1232.02
12	1350.06	1246.51
13	1364.10	1260.76
14	1375.48	1277.21
15	1386.78	1293.71
16	1399.72	1308.96
17	1412.77	1324.11
18	1421.02	1342.33
19	1434.89	1356.74
20	1448.17	1371.55

*** 1.006 ***

Northeast Landfill Cross Section AA', Circular (Seismic)

m:\projects\16219107.00\task 3 - tier iii modification app\permit application\app c - liner and final cover system stability analysis\stabl files\nelf\2023.4.13 nelf_xs_aa'_circ (seismic).pl2 Run By: Username 5/11/2023



PCSTABL5M3 FSmin=1.00

Safety Factors Are Calculated By The Modified Bishop Method

**** PCSTABL5M3 ****
by Purdue University 1985
rev. for SCS Engineers HVA 2008
--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer`s Method of Slices

Run Date: 5/11/2023
Time of Run: 06:06PM
Run By: Username
Input Data Filename: M:2023.4.13 nelf_xs_aa'_circ (seismic).in
Output Filename: M:2023.4.13 nelf_xs_aa'_circ (seismic).OUT
Unit: ENGLISH
Plotted Output Filename: M:2023.4.13 nelf_xs_aa'_circ (seismic).PLT
PROBLEM DESCRIPTION Northeast Landfill
Cross Section AA', Circular (Seismic)

BOUNDARY COORDINATES
Note: User origin value specified.
Add 0.00 to X-values and 0.00 to Y-values listed.

6 Top Boundaries
21 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	0.00	1212.00	154.70	1210.50	3
2	154.70	1210.50	928.90	1404.00	2
3	928.90	1404.00	1029.10	1408.00	2
4	1029.10	1408.00	1043.80	1408.00	2
5	1043.80	1408.00	1144.10	1404.00	2
6	1144.10	1404.00	1603.40	1289.90	2
7	154.70	1210.50	160.70	1210.50	2
8	160.70	1210.50	162.30	1209.40	2
9	162.30	1209.40	928.90	1401.00	4
10	928.90	1401.00	1029.10	1405.00	4
11	1029.10	1405.00	1043.80	1405.00	4
12	1043.80	1405.00	1144.10	1401.00	4
13	1144.10	1401.00	1603.40	1286.90	4
14	162.30	1209.40	261.10	1179.40	2
15	261.10	1179.40	579.00	1182.30	2
16	579.00	1182.30	1386.40	1182.10	2
17	1386.40	1182.10	1603.40	1184.20	2
18	154.70	1210.50	261.10	1175.40	1
19	261.10	1175.40	579.00	1178.30	1
20	579.00	1178.30	1386.40	1178.10	1
21	1386.40	1178.10	1603.40	1180.20	1

ISOTROPIC SOIL PARAMETERS
5 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	120.0	120.0	0.0	25.0	0.00	0.0	1
2	120.0	120.0	200.0	20.0	0.00	0.0	1
3	120.0	120.0	0.0	25.0	0.00	0.0	1
4	70.0	70.0	400.0	35.0	0.00	0.0	1
5	120.0	120.0	1800.0	0.0	0.00	0.0	1

1 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED
Unit Weight of Water = 62.40
Piezometric Surface No. 1 Specified by 2 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	88.50	1168.30
2	1603.40	1177.60

A Horizontal Earthquake Loading Coefficient
Of0.330 Has Been Assigned
A Vertical Earthquake Loading Coefficient
Of0.000 Has Been Assigned
Cavitation Pressure = 0.0 (psf)
A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Circular Surfaces, Has Been Specified.
10000 Trial Surfaces Have Been Generated.
100 Surfaces Initiate From Each Of100 Points Equally Spaced

Along The Ground Surface Between X = 100.00 ft.
and X = 310.00 ft.
Each Surface Terminates Between   X = 541.50 ft.
and   X =1078.00 ft.
Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y = 0.00 ft.
15.00 ft. Line Segments Define Each Trial Failure Surface.
Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Examined. They Are Ordered - Most Critical
First.
* * Safety Factors Are Calculated By The Modified Bishop Method * *
Failure Surface Specified By 75 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	100.00	1211.03
2	112.76	1203.15
3	125.69	1195.54
4	138.77	1188.19
5	152.00	1181.12
6	165.37	1174.33
7	178.88	1167.82
8	192.53	1161.59
9	206.30	1155.65
10	220.19	1149.99
11	234.20	1144.63
12	248.32	1139.55
13	262.54	1134.78
14	276.85	1130.30
15	291.26	1126.11
16	305.75	1122.23
17	320.31	1118.66
18	334.95	1115.38
19	349.66	1112.42
20	364.42	1109.75
21	379.23	1107.40
22	394.09	1105.36
23	408.99	1103.62
24	423.92	1102.20
25	438.88	1101.09
26	453.86	1100.29
27	468.85	1099.80
28	483.85	1099.62
29	498.85	1099.76
30	513.85	1100.21
31	528.83	1100.97
32	543.79	1102.04
33	558.72	1103.43
34	573.63	1105.12
35	588.49	1107.12
36	603.31	1109.44
37	618.08	1112.06
38	632.79	1114.99
39	647.44	1118.22
40	662.02	1121.76
41	676.52	1125.60
42	690.93	1129.75
43	705.26	1134.19
44	719.49	1138.93
45	733.62	1143.96
46	747.64	1149.29
47	761.55	1154.91
48	775.34	1160.82
49	789.00	1167.01
50	802.53	1173.49
51	815.92	1180.24
52	829.17	1187.28
53	842.27	1194.59
54	855.22	1202.17
55	868.00	1210.01
56	880.62	1218.12

57	893.06	1226.50
58	905.33	1235.13
59	917.42	1244.01
60	929.32	1253.15
61	941.02	1262.52
62	952.53	1272.15
63	963.83	1282.00
64	974.93	1292.10
65	985.82	1302.42
66	996.48	1312.96
67	1006.93	1323.73
68	1017.15	1334.71
69	1027.14	1345.90
70	1036.89	1357.30
71	1046.40	1368.89
72	1055.67	1380.69
73	1064.70	1392.67
74	1073.47	1404.84
75	1074.80	1406.76

Circle Center At X = 484.8 ; Y = 1819.9 and Radius, 720.3

*** 1.003 ***

Individual data on the 87 slices

Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Tie Force Norm (lbs)	Tie Force Tan (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Surcharge Load (lbs)
1	12.8	5940.4	0.0	0.0	0.0	0.0	1960.3	0.0	0.0
2	12.9	17838.0	0.0	0.0	0.0	0.0	5886.5	0.0	0.0
3	13.1	29592.9	0.0	0.0	0.0	0.0	9765.6	0.0	0.0
4	13.2	41170.1	0.0	0.0	0.0	0.0	13586.1	0.0	0.0
5	2.7	9756.5	0.0	0.0	0.0	0.0	3219.7	0.0	0.0
6	6.0	23776.5	0.0	0.0	0.0	0.0	7846.3	0.0	0.0
7	1.6	6893.3	0.0	0.0	0.0	0.0	2274.8	0.0	0.0
8	3.1	13752.0	0.0	0.0	0.0	0.0	4538.1	0.0	0.0
9	11.4	56016.0	0.0	0.0	0.0	0.0	18485.3	0.0	0.0
10	2.1	11299.6	0.0	76.1	0.0	0.0	3728.9	0.0	0.0
11	13.6	78836.8	0.0	3924.0	0.0	0.0	26016.1	0.0	0.0
12	13.8	90065.0	0.0	9699.6	0.0	0.0	29721.4	0.0	0.0
13	13.9	100968.2	0.0	15207.4	0.0	0.0	33319.5	0.0	0.0
14	14.0	111517.0	0.0	20445.3	0.0	0.0	36800.6	0.0	0.0
15	14.1	121681.7	0.0	25410.6	0.0	0.0	40154.9	0.0	0.0
16	12.8	117759.9	0.0	26852.5	0.0	0.0	38860.8	0.0	0.0
17	1.4	13691.2	0.0	3249.0	0.0	0.0	4518.1	0.0	0.0
18	14.3	142673.4	0.0	34515.7	0.0	0.0	47082.2	0.0	0.0
19	14.4	154772.5	0.0	38651.8	0.0	0.0	51074.9	0.0	0.0
20	14.5	166440.2	0.0	42507.2	0.0	0.0	54925.3	0.0	0.0
21	14.6	177649.9	0.0	46080.9	0.0	0.0	58624.5	0.0	0.0
22	14.6	188374.6	0.0	49371.0	0.0	0.0	62163.6	0.0	0.0
23	14.7	198589.1	0.0	52376.0	0.0	0.0	65534.4	0.0	0.0
24	14.8	208271.0	0.0	55095.1	0.0	0.0	68729.4	0.0	0.0
25	14.8	217397.2	0.0	57526.6	0.0	0.0	71741.1	0.0	0.0
26	14.9	225947.2	0.0	59669.6	0.0	0.0	74562.6	0.0	0.0
27	14.9	233902.9	0.0	61523.2	0.0	0.0	77188.0	0.0	0.0
28	14.9	241246.6	0.0	63086.7	0.0	0.0	79611.4	0.0	0.0
29	15.0	247962.4	0.0	64359.2	0.0	0.0	81827.6	0.0	0.0
30	15.0	254036.4	0.0	65340.3	0.0	0.0	83832.0	0.0	0.0
31	15.0	259455.9	0.0	66029.4	0.0	0.0	85620.4	0.0	0.0
32	15.0	264211.5	0.0	66426.6	0.0	0.0	87189.8	0.0	0.0
33	15.0	268293.8	0.0	66531.6	0.0	0.0	88536.9	0.0	0.0
34	15.0	271694.5	0.0	66343.9	0.0	0.0	89659.2	0.0	0.0
35	15.0	274410.1	0.0	65864.1	0.0	0.0	90555.3	0.0	0.0
36	15.0	276435.5	0.0	65092.0	0.0	0.0	91223.7	0.0	0.0
37	14.9	277769.9	0.0	64028.5	0.0	0.0	91664.1	0.0	0.0
38	14.9	278412.8	0.0	62673.5	0.0	0.0	91876.2	0.0	0.0
39	5.4	100548.2	0.0	22260.3	0.0	0.0	33180.9	0.0	0.0
40	9.5	177795.6	0.0	38767.3	0.0	0.0	58672.5	0.0	0.0
41	14.8	277515.3	0.0	59092.1	0.0	0.0	91580.1	0.0	0.0
42	14.8	275999.7	0.0	56867.3	0.0	0.0	91079.9	0.0	0.0
43	14.7	273811.1	0.0	54354.3	0.0	0.0	90357.7	0.0	0.0
44	14.6	270958.4	0.0	51554.3	0.0	0.0	89416.3	0.0	0.0

45	14.6	267452.6	0.0	48468.1	0.0	0.0	88259.4	0.0	0.0
46	14.5	263307.5	0.0	45097.8	0.0	0.0	86891.5	0.0	0.0
47	14.4	258535.2	0.0	41444.1	0.0	0.0	85316.6	0.0	0.0
48	14.3	253151.7	0.0	37509.0	0.0	0.0	83540.1	0.0	0.0
49	14.2	247175.7	0.0	33294.2	0.0	0.0	81568.0	0.0	0.0
50	14.1	240624.1	0.0	28801.3	0.0	0.0	79405.9	0.0	0.0
51	14.0	233518.8	0.0	24032.5	0.0	0.0	77061.2	0.0	0.0
52	13.9	225881.9	0.0	18989.8	0.0	0.0	74541.0	0.0	0.0
53	13.8	217734.8	0.0	13675.3	0.0	0.0	71852.5	0.0	0.0
54	13.7	209104.9	0.0	8091.3	0.0	0.0	69004.6	0.0	0.0
55	11.8	175291.7	0.0	2287.5	0.0	0.0	57846.3	0.0	0.0
56	1.7	24724.6	0.0	0.0	0.0	0.0	8159.1	0.0	0.0
57	9.4	134890.1	0.0	0.0	0.0	0.0	44513.7	0.0	0.0
58	4.0	55607.5	0.0	0.0	0.0	0.0	18350.5	0.0	0.0
59	3.8	52099.1	0.0	0.0	0.0	0.0	17192.7	0.0	0.0
60	9.5	129674.7	0.0	0.0	0.0	0.0	42792.6	0.0	0.0
61	13.1	175982.4	0.0	0.0	0.0	0.0	58074.2	0.0	0.0
62	12.9	170103.8	0.0	0.0	0.0	0.0	56134.3	0.0	0.0
63	12.8	163967.4	0.0	0.0	0.0	0.0	54109.2	0.0	0.0
64	12.6	157591.5	0.0	0.0	0.0	0.0	52005.2	0.0	0.0
65	12.4	150994.9	0.0	0.0	0.0	0.0	49828.3	0.0	0.0
66	12.3	144197.8	0.0	0.0	0.0	0.0	47585.3	0.0	0.0
67	12.1	137220.5	0.0	0.0	0.0	0.0	45282.8	0.0	0.0
68	11.5	125624.4	0.0	0.0	0.0	0.0	41456.1	0.0	0.0
69	0.4	4457.7	0.0	0.0	0.0	0.0	1471.1	0.0	0.0
70	11.7	121729.5	0.0	0.0	0.0	0.0	40170.8	0.0	0.0
71	11.5	112391.9	0.0	0.0	0.0	0.0	37089.3	0.0	0.0
72	11.3	103063.0	0.0	0.0	0.0	0.0	34010.8	0.0	0.0
73	11.1	93767.3	0.0	0.0	0.0	0.0	30943.2	0.0	0.0
74	10.9	84529.2	0.0	0.0	0.0	0.0	27894.6	0.0	0.0
75	10.7	75372.4	0.0	0.0	0.0	0.0	24872.9	0.0	0.0
76	10.4	66321.5	0.0	0.0	0.0	0.0	21886.1	0.0	0.0
77	10.2	57401.0	0.0	0.0	0.0	0.0	18942.3	0.0	0.0
78	10.0	48635.6	0.0	0.0	0.0	0.0	16049.7	0.0	0.0
79	2.0	8664.2	0.0	0.0	0.0	0.0	2859.2	0.0	0.0
80	7.8	31299.8	0.0	0.0	0.0	0.0	10328.9	0.0	0.0
81	6.9	23524.5	0.0	0.0	0.0	0.0	7763.1	0.0	0.0
82	2.6	7797.7	0.0	0.0	0.0	0.0	2573.3	0.0	0.0
83	9.3	22753.5	0.0	0.0	0.0	0.0	7508.6	0.0	0.0
84	9.0	14407.5	0.0	0.0	0.0	0.0	4754.5	0.0	0.0
85	8.1	6142.0	0.0	0.0	0.0	0.0	2026.9	0.0	0.0
86	0.7	213.7	0.0	0.0	0.0	0.0	70.5	0.0	0.0
87	1.3	157.8	0.0	0.0	0.0	0.0	52.1	0.0	0.0

Failure Surface Specified By 75 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	104.24	1210.99
2	116.86	1202.87
3	129.64	1195.03
4	142.59	1187.46
5	155.70	1180.17
6	168.96	1173.15
7	182.36	1166.42
8	195.91	1159.98
9	209.59	1153.82
10	223.40	1147.96
11	237.32	1142.39
12	251.37	1137.12
13	265.52	1132.15
14	279.78	1127.48
15	294.13	1123.12
16	308.57	1119.06
17	323.09	1115.31
18	337.69	1111.86
19	352.36	1108.73
20	367.09	1105.91
21	381.88	1103.41
22	396.72	1101.22
23	411.60	1099.35
24	426.52	1097.79

25	441.47	1096.55
26	456.44	1095.63
27	471.43	1095.02
28	486.43	1094.74
29	501.43	1094.77
30	516.42	1095.13
31	531.41	1095.80
32	546.38	1096.79
33	561.32	1098.09
34	576.23	1099.72
35	591.10	1101.66
36	605.93	1103.92
37	620.71	1106.49
38	635.43	1109.37
39	650.09	1112.57
40	664.67	1116.08
41	679.18	1119.90
42	693.60	1124.02
43	707.93	1128.45
44	722.16	1133.18
45	736.29	1138.22
46	750.31	1143.55
47	764.22	1149.18
48	778.00	1155.11
49	791.65	1161.33
50	805.16	1167.83
51	818.54	1174.62
52	831.76	1181.70
53	844.84	1189.05
54	857.75	1196.68
55	870.50	1204.58
56	883.08	1212.75
57	895.48	1221.19
58	907.70	1229.89
59	919.74	1238.84
60	931.58	1248.05
61	943.22	1257.51
62	954.66	1267.22
63	965.88	1277.16
64	976.90	1287.34
65	987.70	1297.76
66	998.27	1308.40
67	1008.61	1319.26
68	1018.72	1330.34
69	1028.59	1341.64
70	1038.23	1353.14
71	1047.61	1364.84
72	1056.74	1376.74
73	1065.62	1388.83
74	1074.24	1401.10
75	1077.95	1406.64

Circle Center At X = 492.3 ; Y = 1800.5 and Radius, 705.8

*** 1.004 ***

Failure Surface Specified By 75 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	104.24	1210.99
2	116.88	1202.91
3	129.69	1195.10
4	142.65	1187.56
5	155.78	1180.30
6	169.06	1173.32
7	182.48	1166.62
8	196.04	1160.21
9	209.73	1154.09
10	223.55	1148.26
11	237.50	1142.72
12	251.55	1137.48
13	265.71	1132.54
14	279.98	1127.91

15	294.34	1123.57
16	308.79	1119.55
17	323.32	1115.83
18	337.93	1112.41
19	352.60	1109.31
20	367.34	1106.53
21	382.14	1104.05
22	396.98	1101.89
23	411.87	1100.05
24	426.79	1098.52
25	441.74	1097.30
26	456.71	1096.41
27	471.70	1095.83
28	486.70	1095.58
29	501.70	1095.64
30	516.69	1096.01
31	531.68	1096.71
32	546.64	1097.72
33	561.58	1099.06
34	576.49	1100.70
35	591.36	1102.67
36	606.19	1104.95
37	620.96	1107.54
38	635.68	1110.45
39	650.33	1113.67
40	664.91	1117.19
41	679.41	1121.03
42	693.83	1125.17
43	708.15	1129.62
44	722.38	1134.37
45	736.50	1139.42
46	750.52	1144.78
47	764.41	1150.42
48	778.19	1156.36
49	791.83	1162.59
50	805.34	1169.11
51	818.71	1175.92
52	831.93	1183.00
53	845.00	1190.37
54	857.90	1198.01
55	870.65	1205.92
56	883.22	1214.11
57	895.61	1222.55
58	907.83	1231.26
59	919.85	1240.23
60	931.69	1249.45
61	943.32	1258.91
62	954.75	1268.62
63	965.98	1278.58
64	976.98	1288.77
65	987.77	1299.19
66	998.34	1309.83
67	1008.68	1320.70
68	1018.79	1331.78
69	1028.65	1343.08
70	1038.28	1354.59
71	1047.66	1366.29
72	1056.79	1378.19
73	1065.66	1390.29
74	1074.28	1402.56
75	1077.04	1406.67

Circle Center At X = 491.4 ; Y = 1802.4 and Radius, 706.9

***   1.004   ***

Failure Surface Specified By 74 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	102.12	1211.01
2	114.97	1203.27
3	127.97	1195.79
4	141.12	1188.58

5	154.42	1181.64
6	167.86	1174.98
7	181.44	1168.59
8	195.14	1162.49
9	208.96	1156.67
10	222.90	1151.13
11	236.96	1145.88
12	251.11	1140.93
13	265.37	1136.26
14	279.72	1131.89
15	294.15	1127.82
16	308.67	1124.04
17	323.26	1120.57
18	337.92	1117.39
19	352.65	1114.52
20	367.42	1111.95
21	382.25	1109.68
22	397.12	1107.72
23	412.03	1106.07
24	426.97	1104.72
25	441.94	1103.68
26	456.92	1102.95
27	471.91	1102.53
28	486.91	1102.42
29	501.91	1102.61
30	516.90	1103.12
31	531.88	1103.93
32	546.84	1105.05
33	561.77	1106.47
34	576.67	1108.21
35	591.53	1110.25
36	606.34	1112.60
37	621.11	1115.25
38	635.82	1118.20
39	650.46	1121.45
40	665.03	1125.01
41	679.53	1128.87
42	693.94	1133.02
43	708.27	1137.47
44	722.50	1142.21
45	736.63	1147.24
46	750.65	1152.57
47	764.56	1158.18
48	778.35	1164.07
49	792.02	1170.25
50	805.56	1176.71
51	818.96	1183.44
52	832.22	1190.45
53	845.34	1197.73
54	858.30	1205.28
55	871.10	1213.10
56	883.74	1221.17
57	896.22	1229.51
58	908.51	1238.10
59	920.63	1246.94
60	932.56	1256.03
61	944.31	1265.36
62	955.86	1274.93
63	967.21	1284.74
64	978.35	1294.78
65	989.29	1305.04
66	1000.01	1315.53
67	1010.52	1326.24
68	1020.80	1337.16
69	1030.86	1348.29
70	1040.68	1359.62
71	1050.27	1371.16
72	1059.62	1382.88
73	1068.73	1394.80
74	1077.41	1406.66

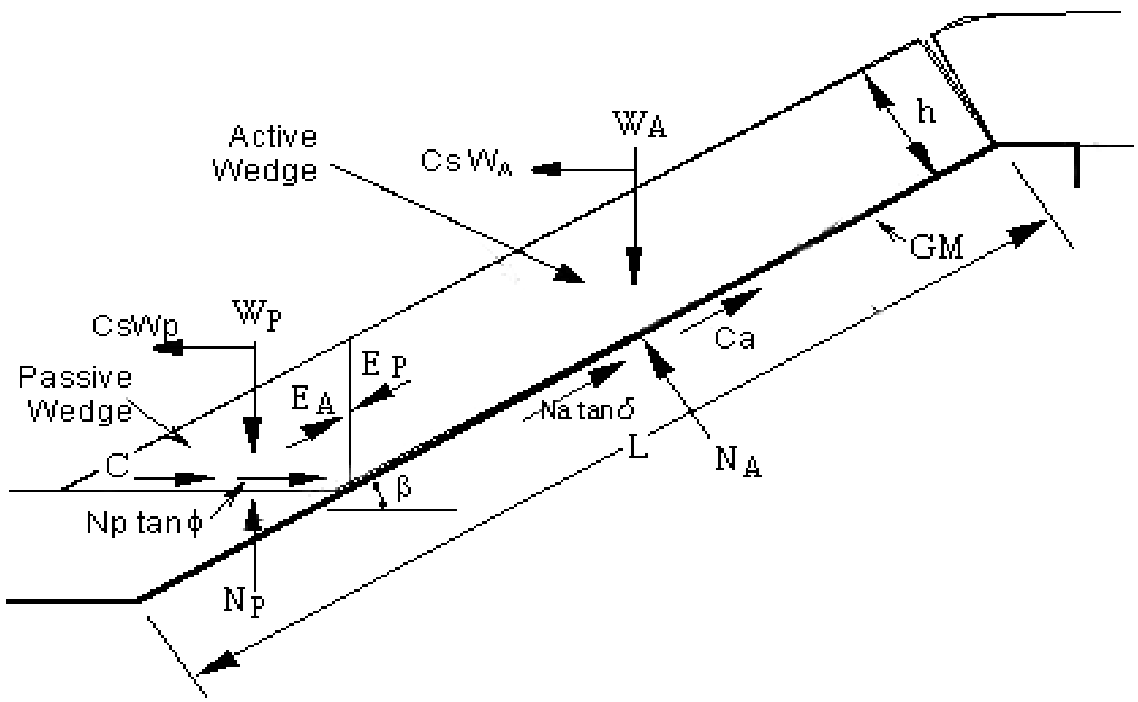
Attachment C-5

Veneer Stability Analyses Results

LINER (VENEER) STABILITY CALCULATION (STATIC)

Project: Northeast C&D Landfill	Calc'd by:	BJD	Date:	5/15/2023
Location: Spencer Oklohoma	Chk'd by:	JL	Date:	6/8/2023
Prepared by: SCS ENGINEERS				
Date: August 18, 2023				

Consideration: To determine the factor of safety (FS) of a geosynthetic lined slope using a static analysis as described by Koerner and Soong (1998) referenced below.



Ref.: R.M. Koerner, and T-Y.Soong, 1998. "Analysis and Design of Veneer Cover Soils". Proceeding of 6th International Conference on Geosynthetics, Vol. 1, pp. 1-23, Atlanta, Georgia, USA.

Parameters:

L	=	length of slope meausured along the geomembrane
β	=	soil slope angle beneath the geomembrane
FS	=	factor of safety against instability
W_A	=	total weight of the active wedge
W_P	=	total weight of the passive wedge
N_A	=	effective force normal to the failure plane of the active wedge
h	=	thickness of the cover soil
γ	=	unit weight of the cover soil
ϕ	=	cover soil friction angle
δ	=	interface friction angle between cover soil and geomembrane
C_a	=	adhesive force between cover soil of the active wedge and the geomembrane
c_a	=	adhesion between cover soil of the active wedge and the geomembrane
C	=	cohesive force along the failure plane of the passive wedge
c	=	cohesion of the cover soil

LINER (VENEER) STABILITY CALCULATION (STATIC)

Calculate Factor of Safety (FS):

$$FS = \frac{-b + (b^2 - 4ac)^{1/2}}{2a}$$

, where

$$a = (C_S W_A + N_A \sin\beta)(\cos\beta) + C_S W_P(\cos\beta)$$

$$b = -[(C_S W_A + N_A \sin\beta)\sin\beta(\tan\phi) + (N_A \tan\delta + C_a)(\cos^2\beta) + (C + W_P \tan\phi)\cos\beta]$$

$$c = (N_A \tan\delta + C_a)\cos\beta\sin\beta\tan\phi$$

, where

$$W_A = \gamma h^2 [(L/h) - (1/\sin\beta) - (\tan\beta/2)]$$

$$N_A = W_A(\cos\beta)$$

$$W_P = \gamma h^2 / \sin 2\beta$$

$$C_a = c_a(L-(h/\sin\beta))$$

$$C = (ch)/(\sin\beta)$$

γ =	18.84	kN/m^3		
h =	1219.00	mm	=	1.22 m
L =	34.00	m		
β =	18.44	°	=	0.32 rad
C_s =	0.00	g		
ϕ =	20.00	°	=	0.35 rad
δ =	20.00	°	=	0.35 rad
c =	4.79	kN/m^2		
c_a =	4.79	kN/m^2		

W_A =	687.67	kN
N_A =	652.36	kN
W_P =	46.65	kN
C_a =	144.40	kN
C =	18.46	kN
a =	195.75	
b =	-401.01	
c =	41.70	

FS = 1.94

Notes:

1. Due to absence of geosynthetic layers, the failure surface is assumed to be along the bottom of liner and recompacted subgrade interface; therefore, $\phi=\delta$ and C=Ca.
2. To be conservative, C and Ca are assumed to be 100 lb/cy (4.79 kN/m^2)

Summary:

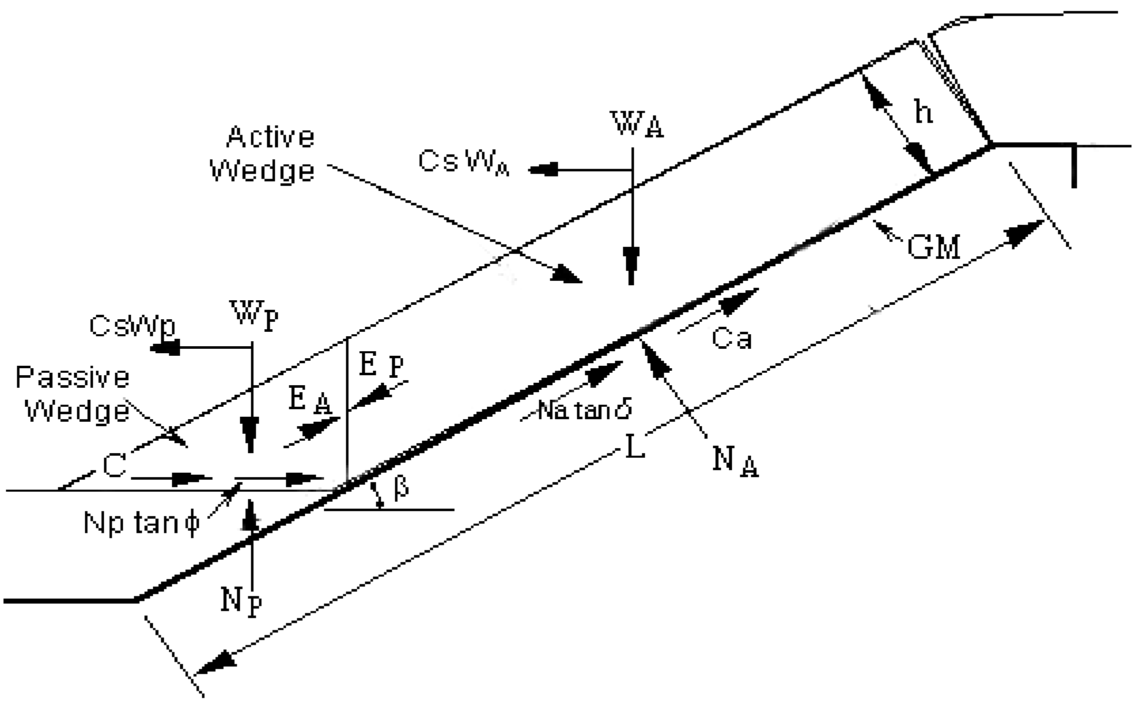
Based on the calculation indicated above, the factor of safety has been calculated as 1.94, indicating that the liner system is stable under the slope conditions analyzed.

FINAL COVER (VENEER) STABILITY CALCULATION (STATIC)

Project: Northeast C&D Landfill
Location: Spencer Oklohoma
Prepared by: SCS ENGINEERS
Date: August 18, 2023

Calc'd by: BJD Date: 5/15/2023
Chk'd by: JL Date: 6/8/2023

Consideration: To determine the factor of safety (FS) of a geosynthetic lined slope using a static analysis as described by Koerner and Soong (1998) referenced below.



Ref.: R.M. Koerner, and T-Y.Soong, 1998. "Analysis and Design of Veneer Cover Soils". Proceeding of 6th International Conference on Geosynthetics, Vol. 1, pp. 1-23, Atlanta, Georgia, USA.

Parameters:

L	=	length of slope meausured along the geomembrane
β	=	soil slope angle beneath the geomembrane
FS	=	factor of safety against instability
W_A	=	total weight of the active wedge
W_P	=	total weight of the passive wedge
N_A	=	effective force normal to the failure plane of the active wedge
h	=	thickness of the cover soil
γ	=	unit weight of the cover soil
ϕ	=	cover soil friction angle
δ	=	interface friction angle between cover soil and geomembrane
C_a	=	adhesive force between cover soil of the active wedge and the geomembrane
c_a	=	adhesion between cover soil of the active wedge and the geomembrane
C	=	cohesive force along the failure plane of the passive wedge
c	=	cohesion of the cover soil

FINAL COVER (VENEER) STABILITY CALCULATION (STATIC)

Calculate Factor of Safety (FS):

$$FS = \frac{-b + (b^2 - 4ac)^{1/2}}{2a}$$, where

$$a = (C_S W_A + N_A \sin\beta)(\cos\beta) + C_S W_P(\cos\beta)$$

$$b = -[(C_S W_A + N_A \sin\beta)\sin\beta(\tan\phi) + (N_A \tan\delta + C_a)(\cos^2\beta) + (C + W_P \tan\phi)\cos\beta]$$

$$c = (N_A \tan\delta + C_a)\cos\beta\sin\beta\tan\phi$$, where

$$W_A = \gamma h^2 [(L/h) - (1/\sin\beta) - (\tan\beta/2)]$$

$$N_A = W_A(\cos\beta)$$

$$W_P = \gamma h^2 / \sin 2\beta$$

$$C_a = c_a(L-(h/\sin\beta))$$

$$C = (ch)/(\sin\beta)$$

γ =	18.84	kN/m^3			
h =	914.40	mm	=	0.91	m
L =	279.00	m			
β =	14.04	°	=	0.25	rad
C_s =	0.00	g			
ϕ =	20.00	°	=	0.35	rad
δ =	20.00	°	=	0.35	rad
c =	4.79	kN/m^2			
c_a =	4.79	kN/m^2			

W_A =	4739.51	kN
N_A =	4597.93	kN
W_P =	33.47	kN
C_a =	1318.36	kN
C =	18.05	kN
a =	1082.13	
b =	-2943.61	
c =	256.29	

FS = 2.63

Notes:

1. Due to absence of geosynthetic layers, the failure surface is assumed to be along the final cover/intermediate cover interface; therefore, $\phi=\delta$ and C=Ca.
2. To be conservative, C and Ca are assumed to be 100 lb/cy (4.79 kN/m^2)

Summary:

Based on the calculation indicated above, the factor of safety has been calculated as 2.63, indicating that the final cover system is stable under the slope conditions analyzed.

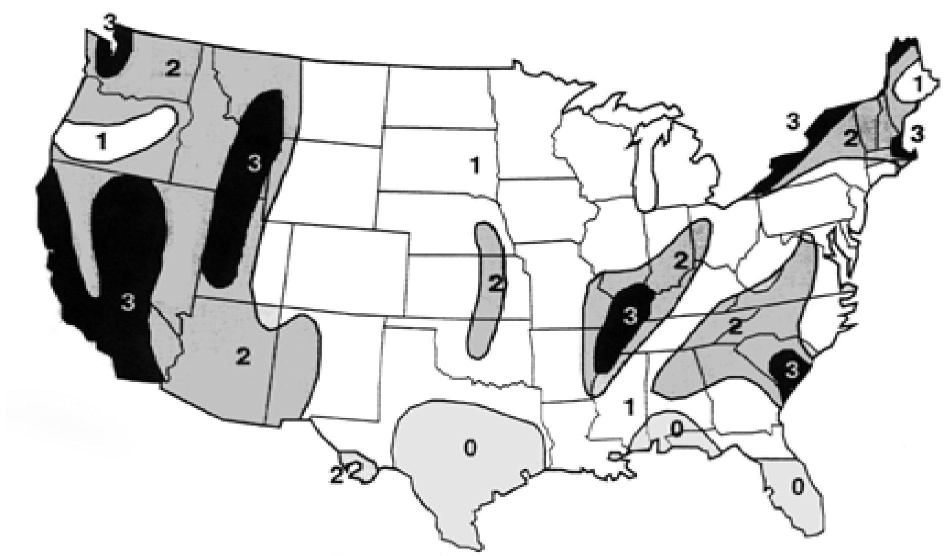
COVER STABILITY CALCULATION (SEISMIC)

Project: Northeast C&D Landfill
Location: Spencer Oklohoma
Prepared by: SCS ENGINEERS
Date: August 18, 2023

Calc'd by: BJD Date: 5/15/2023
Chk'd by: JL Date: 6/8/2023

Consideration: To determine the factor of safety (FS) of a geosynthetic lined slope using a pseudo-static analysis as described by Koerner and Soong (1998) referenced below.

Seismic Coefficient: Subtitle "D" of the U.S. EPA regulations requires a seismic analysis if the site has experienced a 0.1g horizontal acceleration, or more, in the past 250 years. The map below shows the seismic coefficients for various zones in the USA. Based on the site location, the seismic coefficient of 0.07g was used in the analysis.



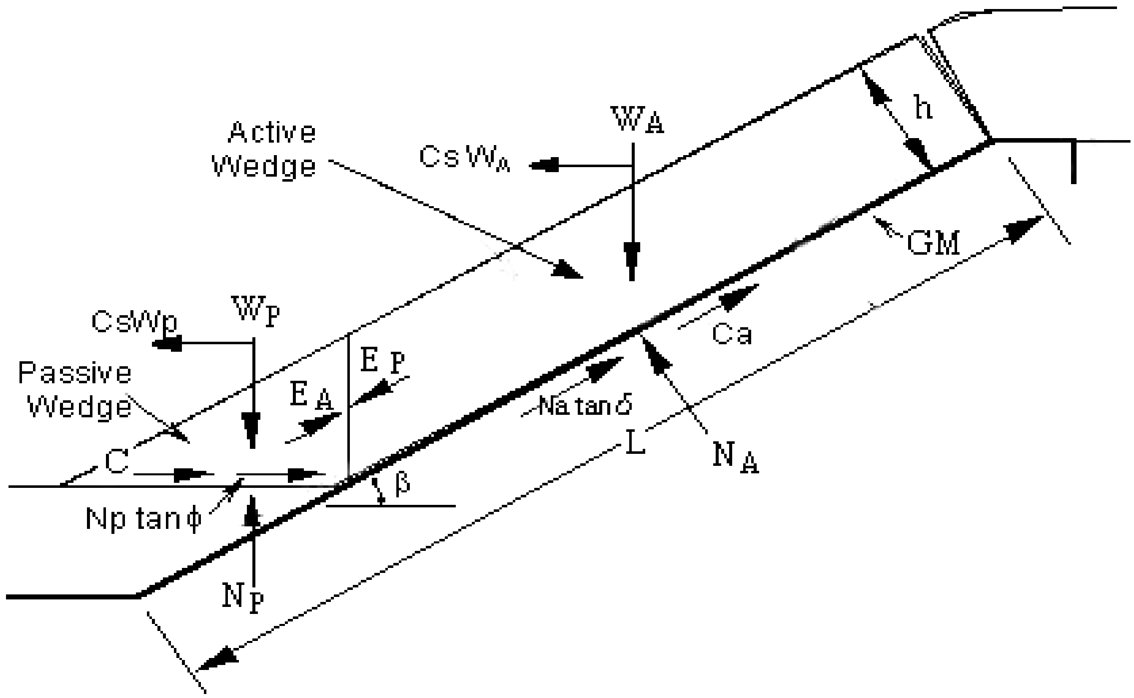
Legend:

Zone 0: No damage
Zone 1: Minor damage; corresponds to intensities V and VI on the modified Mercalli intensity scale
Zone 2: Moderage damage; corresponds to intensity VII on the modified Mercalli intensity scale
Zone 3: Major damage; corresponds to intensity VIII or higher on the modified Mercalli intensity scale

Seismic coefficients corresponding to each zone:

Zone	Remark	Modified Mercalli Scale	Average Seismic Coefficient (C_s)
0	No damage	-	0
1	Minor damage	V and VI	0.03 to 0.07
2	Moderate damage	VII	0.13
3	Major damage	VIII or higher	0.27

COVER STABILITY CALCULATION (SEISMIC)



Ref.: R.M. Koerner, and T-Y.Soong, 1998. "Analysis and Design of Veneer Cover Soils". Proceeding of 6th International Conference on Geosynthetics, Vol. 1, pp. 1-23, Atlanta, Georgia, USA.

Parameters:

L	=	length of slope meausured along the geomembrane
β	=	soil slope angle beneath the geomembrane
FS	=	factor of safety against instability
W_A	=	total weight of the active wedge
W_P	=	total weight of the passive wedge
N_A	=	effective force normal to the failure plane of the active wedge
h	=	thickness of the cover soil
γ	=	unit weight of the cover soil
ϕ	=	cover soil friction angle
δ	=	interface friction angle between cover soil and geomembrane
C_a	=	adhesive force between cover soil of the active wedge and the geomembrane
c_a	=	adhesion between cover soil of the active wedge and the geomembrane
C	=	cohesive force along the failure plane of the passive wedge
c	=	cohesion of the cover soil

COVER STABILITY CALCULATION (SEISMIC)

Calculate Factor of Safety (FS):

$$FS = \frac{-b + (b^2 - 4ac)^{1/2}}{2a}$$, where

$$a = (C_S W_A + N_A \sin\beta)(\cos\beta) + C_S W_P(\cos\beta)$$

$$b = -[(C_S W_A + N_A \sin\beta)\sin\beta(\tan\phi) + (N_A \tan\delta + C_a)(\cos^2\beta) + (C + W_P \tan\phi)\cos\beta]$$

$$c = (N_A \tan\delta + C_a)\cos\beta \sin\beta \tan\phi$$, where

$$W_A = \gamma h^2 [(L/h) - (1/\sin\beta) - (\tan\beta/2)]$$

$$N_A = W_A(\cos\beta)$$

$$W_P = \gamma h^2 / \sin 2\beta$$

$$C_a = c_a(L-(h/\sin\beta))$$

$$C = (ch)/(\sin\beta)$$

γ =	18.04	kN/m^3		
h =	914.40	mm	=	0.91 m
L =	279.00	m		
β =	14.04	°	=	0.25 rad
C_s =	0.27	g		
ϕ =	20.00	°	=	0.35 rad
δ =	20.00	°	=	0.35 rad
c =	4.79	kN/m^2		
c_a =	4.79	kN/m^2		

W_A =	4538.26	kN
N_A =	4402.69	kN
W_P =	32.05	kN
C_a =	1318.36	kN
C =	18.05	kN
a =	2233.30	
b =	-2980.24	
c =	250.20	
FS =	**1.24**	

Notes:

1. Due to absence of geosynthetic layers, the failure surface is assumed to be along the final cover/intermediate cover interface; therefore, $\phi=\delta$ and C=Ca.
2. To be conservative, C and Ca are assumed to be 100 lb/cy (4.79 kN/m^2)

Summary:

Based on the calculation indicated above, the factor of safety has been calculated as 1.24, indicating that the final cover system is stable under the seismic slope conditions analyzed.

Appendix D

Explosive Gas Management Plan

Appendix D
Explosive Gas Monitoring Plan

Northeast C&D Landfill

Prepared for:

N.E. Land Fill, LLC.
2601 North Midwest Blvd
Spencer, OK 73084
405-495-0800

Prepared by:

SCS ENGINEERS
1901 Central Drive, Suite 550
Bedford, TX 76021
817-571-2288

August 2023
File No. 16219107.00

TABLE OF CONTENTS AND CERTIFICATION PAGE

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Certification

This Explosive Gas Monitoring Plan has been prepared in accordance with good engineering practice, including consideration of industry standards and the requirements of the Oklahoma Department of Environmental Quality, as defined in Oklahoma Administrative Code (OAC) 252:515-15.

Prepared by:

Sandeep Saraf P.E.
Senior Project Manager
SCS Engineers

1.0 INTRODUCTION

1.1 SITE LOCATION

The proposed C&D landfill expansion (landfill) is located at 2601 N. Midwest Boulevard in Spencer, Oklahoma County (see application narrative, Figure 1).

1.2 FACILITY BACKGROUND

The existing C&D landfill permit boundary contains 90.1 acres, of which 67.7 acres has been or will be developed for C&D waste disposal under Permit No. 3555050. The proposed landfill expansion will have a permit boundary of 73.2 acres, of which 53.5 acres will be developed for disposal of C&D waste. The combined total property boundary area (existing and proposed) is 163.3 acres, out of which 121.2 acres will be available for C&D waste disposal upon obtaining approval of the permit application.

1.3 SITE GEOLOGY

Information regarding the site geology and the site hydrogeology can be found in the *Hydrogeologic and Geotechnical Investigation,* prepared by SCS Engineers, and included in Appendix B.

1.4 PURPOSE

This plan is intended to provide guidance for explosive gas monitoring at the proposed landfill to avoid adverse gas-related environmental impact and potential hazards to public health and safety. The plan has been prepared in general accordance with the Oklahoma Administrative Code (OAC) 252:515-15-3(a).

2.0 EXPLOSIVE GAS OVERVIEW

The decomposition of encapsulated C&D waste within a landfill could produce landfill gas (LFG), typically consisting of approximately methane (CH_4) and carbon dioxide (CO_2). Trace amounts of non-methane organic compounds (NMOCs), oxygen, hydrogen sulfide, and reactive organic gases could also be present.

As LFG is generated, pressure within the landfill builds until equilibrium is reached between the quantity of LFG being generated and the quantity leaving the landfill. The increased pressure within the landfill provides the main source of energy for LFG migration along pressure gradients through preferential pathways.

LFG can present several problems or hazards, including the potential for explosion or fire, odor, toxic trace gases, vegetation stress, and asphyxiation. Of these, the main hazard associated with LFG is the potential for fire or explosion. Explosive gas monitoring is performed to protect lives and property from the hazards associated with LFG migration.

3.0 REGULATORY FRAMEWORK

This plan details how the landfill plans to maintain compliance with the methane concentration limit set in OAC 252:515-15. In accordance with OAC 252:515-15-2, the concentration of methane gas generated by the facility shall not exceed twenty-five percent (25%) of the lower explosive limit (LEL) for methane in all structures within the permit boundary (excluding gas control or recovery system components) or exceed the LEL for methane at the permit boundary. The LEL is defined as the lowest percent by volume of a mixture of explosive gases in air that will propagate a flame at 25°C and atmospheric pressure. The LEL for methane is 5% by volume in air. The allowable percentages of LEL and the equivalent explosive gas level concentrations are listed in the following table:

Table 1. Maximum Allowable Explosive Gas Concentrations

Location	Maximum Allowable % of LEL	Equivalent Methane Concentration in Air (% vol)
Facility Structures	25	1.25
Property Boundary	100	5.0

The only structures located onsite include the existing scale house and landfill office, as shown on Drawing 2 of the permit drawings, which are located within the existing C&D landfill permit boundary.

Routine sampling of gas monitoring probes will be conducted on a quarterly basis in accordance with OAC 252:515-15-3(c). The monitoring frequency will remain the same but may increase if deemed necessary by Owner/Operator or DEQ.

4.0 EXPLOSIVE GAS MONITORING

An explosive gas monitoring program has been implemented at the existing C&D landfill, and will be implemented at the proposed landfill expansion in order to comply with DEQ regulations. The routine monitoring program includes monitoring of the gas monitoring probes and the structures within the two permit boundaries. The following sections outline the explosive gas monitoring program, including the gas monitoring probe network, monitoring equipment, monitoring procedures, gas monitoring probe inspection and maintenance, and recordkeeping.

4.1 EXPLOSIVE GAS MONITORING PROBE NETWORK

The gas monitoring probe network at the existing C&D landfill consists of seventeen (17) gas monitoring probes (GP-1 through GP-4, GP-6A through GP-8A, and GP-9 through GP-18), as described in the Explosive Gas Monitoring Plan for Permit No. 3555050.

Following approval of this application, the gas monitoring probe network will be comprised of 24 gas monitoring probes installed sequentially as the proposed landfill is developed. The gas monitoring probe network will be as follows, as shown on Figure D.1 in this plan:

- Fourteen (14) existing gas monitoring probes (GP-1 through GP-4, GP-6A through GP-8A, and GP-12 through GP-18) will remain in place, three existing gas probes will be decommissioned (GP-9, GP-10, and GP-11), and

- Ten (10) new gas monitoring probes (GP-9A through GP-11A, and GP-19 through GP-25) will be installed to a depth corresponding to the deepest placement of waste (1170 msl). As such, these probes will range in depth from 12.6 to 39.8 feet below ground surface (bgs).

The new gas monitoring probes will be located within the permit boundary of the proposed landfill. The details (location and depth) and timeframe for installing the gas monitoring probes is provided in Table 2. Gas monitoring probes will be installed when cells are constructed within 1,000 feet of the proposed probe location. Gas monitoring probes will be installed and decommissioned in accordance with the Oklahoma Water Resources Board (OWRB) requirements detailed in OAC 785:35. Within 90 days of installation, as-built drawings of new probes will be submitted to the DEQ to demonstrate the probes were installed in accordance with OAC 252:515-15-4. New gas monitoring probes will be constructed in accordance with Figure D.2 and the information provided in Table 2.

4.2 MONITORING EQUIPMENT

A portable methane detection instrument (Landtec GEM-5000 or similar instrument) will be used to measure the concentration of methane in the gas monitoring probes and structures within the permit boundary. The instrument will be capable of sampling in an oxygen-deficient atmosphere. This type of instrument employs a meter calibrated to methane and is capable of measuring oxygen, methane, carbon dioxide, and balance gas. The instrument will be operated and calibrated according to the manufacturer's instructions.

4.3 MONITORING PROCEDURES

Sampling of the gas monitoring probes and structures within the permit boundary will be conducted in accordance with DEQ regulations. A properly calibrated portable methane detection instrument will be used during quarterly monitoring events to sample each gas monitoring probe and within existing structures within the permit boundary. The equipment will be connected to the sampling port and a sample will be continuously collected until the composition of the gas sample stabilizes. Once the gas composition stabilizes, the reading will be recorded. The methane detection instrument will give a direct reading of methane concentration by volume. Monitoring will be conducted under the oversight of the Landfill Manager by individuals trained in the use of the monitoring equipment and procedures or by a qualified consultant. Methane concentrations will be measured and recorded for each gas monitoring probe and structure within the permit boundary. Records of quarterly monitoring events will be maintained in the Site Operating Record. If monitoring results indicate that the regulatory limit of methane concentration has been exceeded, immediate action will be taken, as described in Section 5.1 of this attachment.

4.4 GAS MONITORING PROBE INSPECTION AND MAINTENANCE

During each explosive gas monitoring event, the integrity of the gas monitoring probes will be evaluated. Each gas monitoring probe will be inspected for the following:

- Probe number clearly labeled and permanently affixed to outer casing;
- Protective casing intact, straight, and not excessively corroded;
- Concrete pad intact;
- Functional padlock; and
- Inner casing is intact and properly capped.

If damage or excessive wear to a gas monitoring probe is observed during routine inspection and maintenance, an attempt will be made to mitigate or repair that probe in a timely fashion. If necessary, the damaged gas monitoring probe will be decommissioned and replaced with a new monitoring probe. Gas monitoring probes will be decommissioned in accordance with OWRB requirements detailed in OAC 785:35.

4.5 RECORDKEEPING

Results of quarterly monitoring events will be maintained in the Site Operating Record. If methane levels exceed the regulatory limits, described in Section 3, Owner/Operator will implement the steps outlined in Section 5.

5.0 CONTINGENCY PLAN

If methane gas levels exceed regulatory limits, Owner/Operator will implement a contingency plan to control off-site migration or to prevent continued migration into on-site structures. This will be conducted in accordance with DEQ rules and regulations.

5.1 IMMEDIATE ACTIONS

Upon initial detection of methane gas concentrations exceeding the regulatory limit in gas monitoring probes or on-site structures, the DEQ will be notified immediately and landfill staff will immediately take the necessary steps to ensure protection of public health and safety. This includes potentially evacuating any structure within 1,000 feet of the exceedance while further assessment of the potential for off-site migration is underway.

Upon completion of the required activities and no later than seven days from initial detection, a report describing the steps taken to protect public health and safety will be submitted to the DEQ.

5.2 CORRECTIVE ACTION

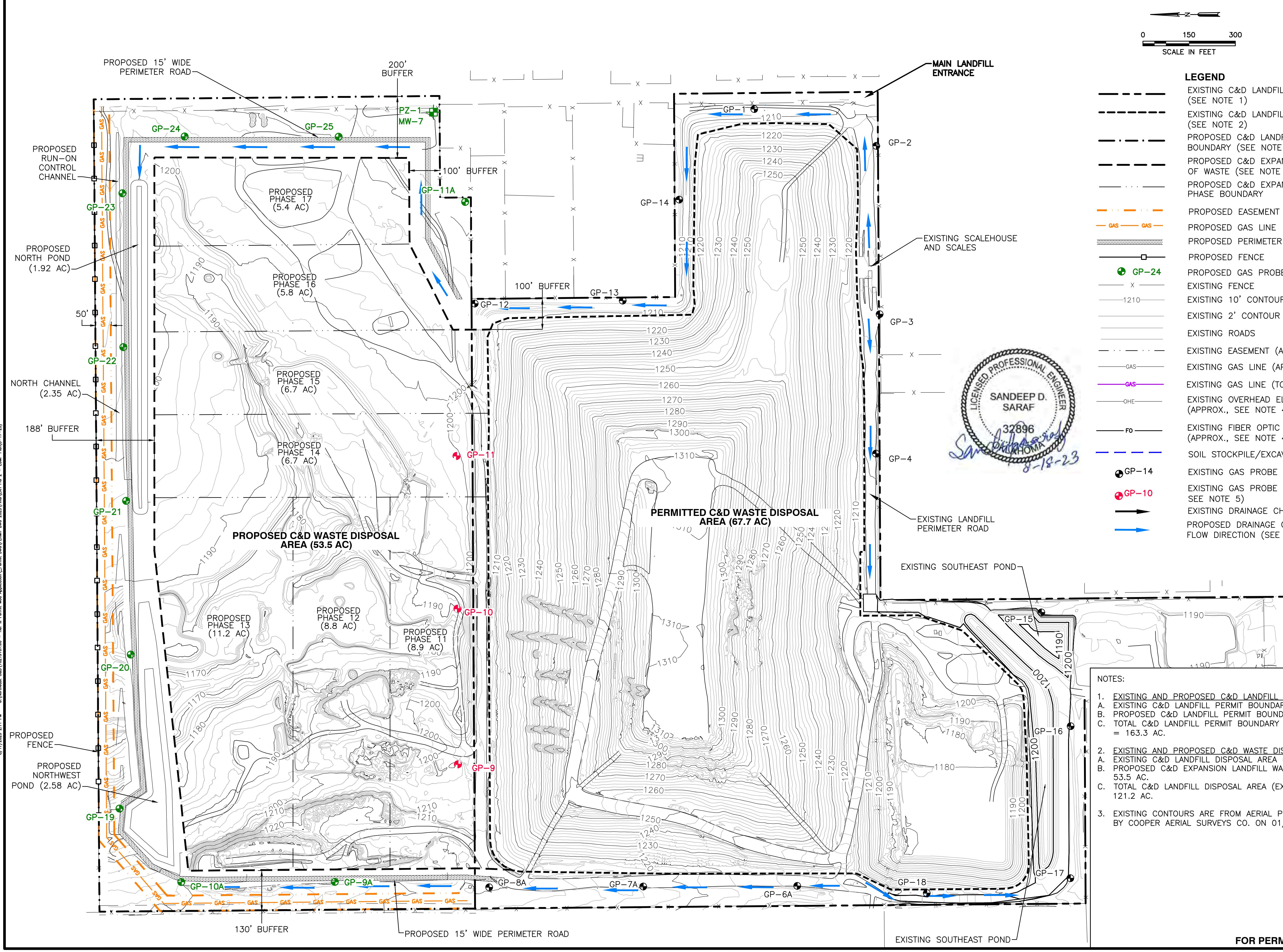
After the immediate safety issues have been addressed as described above, landfill staff will begin focusing on corrective action to address a long-term remedy to control methane migration. This action will be taken in accordance with DEQ consultation, rules, and regulations. Within 30 days of detection, a remediation plan describing the nature and extent of the problem and the proposed remedy will be submitted to DEQ.

The approved remediation plan shall be implemented within 60 days of the initial detection. The plan may be modified to meet current conditions, with the written approval of the DEQ. DEQ will also be notified in writing when the remediation plan has been implemented, and a copy is placed in the Site Operating Record. An alternate schedule for corrective actions may be acceptable if approved by the DEQ.

Table 2. Proposed Gas Monitoring Probe Network Summary

Monitoring Probe	Northing	Easting	Surface Elevation (ft MSL)	Total Depth (ft bgs)	Bottom of Probe Elevation (ft MSL)	Timeframe for Installation
GP-9A	183,164.07	2,147,930.26	1209.8	39.8	1170.0	Phase 11
GP-10A	183,662.55	2,147,929.95	1201.9	31.9	1170.0	Phase 11
GP-11A	182,741.28	2,150,137.61	1211.8	41.8	1170.0	Phase 14
GP-19	183,863.11	2,148,168.43	1184.6	14.6	1170.0	Phase 11
GP-20	183,826.97	2,148,668.41	1185.0	15.0	1170.0	Phase 11
GP-21	183,841.84	2,149,167.46	1197.1	27.1	1170.0	Phase 11
GP-22	183,850.79	2,149,666.51	1202.6	32.6	1170.0	Phase 11
GP-23	183,651.71	2,150,350.18	1204.4	34.4	1170.0	Phase 14
GP-24	183,853.90	2,150,165.56	1205.4	35.4	1170.0	Phase 14
GP-25	183,151.74	2,150,349.39	1210.5	40.5	1170.0	Phase 14

Figures



LEGEND

- EXISTING C&D LANDFILL PERMIT BOUNDARY (SEE NOTE 1)
- EXISTING C&D LANDFILL LIMITS OF WASTE (SEE NOTE 2)
- PROPOSED C&D LANDFILL EXPANSION PERMIT BOUNDARY (SEE NOTE 1)
- PROPOSED C&D EXPANSION AREA LIMITS OF WASTE (SEE NOTE 2)
- PROPOSED C&D EXPANSION DISPOSAL AREA PHASE BOUNDARY
- PROPOSED EASEMENT
- PROPOSED GAS LINE
- PROPOSED PERIMETER ROAD
- PROPOSED FENCE
- GP-24 PROPOSED GAS PROBE
- EXISTING FENCE
- 1210 EXISTING 10' CONTOUR (SEE NOTE 3)
- EXISTING 2' CONTOUR (SEE NOTE 3)
- EXISTING ROADS
- EXISTING EASEMENT (APPROX., SEE NOTE 4)
- GAS EXISTING GAS LINE (APPROX., SEE NOTE 4)
- GAS EXISTING GAS LINE (TO BE REMOVED)
- OHE EXISTING OVERHEAD ELECTRIC LINE (APPROX., SEE NOTE 4)
- FO EXISTING FIBER OPTIC LINE (APPROX., SEE NOTE 4)
- SOIL STOCKPILE/EXCAVATION BOUNDARY
- GP-14 EXISTING GAS PROBE (TO REMAIN)
- GP-10 EXISTING GAS PROBE (TO BE ABANDONED, SEE NOTE 5)
- EXISTING DRAINAGE CHANNEL AND FLOW DIRECTION
- PROPOSED DRAINAGE CHANNEL AND FLOW DIRECTION (SEE NOTE 6)

NOTES:

1. EXISTING AND PROPOSED C&D LANDFILL PERMIT BOUNDARY AREA:
   A. EXISTING C&D LANDFILL PERMIT BOUNDARY AREA = 90.1 AC.
   B. PROPOSED C&D LANDFILL PERMIT BOUNDARY AREA = 73.2 AC.
   C. TOTAL C&D LANDFILL PERMIT BOUNDARY (EXISTING AND EXPANSION) = 163.3 AC.

2. EXISTING AND PROPOSED C&D WASTE DISPOSAL BOUNDARY AREA:
   A. EXISTING C&D LANDFILL DISPOSAL AREA = 67.7 AC.
   B. PROPOSED C&D EXPANSION LANDFILL WASTE DISPOSAL AREA = 53.5 AC.
   C. TOTAL C&D LANDFILL DISPOSAL AREA (EXISTING AND EXPANSION) = 121.2 AC.

3. EXISTING CONTOURS ARE FROM AERIAL PHOTOGRAPHY PERFORMED BY COOPER AERIAL SURVEYS CO. ON 01/23/2023.

FOR PERMITTING PURPOSES ONLY

REV	DATE	DESCRIPTION	BY

DRAWING TITLE: GAS MONITORING PROBE PLAN

PROJECT TITLE: NORTHEAST LANDFILL TIER III PERMIT MODIFICATION APPLICATION

CLIENT: N.E. LAND FILL, LLC
NORTHEAST LANDFILL
2601 NORTH MIDWEST BLVD.
SPENCER, OK 73084

SCS ENGINEERS
STEARNS, CONRAD AND SCHMIDT
CONSULTING ENGINEERS, INC.
1901 CENTRAL DRIVE, SUITE 550, BEDFORD, TX 76021
PH (817) 571-2288 FAX NO. (817) 571-2188

PROJ. NO. 16219107.00 | DSN. BY: SS | DWN. BY: DS | CHK. BY: SDS | Q/A RVW BY: SS | APP. BY: RRK

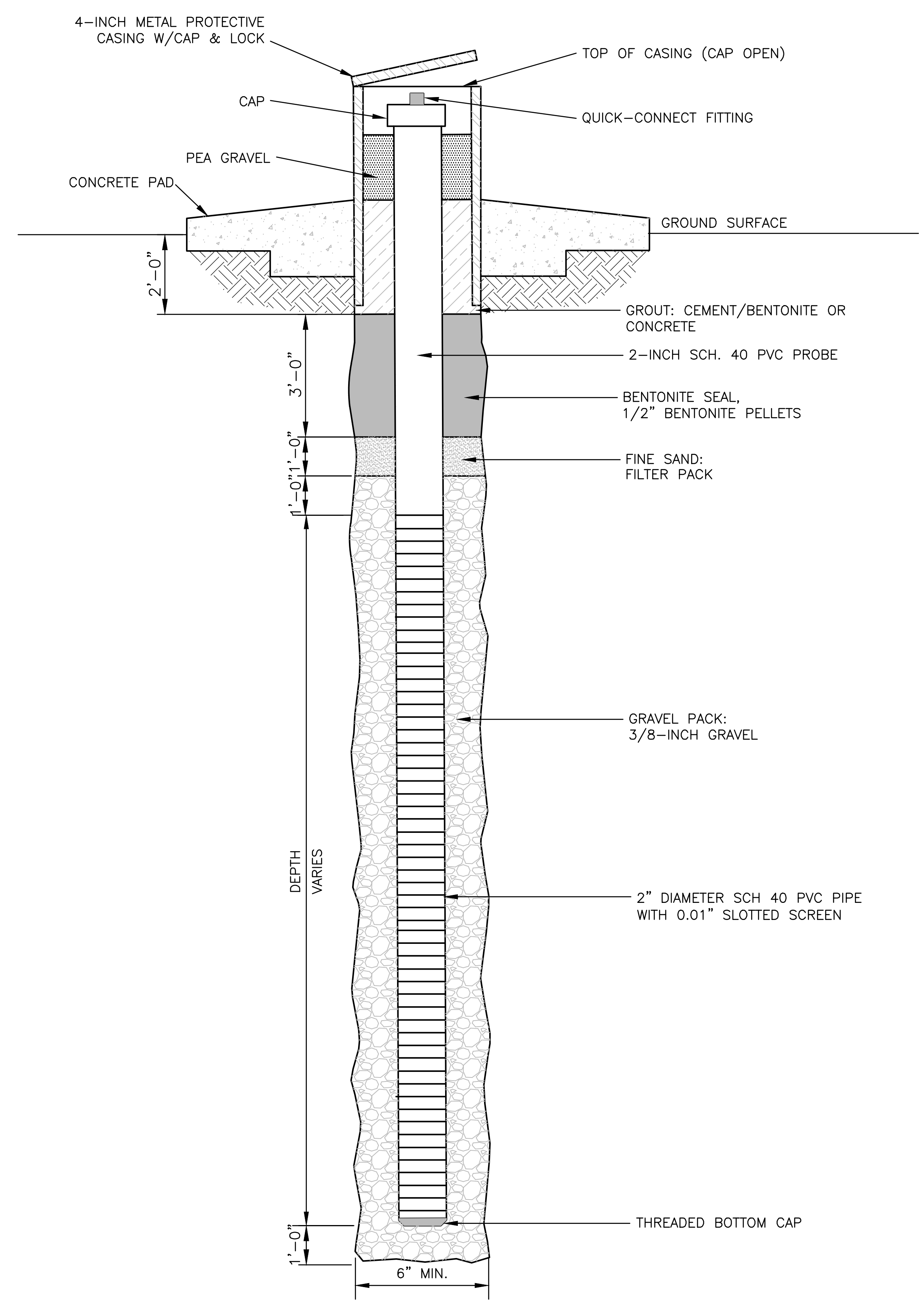
CADD FILE: EXH FIG 2 - EGMP PLAN(8-17-23)

DATE: 08/2023

SCALE: AS SHOWN

DRAWING NO. D.1

8/17/2023 3:11 PM G:\Northeast CAD\16219107.00 - Tier III Permit Mod Application_Permit DWG\PERMIT DWG 2023\Final\EXH FIG 2 - EGMP Plan(8-17-23)



NOTE: ALL SIZES AND DIMENSIONS ARE APPROXIMATE.

TYPICAL GAS MONITORING PROBE (GMP)

NTS

A
D.2

LICENSED PROFESSIONAL ENGINEER
SANDEEP D. SARAF
32896
OKLAHOMA
8-18-23

FOR PERMITTING PURPOSES ONLY

REV	DATE	DESCRIPTION	BY

DRAWING TITLE
GAS MONITORING PROBE DETAIL

PROJECT TITLE
NORTHEAST LANDFILL
TIER III PERMIT MODIFICATION
APPLICATION

CLIENT
N.E. LAND FILL, LLC
NORTHEAST LANDFILL
2601 NORTH MIDWEST BLVD.
SPENCER, OK 73084

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PROJ. NO. 16219107.00 | DSN. BY: SS | DWN. BY: DS | CHK. BY: SDS | Q/A RVW BY: SS | APP. BY: RRK

CADD FILE: GAS PROBE DETAILS(5-4-23)

DATE: 08/2023

SCALE: AS SHOWN

DRAWING NO.
D.2

8/17/2023 2:17 PM G:\Northeast CAD\16219107.00 - Tier III Permit Mod Application_Permit DWG\PERMIT DWG 2023\Final\Gas Probe Details(5-4-23)

Appendix E

Surface Water Management System Design Plan

Appendix E
Surface Water Management System Design Plan

Northeast C&D Landfill

Prepared for:

N.E. Land Fill, LLC
2601 North Midwest Blvd
Spencer, OK 73084
405-495-0800

Prepared by:

SCS ENGINEERS
1901 Central Drive, Suite 550
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817-571-2288

August 2023
File No. 16219107.00

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Certification

This Surface Water Management System Design Plan has been prepared in accordance with good engineering practice, including consideration of industry standards and the requirements of the Oklahoma Department of Environmental Quality, as defined in Oklahoma Administrative Code (OAC) 252:515-17.

Prepared by:

Ryan Kuntz, P.E.
Vice President / Satellite Unit Director
SCS Engineers

1.0 INTRODUCTION

The proposed construction and demolition (C&D) waste landfill is located at 2601 N. Midwest Boulevard in Spencer, Oklahoma County (see application narrative, Figure 1).

This Surface Water System Design Plan for the landfill has been prepared for existing and proposed C&D landfill (landfill) consistent with Oklahoma Department of Environmental Quality (DEQ) 252:515-17 to convey post-development run-on and runoff from a 25-year, 24-hour storm event. As such, this plan describes the methodology for modeling the peak run-off from the landfill, and hydraulic calculations used for sizing the proposed surface water drainage and erosion control features. Permit-level plans and details for the proposed surface water and erosion control features are presented in permit drawings of this application.

2.0 METHODOLOGY

2.1 HYDROLOGIC ANALYSIS METHODS

This subsection describes the hydrologic methodology used for the surface water system drainage design. Stormwater discharges are estimated for pre-development conditions and post-development conditions. Pre-development conditions are depicted on Drawing E1, while post-development conditions, which are representative of the landfill at final grade, are shown on Drawing E2. To evaluate impacts to existing drainage patterns, pre- and post-development peak flow rates were compared at offsite discharge locations. Based on review of pre-development conditions, surface water is discharged from the property at two (2) discharge points. Each discharge point from the property is referred herein as point-of-demonstration [POD] for comparison of the pre- and post-development discharge rates. The comparison of pre- and post-development discharge rates at these PODs is summarized in Table E-3 of this submittal.

In accordance with OAC 252:515-17, the pre- and post-development hydrologic conditions were modeled for a 25-year, 24-hour storm event using the U.S. Army Corp of Engineers', Hydrologic Engineering Center's - Hydrologic Modeling System, Version 4.0 computer software (referred to as HEC-HMS). HEC-HMS was used to develop hydrographs for both the pre-development and post-development conditions for computation of the peak flow rates, as described in the following subsections.

Peak flow rates were compared between the pre- and post-development conditions to evaluate potential impacts to existing drainage patterns, as described in Section 5. Additionally, the peak flow rates modeled using HEC-HMS were used in the design of the major surface water drainage features proposed for the landfill property (i.e., perimeter drainage channels, detention basins, and outlet structures), as described in Section 4.

2.1.1 Description of HEC-HMS Computer Program

HEC-HMS is a Windows-based program incorporating analytical methods to simulate the surface runoff response of a watershed subjected to a design storm event. The HEC-HMS model represents a watershed as a network of hydrologic and hydraulic components. The modeling process results in the computation of hydrographs for surface water runoff, channel-flow, and detention basin storage within the watershed. HEC-HMS then combines and routes the hydrographs through user-defined up- and down-gradient drainage features to defined watershed outlets.

Input parameters for the HEC-HMS model are described below. The input parameters assumed for the HEC-HMS modeling are summarized in tables included in Attachment E-1. The tables include parameters for both the pre-development subbasins, post-development subbasins, channels, and detention basins.

2.1.1.1 Watershed Subbasins

Subbasins are generally assumed to be drainage areas that share similar run-on and runoff characteristics, surface features, and typically discharge to a single reach (i.e., channel), detention basin, or off-site discharge location. The on-site and off-site watershed subbasins and surrounding drainage features modeled using HEC-HMS are presented on Drawings E1 and E2, related to the pre-development and post-development conditions, respectively.

2.1.1.2 Time Step

The time step, or the program computation interval, and model duration are used to develop the hydrographs. The time step interval determines the resolution of the model results computed during a model run. A time interval of one minute was used for the computations, resulting in 1,440 hydrograph ordinates per 24-hour period. The model duration was set at 48 hours. This duration allowed precipitation from the design storm to exit the landfill property, with the exception of any stormwater retained in the basin sediment storage. This duration was also long enough that the hydrograph peak had clearly passed and that flows had decreased to a level at which a longer time period would yield no usable information.

2.1.1.3 Hypothetical Precipitation Distribution

The hypothetical precipitation distribution was derived from the National Oceanic and Atmospheric Administration, Atlas 14. A Type II storm event with a return period of 25 years and duration of 24 hours was used for the hydrologic modeling. This storm event is associated with approximately 6.80 inches of precipitation, which was assumed to be evenly distributed across the entire watershed for the return period. A figure presenting the source of the precipitation data used in the model is included in Attachment E-1.

2.1.1.4 Precipitation Losses

Precipitation losses (the precipitation that does not contribute to runoff) were estimated in the HEC-HMS model by the National Resource Conservation Service (NRCS) Curve Number (CN) method. This method relates the hydrologic soil group to the CN as a function of soil type, land use, and antecedent moisture conditions. Input values for the method typically include the CN value, the initial abstraction, and the percent impervious area for each subbasin.

Initial abstraction (IA) represents the precipitation loss that occurs at the beginning of a storm event, prior to runoff beginning. The model allows either IA values to be input, or to be calculated by the model. For this analysis, the model calculated the IA values as a function of the CN method.

CN values for pre-development (areas not associated with the existing landfill disposal footprint) were selected based on the cover type. A CN value of 80 was used for post-development conditions and pre-development conditions associated with the existing landfill, which is a conservative assumption. References for CN values are provided in Attachment E-1. Based on Soil Survey Maps and subsurface explorations conducted as part of this permit application, on-site soils are predominantly silty and sandy loams. Therefore, Hydrologic Soil Group (HSG) B was used for curve number determination for pre-development conditions, with the exception of drainage areas associated with the existing landfill. As such, for pre- and post-development conditions associated with either the existing landfill or proposed landfill disposal areas, HSG C was conservatively used for final cover areas.

2.1.1.5 Routing and Hydrograph Methods

Numerous routing and hydrograph methods are available within the HEC-HMS model. The routing and hydrograph method represents the methodology used by the model to develop hydrographs for each subbasin, channel, and detention basin, which are then combined by the program to represent the watershed being analyzed. The specific routing and hydrograph methods used for the analysis are discussed in subsequent subsections. HEC-HMS routing and hydrograph methods were used to predict the peak flow rates (peak of hydrograph) associated with pre- and post-development conditions.

2.1.1.6 Subbasin Transform

NRCS Unit Hydrograph Transform Method - The NRCS Unit Hydrograph (UH) method was used for developing a hydrograph that develops surface runoff calculations for pre-development subbasins (areas not associated with the existing landfill disposal footprint) and small post-development subbasins that do not have main channels, which are required when using the Kinematic Wave Method. These post-development areas include the areas occupied by detention basins and landfill sideslope areas that discharge to perimeter channels.

The UH method generalizes the surface water flow of a drainage area into a dimensionless unit hydrograph, based on the ratio of discharge to UH peak discharge and the ratio of time to UH time to peak. The UH time to peak is dependent on the drainage area lag time, which is defined as the length of time between the centroid of precipitation mass and the peak flow of the resulting hydrograph. The input parameter for this method is the lag time, which is typically approximated by taking 60 percent of the time-of-concentration for these areas. Time of concentrations for these areas were estimated using the Velocity Method. As introduced in the USDA Part 630 Hydrology National Engineering Handbook Chapter 15 (May, 2010), the Velocity Method assumes that time of concentration is the sum of travel times for segments along the hydraulically most distant flow path. The segments used in the Velocity Method may be of three types: sheet flow, shallow concentrated flow, and open channel flow. Time of concentration is calculated for each segment and total time of concertation is used for lag time calculation. Equations used for sheet flow, shallow concentrated flow, and open channel flow are presented in the pre-development and post-development summary tables in Attachment E-1 along with the input parameters.

Kinematic Wave Transform Method - The Kinematic Wave method is designed principally for representing urban areas. It is a model that includes one or two representative planes. Typically, one plane is used for pervious surfaces and one for impervious. The same meteorological boundary conditions are applied to each plane. However, separate loss rate information is required for each plane. The Kinematic Wave Transform methodology was used to develop surface runoff calculations for developed pre-development and post-development subbasins located within the limits of waste of the landfill or areas outside the waste limit boundary, such as detention basins and other disturbed areas.

Various input parameters for the Kinematic Wave Transform method components are summarized below:

- **Flow Plane**: Requires the input of average flow plane length, slope, and surface roughness (N, representative of land-use and ground cover). Parameters were determined from review of design final grades for post-development conditions.

- **Collector:** Requires the input of average collector length, average slope, Manning's "n", channel geometry, and average contributing area. The average contributing area within the subbasin (drainage area) discharges into a single collector (drainage swale). The subbasin area is divided by this average contributing area to estimate the number of collectors within each subbasin. Parameters for collectors are based on the landfill completion design for post-development conditions.

- **Main Channel:** Requires input of channel length, average slope, Manning's "n", and channel geometry. Parameters were determined from review of design final grades for post-development conditions.

The pre- and post-development conditions (areas located with existing or proposed disposal areas) were separated into subbasins that are representative of either landfill sideslopes or areas outside the waste limit boundary, such as detention basins and other disturbed areas. The flow planes, collectors, and main channels for landfill topslopes and sideslopes are represented as follows:

- Flow planes are represented by the topslope area and/or areas between drainage swales proposed for the sideslopes.
- Flow planes discharge into collectors that are represented by the drainage swales.
- The collectors or drainage swales discharge into a main channel, which is represented by a downchute located in each sideslope subbasin.

It should be noted that the perimeter channels, into which the sideslope drainage features discharge, were evaluated using the Muskingum-Cunge method as discussed in Subsection 2.1.1.8. The input parameters, as described above, for overland flow planes, collectors, and main channels for each post-development subbasin are summarized in Attachment E-1.

2.1.1.7 Detention Basin Routing

Detention basins are used in the design to reduce the combined peak flow rates from the post-development subbasins to a level that will not adversely impact down-gradient properties, when compared to the pre-development conditions. Additionally, detention basins will provide off-site sedimentation control, as described in Subsection 4.2 of this attachment.

HEC-HMS is capable of modeling the effects of detention basins based on the inflow hydrographs using the Modified Puls method of storage routing. The program assumes level-pool routing, such that inflow into the detention basin is assumed to affect the entire basin immediately. Input parameters consist of elevation-area and elevation-discharge relationships for each detention basin. Elevation-area-discharge relationships are presented in Attachment E-1.

2.1.1.8 Perimeter Channel Routing

Perimeter channel routing in the HEC-HMS model was performed using the Muskingum-Cunge method. The Muskingum-Cunge method was selected based upon its ability to account for hydrograph attenuation inherent in the physical properties of the channel and the inflow hydrograph. The input parameters for the model are based on the length, channel geometry, and surface roughness of the channel. Input parameters for post-development drainage channels are summarized in Attachment E-1.

Channel capacity, velocity, and peak flow depths for input onto the channel profile drawings were estimated using Manning's equation, as described in Subsection 2.2 of this plan.

2.2 HYDRAULIC ANALYSIS METHODS

This section describes the methodology used for evaluating hydraulic parameters, including geometry and peak flow velocities, for the stormwater conveyance structures, such as drainage swales and downchutes, perimeter drainage channels, culverts, and detention basin outlet structures that will be constructed at the landfill.

2.2.1 Permissible Non-Erosive Velocities

The peak flow velocities calculated using the methodologies described herein were compared to the permissible non-erosive velocity for vegetated landfill slopes or drainage features. Landfill cover or drainage features experiencing erosive velocities (i.e., in excess of the defined non-erosive velocity) will be armored or protected using rip rap, turf reinforcement mat, or other suitable armoring materials.

In accordance with published literature, as provided with calculations in Attachment E-1, permissible non-erosive velocities are defined as velocities less than or equal to 6 feet per second (fps) for vegetated perimeter channels or drainage swales, and 5 fps for final cover slopes and downchutes.

2.2.2 Analysis of Drainage Swales and Downchutes

Drainage swales and downchutes are structural controls used to convey runoff from the landfill cover to the perimeter drainage system and to reduce cover erosion by limiting uninterrupted flow lengths. These structures will be installed on final cover at the frequencies specified. These structures will be utilized on sideslopes to convey runoff to the installed perimeter drainage system and for control of erosion and offsite sedimentation.

Drainage swales will be installed following construction and placement of final cover to the representative grades coinciding with the elevations and/or maximum spacing between swales. The maximum horizontal spacing between swales will be 160 horizontal feet or 40 vertical feet on a 4H:1V slope. The installation schedule or frequency of drainage swales is based on potential soil loss, as described in Section 2.3. Drainage swales and downchutes on final cover will be installed at the locations depicted on Drawing E2.

The methodology for sizing drainage swales and downchutes is described below. Drainage swale and downchute details are depicted on Permit Drawings No. 23 and 24, respectively.

2.2.2.1 Rational Method

The Rational Method was used to estimate peak runoff from typical contributing areas for design of the drainage swales and downchutes installed on final cover. The Rational Method estimates the peak rate of runoff at any location in a watershed as a function of the drainage area, runoff coefficient, and mean rainfall intensity for a duration equal to the time-of-concentration (the time required for water to flow from the most remote point of the drainage area to the location being analyzed).

The Rational Method is expressed as the following in Oklahoma Department of Transportation (ODOT) Roadway Drainage Manual (2014):

$$Q = C_f CIA$$

Where, Q = maximum rate of runoff, cfs

C_f = 1.1 for 25-year

C = runoff coefficient representing a ratio of runoff to rainfall

I = average rainfall intensity for a duration equal to the time-of-concentration, inches per hour

A = drainage area contributing to the discharge location, acres

The runoff coefficient (C) used for the drainage swale and downchute analysis is described in the calculations provided in Attachment E-4. The 25-year rainfall intensity (I) was determined for Oklahoma County (Zone 5) from ODOT Roadway Drainage Manual (Chapter 7) assuming a minimum time-of-concentration (tc) of 10 minutes for sizing landfill drainage swales and downchutes.

2.2.2.2 Manning's Equation for Uniform Flow

Hydraulic analysis of the drainage swale and downchute geometry was performed using Manning's uniform flow equation. The uniform flow assumption used by Manning's equation is applicable to long prismatic channels of uniform slope, such as those proposed for the drainage swales or downchutes.

The general form of Manning's equation is:

$$V = \frac{1.49R^{0.667}S^{0.5}}{n}$$

Where, V = Velocity of flow, fps

n = Manning's "n"

R = Hydraulic Radius, ft, or

$$R = \frac{A}{P}$$

S = Friction slope for non-uniform flow or channel slope for uniform flow, ft/ft

A = Area of water perpendicular to direction of flow, sf

P = Wetted perimeter, ft

Using the relationship Q = VA, Manning's equation can be written as:

$$Q = \frac{1.49AR^{0.667}S^{0.5}}{n}$$

The uniform flow assumption equates the slope of the structure to the friction slope. Therefore, the slope of the channel can be used for "S" in Manning's equation for computation of uniform flow. Using the peak flow rate for a 25-year storm event calculated using the Rational Method (described above), the velocity and peak flow depth within drainage swales and downchutes was calculated using Manning's equation.

The following assumptions were used when evaluating the peak velocity with drainage swales and downchutes:

- Drainage swales will be grass-lined for velocities less than or equal to 6 fps. These structures were designed assuming a Manning's "n" of 0.027.

- When velocities exceed permissible velocities, typically downchutes and some channels, the structure will be lined with armoring materials, as described below.

- Armoring materials will be geomembrane or HydroTurf for downchutes. Downchutes were designed assuming a Manning's "n" of 0.027, as this surface roughness provides the greatest flow depth within the respective structure for the referenced armoring material.

- Energy dissipation in the form of rip rap or dissipation blocks will be installed at the confluence of downchutes and the landfill toe of slope and/or perimeter drainage channels.

Both the drainage swale and downchute cross-sections will be designed with a minimum 1-foot freeboard and will be capable of retaining the peak flow rate, as calculated using the rational method described above. A peak flow analysis was performed for drainage swales and downchutes installed on final cover. Calculations using Manning's equation for the hydraulic properties of the drainage swales and downchutes were performed using the AutoCAD Civil 3D Hydraflow Express Extension (2018). This flow analysis and the Hydraflow Express output summary sheets for these calculations are presented in Appendix E-4.

2.2.3 Flow Capacity of Perimeter Drainage Channels

Perimeter drainage channels were designed to convey runoff from the developed landfill property to down-gradient detention basins or offsite discharge locations. The peak flow rates obtained from HEC-HMS for contributing subbasins were used to evaluate the flow capacity of the perimeter drainage channels. Hydraflow Express was used to confirm that the designed channel geometry, depth, and invert slope will provide sufficient capacity to discharge the 25-year, 24-hour storm event. The following assumptions were incorporated into the channel modeling:

- Manning's coefficient values of 0.027 for grass-lined channels or 0.033 for rip rap or TRM-lined channels was used for the analysis.

- Channels were designed with trapezoidal cross-sections with 2H:1V sideslopes.

- Each channel was analyzed for peak flow for the 25-year, 24-hour storm event, and then a minimum 1-foot of freeboard above the flow depth associated with the peak flow rate was added to the channel design.

Information derived from the Hydraflow Express output files includes channel flow depth and peak velocity at the peak flow conditions. The respective Hydraflow Express output files for each of the perimeter channels are included in Attachment E-4.

2.2.4 Detention Basin Outlet Structures

As part of this permit modification application, the surface water drainage system for the NELF will now have two detention ponds (South Pond and Southeast Pond) in series located to the south of the existing C&D disposal area. The South Pond will discharge to Southeast Pond via two (2), 24-inch diameter corrugated metal pipes (CMPs). The Southeast Pond is a zero-discharge pond during the design storm event. Two detention ponds (North Pond and Northwest Pond) in series will be located on the north side of the proposed landfill. The North pond will discharge to the Northwest Pond with three (3), 36-inch diameter concrete culverts. The Northwest Pond has one discharge point, where it will discharge to a location to the northwest of the landfill (i.e., Point of Discharge, POD-1) via seven (7), 30-inch concrete culverts.

Elevation-area-discharge relationships were developed for each detention basin based on varying hydraulic heads on each specific outlet structure configuration. These elevation-area-discharge relationships were input into the HEC-HMS model for routing runoff through the detention basins and ultimately to offsite discharge location. The discharge relationships for each detention basin are provided in Attachment E-1 of this Appendix. Permit Drawing No. 24 depicts the detention basin outlet structure, including each outlet elevation and dimensions. This information is also summarized in Section 4 of this attachment.

2.3 SOIL LOSS ANALYSIS METHODS

The Universal Soil Loss Equation (USLE)/Revised Universal Soil Loss Equation (RUSLE) was used to calculate the soil loss resulting from precipitation contacting the final cover. The estimated soil loss was compared to the permissible soil loss for final cover, in accordance with published literature. The USLE/RUSLE is an empirical equation which estimates soil losses from rainfall and runoff. The USLE was developed by statistical analysis of many plot-years of rainfall, runoff, and sediment loss data from many small plots located around the country. The USLE is supported by the National Resource Conservation Service (NRCS). The Universal Soil Loss Equation is:

$$A=RKLSCP$$

Where A = average annual soil loss (tons/acre/ year)

R = rainfall and runoff erosivity index for a given location

K = soil erodibility factor

L = slope length factor

S = slope steepness factor

C = cover and management factor

P = erosion control practice factor

The input parameters into the USLE/RUSLE and soil loss calculations for are presented in Attachment E-4 of this appendix.

The purpose of calculating the soil loss from final cover is to evaluate the frequency (i.e., spacing between drainage swales) at which the drainage swales must be installed to maintain soil loss at less than or equal to 3 tons/acre/year (maximum permissible soil loss recommended for final cover slopes). The analysis for the topslope is based on the greatest flow length on the 4 percent topslope. Drainage swales on final cover sideslopes will be installed at a maximum spacing of 160 horizontal feet or 40 vertical feet, assuming a 4H:1V sideslope. Soil loss calculations for final cover were based on the assumption that vegetation would be established following application of final cover, and that the vegetation would provide approximately 90 percent ground coverage. Based on the results, the maximum erosion potential of the final cover was estimated to be 0.20 tons/acre/year and 1.8 tons/acre/year on the topslope and sideslope, respectively.

3.0 PRE-DEVELOPMENT CONDITIONS

The pre-development conditions are defined as existing drainage patterns associated with the upstream drainage areas of adjacent properties that contribute run-on to the permit boundary property, and the existing permitted landfill, including drainage areas, drainage swales/downchutes, and channels, consistent with the previously approved Tier I Permit Modification, Vertical Expansion of the Northeast C&D Landfill, dated June 2013 prepared by Shepard Engineering.

Surface water from the southern portion of the existing disposal area flows into one existing pond located to the south of the disposal area. According to the previously approved Tier 1 Permit Modification, the existing pond of the C&D disposal area was designed with 2-feet freeboard and no discharge structures. As such, the South Pond was designed to be a zero-discharge pond. Therefore, the majority of the southern portion of the existing landfill area does not contribute to the pre-development flow discharging to POD-2. Drainage area, Pre_A_South, is an area south of the existing C&D disposal area that sheet flows off the property to POD-2.

Surface water from the existing C&D disposal areas, including northern drainage areas, areas discharging to the eastern perimeter channels, portion of the western perimeter channels, and the entire expansion area (i.e, north of the existing C&D disposal area) flows into a natural stream within the expansion area footprint. This natural stream flows from east to northwest across the property discharging to POD-1 and then flows towards the nearby Cutcho Creek. There are five off-site run-on areas that are adjacent to the proposed expansion area that discharge to the stream within the expansion area. OFS-A1-North and OFS-A2-North, each to the north of the proposed expansion area, are direct run-on areas to the on-site stream. OFS-A-East area flow enters the proposed expansion through a 36-in by 48-in elliptical corrugated metal culvert, and discharges to the on-site stream. OFS-B1-East and OFS-B2-East areas each sheet flow into the expansion area, and discharge to the on-site stream.

Pre-development conditions, including on- and off-site drainage areas and POD-1 and 2 locations are depicted on Drawing E1.

4.0 POST-DEVELOPMENT CONDITIONS

Post-development conditions with delineated drainage areas and direction of surface water flow to each detention basin and POD are depicted on Drawing E2. Additionally, a general layout of the post-development drainage system, including perimeter drainage channels and detention basins, is also presented on Drawing E2. As shown, rainfall contacting the landfill topslope and sideslopes will be collected as runoff in drainage swales located at set intervals (see Section 2.2.2) on the 4H:1V sideslopes. Runoff will flow within the drainage swales, roughly parallel to the slope, into downchutes that will convey runoff to the toe of the landfill and into the perimeter drainage channels or discharge directly into detention basins.

The perimeter drainage channels discharge into one of three detention basins: South Pond, North Pond, and Northwest Pond. East perimeter channels discharge into the North Pond, which discharges to the Northwest Pond with three (3), 36-inch diameter concrete culverts. West perimeter channels primarily discharge into the Northwest Pond, with exception to a small section of the west perimeter channels which discharge into the South Pond. The Northwest Pond discharges through the basin outlet structure, comprised of seven (7), 30-inch diameter concrete culverts, towards POD-1. The south perimeter channels and a portion of the west perimeter channels discharge into the South Pond. The existing South Pond of the C&D disposal area has been modified as two separate larger South and Southeast Ponds, in series, as part of this permit application. The South and Southeast Ponds have been designed to control the corresponding final cover area consistent with the drainage areas depicted on Drawing E2. The South Pond will discharge to Southeast Pond via two (2), 24-inch diameter CMP culverts. There is no outlet structure for the Southeast Pond, as this is a zero-discharge pond consistent with the pre-development conditions.

4.1 PERIMETER CHANNEL DESIGN

The channels were designed to have peak flow velocities of less than 6 feet per second where only vegetation is proposed for the channel lining. For velocities greater than approximately 6 feet per second, the channels were designed with either rip rap lining or TRM. The hydraulic analysis of the perimeter drainage channels is described in Subsection 2.2.3. As described in this subsection, the peak flow rates in the channels were determined from the HEC-HMS output for the respective contributing drainage areas. The peak velocity and flow depth within each channel were calculated using HydraFlow Express, based on the proposed channel geometry. A summary of the channel design parameters, which were incorporated into HEC-HMS and HydraFlow Express, are included in Attachment E-1. Additionally, the HydraFlow output files for each channel are included in Attachment E-4. A typical cross-section is presented on Permit Drawing No.23.

4.2 DETENSION BASIN DESIGN

The South and Southeast Ponds have been designed to control the corresponding final cover area consistent with the drainage areas depicted on Drawing E2. The South Pond will discharge to Southeast Pond via two (2), 24-inch diameter CMP culverts. There is no outlet structure for the Southeast Pond, as this is a zero-discharge pond. The North Pond and Northwest Pond have been designed for storm water routed from the proposed C&D landfill based on the post-development runoff characteristics modeled in HEC-HMS, as described in Section 2 of this attachment. The North Pond will discharge to Northwest Pond via three (3), 36-inch diameter concrete culverts. The outlet structure of the Northwest Pond will be comprised of seven, 30-inch diameter concrete culverts discharging to POD-1. Additionally, each detention basin has been designed with a minimum 1-foot of freeboard to prevent overtopping during the design storm event.

Elevation-area-discharge relationships for the basins are presented in Attachment E-1. HEC-HMS output for the detention basins, including the peak discharge, storage, and pool depth associated with the 25-year, 24-hour storm event is presented in Attachment E-3. This information also has been summarized in Table E-1. Detention basin layout plans are depicted on Permit Drawing No. 22.

4.3 BASIN OUTLET STRUCTURE DESIGN

The South Pond discharges into the Southeast Pond, which has no discharge consistent with the current Storm Water Drainage Design Plan for the C&D Landfill (Permit No. 3555050) and as shown in post-development HEC-HMS output file (Attachment E-3). The North Pond discharges into the Northwest Pond, which discharge to off-site at POD-1. Peak discharge rates were calculated for North and Northwest Pond's detention basin outlet structures, as described in Subsection 2.2.4 of this submittal. As previously described, the peak discharge rates were incorporated into the elevation-area-discharge relationships used in the HEC-HMS model, as provided in Attachment E-1. Design details for the culverts are shown on Permit Drawing No. 24. Additionally, Table E-2 describes the culvert outlet dimensions/elevations.

Table E-1. Detention Basin Peak Storage and Discharge

Detention Basin	Discharge Points	Peak Storage (acre-feet)	Peak Pool Depth (ft msl)	Peak Discharge (cfs)
North Pond	Northwest Pond	6.6	1199.0	211.0
Northwest Pond	POD-1	7.4	1175.7	260.2
South Pond	Southeast Pond	4.9	1200.5	8.7
Southeast Pond	N/A	4.0	1201.0	0.0

Table E-2. Culvert Outlet Configuration Summary

Detention Basin	Discharge Points	Basin Invert Elevation (ft msl)	Diameter of Pipe (inches)	Number of Culverts	Downstream Invert Elevation (ft msl)	Culvert Length (ft)
North Pond	Northwest Pond	1191.0	36	3	1176.0	250
Northwest Pond	POD-1	1167.0	30	7	1166.0	100
South Pond	Southeast Pond	1194	24	2	1199.0	80

4.4 NORTH OFF-SITE RUN-ON CONTROL CHANNEL

A run-on control channel was designed along the north property boundary of the C&D expansion, which will convey run-on from drainage areas OFS_A_North, OFS_A_East, and OFS_B_East to POD-1 consistent with pre-development drainage conditions. This run-on control channel allows the diversion of stormwater from these off-site drainage areas without impacting the proposed landfill surface water management system design. The North Run-on Control Channel will have peak flow velocities of less than 6 feet per second during the design storm event, as such vegetation is proposed for the channel lining. The hydraulic analysis of the North Run-on Control Channel is included in Attachment E-4.

5.0 SUMMARY OF RESULTS

The pre-development subbasins, as described in Section 3, are presented on Drawing E1. Input parameters for the HEC-HMS modeling performed for pre-development conditions are presented in tables included in Attachment E-1. The results of HEC-HMS modeling of the pre-development conditions are included in Attachment E-2.

Post-development conditions are represented by the fully developed landfill, with final closure having been completed, and all drainage features in-place and operational, as described in Section 4 and presented on Drawing E2. The post-development discharge conditions were analyzed at the same POD as pre-development conditions. Input parameters for the HEC-HMS modeling performed for post-development conditions are presented in tables included in Attachment E-1. The results of HEC-HMS modeling of the post-development conditions are included in Attachment E-3.

The pre- and post-development peak discharge rates are summarized in Table E-3. As shown in this table, the landfill development will not result in significant increases in peak discharge rates at the PODs as demonstrated by comparison of the pre- and post-development conditions. Therefore, no adverse impact to existing drainage patterns will result from the proposed landfill development.

Discharge velocities from the property will be below the 6 feet per second threshold, which typically is considered the threshold for erosion damage. This will be accomplished by dissipating discharge velocities at the basin outlet structures prior to off-site discharge. Velocity dissipation from the outlet structures will be provided by either rip rap blankets, dissipation blocks or stilling basins installed at the outlet of each structure.

Table E-3. Comparison of Pre- and Post-Development Peak Discharge Rates

Discharge Point	Peak Pre-Development Discharge Rate (cfs)	Peak Post-Development Discharge Rate (cfs)
POD-1	487.5	396.4
POD-2	13.2	10.9

2.0 METHODOLOGY

2.1 HYDROLOGIC ANALYSIS METHODS

This subsection describes the hydrologic methodology used for the surface water system drainage design. Stormwater discharges are estimated for pre-development conditions and post-development conditions. Pre-development conditions are depicted on Drawing E1, while post-development conditions, which are representative of the landfill at final grade, are shown on Drawing E2. To evaluate impacts to existing drainage patterns, pre- and post-development peak flow rates were compared at offsite discharge locations. Based on review of pre-development conditions, surface water is discharged from the property at two (2) discharge points. Each discharge point from the property is referred herein as point-of-demonstration [POD] for comparison of the pre- and post-development discharge rates. The comparison of pre- and post-development discharge rates at these PODs is summarized in Table E-3 of this submittal.

In accordance with OAC 252:515-17, the pre- and post-development hydrologic conditions were modeled for a 25-year, 24-hour storm event using the U.S. Army Corp of Engineers', Hydrologic Engineering Center's - Hydrologic Modeling System, Version 4.0 computer software (referred to as HEC-HMS). HEC-HMS was used to develop hydrographs for both the pre-development and post-development conditions for computation of the peak flow rates, as described in the following subsections.

Peak flow rates were compared between the pre- and post-development conditions to evaluate potential impacts to existing drainage patterns, as described in Section 5. Additionally, the peak flow rates modeled using HEC-HMS were used in the design of the major surface water drainage features proposed for the landfill property (i.e., perimeter drainage channels, detention basins, and outlet structures), as described in Section 4.

2.1.1 Description of HEC-HMS Computer Program

HEC-HMS is a Windows-based program incorporating analytical methods to simulate the surface runoff response of a watershed subjected to a design storm event. The HEC-HMS model represents a watershed as a network of hydrologic and hydraulic components. The modeling process results in the computation of hydrographs for surface water runoff, channel-flow, and detention basin storage within the watershed. HEC-HMS then combines and routes the hydrographs through user-defined up- and down-gradient drainage features to defined watershed outlets.

Input parameters for the HEC-HMS model are described below. The input parameters assumed for the HEC-HMS modeling are summarized in tables included in Attachment E-1. The tables include parameters for both the pre-development subbasins, post-development subbasins, channels, and detention basins.

2.1.1.1 Watershed Subbasins

Subbasins are generally assumed to be drainage areas that share similar run-on and runoff characteristics, surface features, and typically discharge to a single reach (i.e., channel), detention basin, or off-site discharge location. The on-site and off-site watershed subbasins and surrounding drainage features modeled using HEC-HMS are presented on Drawings E1 and E2, related to the pre-development and post-development conditions, respectively.

2.1.1.2 Time Step

The time step, or the program computation interval, and model duration are used to develop the hydrographs. The time step interval determines the resolution of the model results computed during a model run. A time interval of one minute was used for the computations, resulting in 1,440 hydrograph ordinates per 24-hour period. The model duration was set at 48 hours. This duration allowed precipitation from the design storm to exit the landfill property, with the exception of any stormwater retained in the basin sediment storage. This duration was also long enough that the hydrograph peak had clearly passed and that flows had decreased to a level at which a longer time period would yield no usable information.

2.1.1.3 Hypothetical Precipitation Distribution

The hypothetical precipitation distribution was derived from the National Oceanic and Atmospheric Administration, Atlas 14. A Type II storm event with a return period of 25 years and duration of 24 hours was used for the hydrologic modeling. This storm event is associated with approximately 6.80 inches of precipitation, which was assumed to be evenly distributed across the entire watershed for the return period. A figure presenting the source of the precipitation data used in the model is included in Attachment E-1.

2.1.1.4 Precipitation Losses

Precipitation losses (the precipitation that does not contribute to runoff) were estimated in the HEC-HMS model by the National Resource Conservation Service (NRCS) Curve Number (CN) method. This method relates the hydrologic soil group to the CN as a function of soil type, land use, and antecedent moisture conditions. Input values for the method typically include the CN value, the initial abstraction, and the percent impervious area for each subbasin.

Initial abstraction (IA) represents the precipitation loss that occurs at the beginning of a storm event, prior to runoff beginning. The model allows either IA values to be input, or to be calculated by the model. For this analysis, the model calculated the IA values as a function of the CN method.

CN values for pre-development (areas not associated with the existing landfill disposal footprint) were selected based on the cover type. A CN value of 80 was used for post-development conditions and pre-development conditions associated with the existing landfill, which is a conservative assumption. References for CN values are provided in Attachment E-1. Based on Soil Survey Maps and subsurface explorations conducted as part of this permit application, on-site soils are predominantly silty and sandy loams. Therefore, Hydrologic Soil Group (HSG) B was used for curve number determination for pre-development conditions, with the exception of drainage areas associated with the existing landfill. As such, for pre- and post-development conditions associated with either the existing landfill or proposed landfill disposal areas, HSG C was conservatively used for final cover areas.

2.1.1.5 Routing and Hydrograph Methods

Numerous routing and hydrograph methods are available within the HEC-HMS model. The routing and hydrograph method represents the methodology used by the model to develop hydrographs for each subbasin, channel, and detention basin, which are then combined by the program to represent the watershed being analyzed. The specific routing and hydrograph methods used for the analysis are discussed in subsequent subsections. HEC-HMS routing and hydrograph methods were used to predict the peak flow rates (peak of hydrograph) associated with pre- and post-development conditions.

2.1.1.6 Subbasin Transform

NRCS Unit Hydrograph Transform Method - The NRCS Unit Hydrograph (UH) method was used for developing a hydrograph that develops surface runoff calculations for pre-development subbasins (areas not associated with the existing landfill disposal footprint) and small post-development subbasins that do not have main channels, which are required when using the Kinematic Wave Method. These post-development areas include the areas occupied by detention basins and landfill sideslope areas that discharge to perimeter channels.

The UH method generalizes the surface water flow of a drainage area into a dimensionless unit hydrograph, based on the ratio of discharge to UH peak discharge and the ratio of time to UH time to peak. The UH time to peak is dependent on the drainage area lag time, which is defined as the length of time between the centroid of precipitation mass and the peak flow of the resulting hydrograph. The input parameter for this method is the lag time, which is typically approximated by taking 60 percent of the time-of-concentration for these areas. Time of concentrations for these areas were estimated using the Velocity Method. As introduced in the USDA Part 630 Hydrology National Engineering Handbook Chapter 15 (May, 2010), the Velocity Method assumes that time of concentration is the sum of travel times for segments along the hydraulically most distant flow path. The segments used in the Velocity Method may be of three types: sheet flow, shallow concentrated flow, and open channel flow. Time of concentration is calculated for each segment and total time of concertation is used for lag time calculation. Equations used for sheet flow, shallow concentrated flow, and open channel flow are presented in the pre-development and post-development summary tables in Attachment E-1 along with the input parameters.

Kinematic Wave Transform Method - The Kinematic Wave method is designed principally for representing urban areas. It is a model that includes one or two representative planes. Typically, one plane is used for pervious surfaces and one for impervious. The same meteorological boundary conditions are applied to each plane. However, separate loss rate information is required for each plane. The Kinematic Wave Transform methodology was used to develop surface runoff calculations for developed pre-development and post-development subbasins located within the limits of waste of the landfill or areas outside the waste limit boundary, such as detention basins and other disturbed areas.

Various input parameters for the Kinematic Wave Transform method components are summarized below:

- Flow Plane: Requires the input of average flow plane length, slope, and surface roughness (N, representative of land-use and ground cover). Parameters were determined from review of design final grades for post-development conditions.

- Collector: Requires the input of average collector length, average slope, Manning's "n", channel geometry, and average contributing area. The average contributing area within the subbasin (drainage area) discharges into a single collector (drainage swale). The subbasin area is divided by this average contributing area to estimate the number of collectors within each subbasin. Parameters for collectors are based on the landfill completion design for post-development conditions.

- Main Channel: Requires input of channel length, average slope, Manning's "n", and channel geometry. Parameters were determined from review of design final grades for post-development conditions.

The pre- and post-development conditions (areas located with existing or proposed disposal areas) were separated into subbasins that are representative of either landfill sideslopes or areas outside the waste limit boundary, such as detention basins and other disturbed areas. The flow planes, collectors, and main channels for landfill topslopes and sideslopes are represented as follows:

- Flow planes are represented by the topslope area and/or areas between drainage swales proposed for the sideslopes.
- Flow planes discharge into collectors that are represented by the drainage swales.
- The collectors or drainage swales discharge into a main channel, which is represented by a downchute located in each sideslope subbasin.

It should be noted that the perimeter channels, into which the sideslope drainage features discharge, were evaluated using the Muskingum-Cunge method as discussed in Subsection 2.1.1.8. The input parameters, as described above, for overland flow planes, collectors, and main channels for each post-development subbasin are summarized in Attachment E-1.

2.1.1.7 Detention Basin Routing

Detention basins are used in the design to reduce the combined peak flow rates from the post-development subbasins to a level that will not adversely impact down-gradient properties, when compared to the pre-development conditions. Additionally, detention basins will provide off-site sedimentation control, as described in Subsection 4.2 of this attachment.

HEC-HMS is capable of modeling the effects of detention basins based on the inflow hydrographs using the Modified Puls method of storage routing. The program assumes level-pool routing, such that inflow into the detention basin is assumed to affect the entire basin immediately. Input parameters consist of elevation-area and elevation-discharge relationships for each detention basin. Elevation-area-discharge relationships are presented in Attachment E-1.

2.1.1.8 Perimeter Channel Routing

Perimeter channel routing in the HEC-HMS model was performed using the Muskingum-Cunge method. The Muskingum-Cunge method was selected based upon its ability to account for hydrograph attenuation inherent in the physical properties of the channel and the inflow hydrograph. The input parameters for the model are based on the length, channel geometry, and surface roughness of the channel. Input parameters for post-development drainage channels are summarized in Attachment E-1.

Channel capacity, velocity, and peak flow depths for input onto the channel profile drawings were estimated using Manning's equation, as described in Subsection 2.2 of this plan.

2.2 HYDRAULIC ANALYSIS METHODS

This section describes the methodology used for evaluating hydraulic parameters, including geometry and peak flow velocities, for the stormwater conveyance structures, such as drainage swales and downchutes, perimeter drainage channels, culverts, and detention basin outlet structures that will be constructed at the landfill.

2.2.1 Permissible Non-Erosive Velocities

The peak flow velocities calculated using the methodologies described herein were compared to the permissible non-erosive velocity for vegetated landfill slopes or drainage features. Landfill cover or drainage features experiencing erosive velocities (i.e., in excess of the defined non-erosive velocity) will be armored or protected using gabions, rip rap, turf reinforcement mat, or other suitable armoring materials.

In accordance with published literature, as provided with calculations in Attachment E-1, permissible non-erosive velocities are defined as velocities less than or equal to 6 feet per second (fps) for vegetated perimeter channels or drainage swales, and 5 fps for final cover slopes and downchutes.

2.2.2 Analysis of Drainage Swales and Downchutes

Drainage swales and downchutes are structural controls used to convey runoff from the landfill cover to the perimeter drainage system and to reduce cover erosion by limiting uninterrupted flow lengths. These structures will be installed on final cover at the frequencies specified. These structures will be utilized on sideslopes to convey runoff to the installed perimeter drainage system and for control of erosion and offsite sedimentation.

Drainage swales will be installed following construction and placement of final cover to the representative grades coinciding with the elevations and/or maximum spacing between swales. The maximum horizontal spacing between swales will be 160 horizontal feet or 40 vertical feet on a 4H:1V slope. The installation schedule or frequency of drainage swales is based on potential soil loss, as described in Section 2.3. Drainage swales and downchutes on final cover will be installed at the locations depicted on Drawing E2.

The methodology for sizing drainage swales and downchutes is described below. Drainage swale and downchute details are depicted on Permit Drawings No. 23 and 24, respectively.

2.2.2.1 Rational Method

The Rational Method was used to estimate peak runoff from typical contributing areas for design of the drainage swales and downchutes installed on final cover. The Rational Method estimates the peak rate of runoff at any location in a watershed as a function of the drainage area, runoff coefficient, and mean rainfall intensity for a duration equal to the time-of-concentration (the time required for water to flow from the most remote point of the drainage area to the location being analyzed).

The Rational Method is expressed as the following in Oklahoma Department of Transportation (ODOT) Roadway Drainage Manual (2014):

$$Q = C_f CIA$$

Where, Q = maximum rate of runoff, cfs

C_f = 1.1 for 25-year

C = runoff coefficient representing a ratio of runoff to rainfall

I = average rainfall intensity for a duration equal to the time-of-concentration, inches per hour

A = drainage area contributing to the discharge location, acres

The runoff coefficient (C) used for the drainage swale and downchute analysis is described in the calculations provided in Attachment E-4. The 25-year rainfall intensity (I) was determined for Oklahoma County (Zone 5) from ODOT Roadway Drainage Manual (Chapter 7) assuming a minimum time-of-concentration (tc) of 10 minutes for sizing landfill drainage swales and downchutes.

2.2.2.2 Manning's Equation for Uniform Flow

Hydraulic analysis of the drainage swale and downchute geometry was performed using Manning's uniform flow equation. The uniform flow assumption used by Manning's equation is applicable to long prismatic channels of uniform slope, such as those proposed for the drainage swales or downchutes.

The general form of Manning's equation is:

$$V = \frac{1.49R^{0.667}S^{0.5}}{n}$$

Where, V = Velocity of flow, fps

n = Manning's "n"

R = Hydraulic Radius, ft, or

$$R = \frac{A}{P}$$

S = Friction slope for non-uniform flow or channel slope for uniform flow, ft/ft

A = Area of water perpendicular to direction of flow, sf

P = Wetted perimeter, ft

Using the relationship Q = VA, Manning's equation can be written as:

$$Q = \frac{1.49AR^{0.667}S^{0.5}}{n}$$

The uniform flow assumption equates the slope of the structure to the friction slope. Therefore, the slope of the channel can be used for "S" in Manning's equation for computation of uniform flow. Using the peak flow rate for a 25-year storm event calculated using the Rational Method (described above), the velocity and peak flow depth within drainage swales and downchutes was calculated using Manning's equation.

The following assumptions were used when evaluating the peak velocity with drainage swales and downchutes:

- Drainage swales will be grass-lined for velocities less than or equal to 6 fps. These structures were designed assuming a Manning's "n" of 0.027.

- When velocities exceed permissible velocities, typically downchutes and some channels, the structure will be lined with armoring materials, as described below.

- Armoring materials will be geomembrane or hydroturf for downchutes. Downchutes were designed assuming a Manning's "n" of 0.027, as this surface roughness provides the greatest flow depth within the respective structure for the referenced armoring material.

- Energy dissipation in the form of gabions, rip rap, or dissipation blocks will be installed at the confluence of downchutes and the landfill toe of slope and/or perimeter drainage channels.

Both the drainage swale and downchute cross-sections will be designed with a minimum 1-foot freeboard and will be capable of retaining the peak flow rate, as calculated using the rational method described above. A peak flow analysis was performed for drainage swales and downchutes installed on final cover. Calculations using Manning's equation for the hydraulic properties of the drainage swales and downchutes were performed using the AutoCAD Civil 3D Hydraflow Express Extension (2018). This flow analysis and the Hydraflow Express output summary sheets for these calculations are presented in Appendix E-4.

2.2.3 Flow Capacity of Perimeter Drainage Channels

Perimeter drainage channels were designed to convey runoff from the developed landfill property to down-gradient detention basins or offsite discharge locations. The peak flow rates obtained from HEC-HMS for contributing subbasins were used to evaluate the flow capacity of the perimeter drainage channels. Hydraflow Express was used to confirm that the designed channel geometry, depth, and invert slope will provide sufficient capacity to discharge the 25-year, 24-hour storm event. The following assumptions were incorporated into the channel modeling:

- Manning's coefficient values of 0.027 for grass-lined channels or 0.033 for rip rap or TRM-lined channels was used for the analysis.

- Channels were designed with trapezoidal cross-sections with 2H:1V sideslopes.

- Each channel was analyzed for peak flow for the 25-year, 24-hour storm event, and then a minimum 1-foot of freeboard above the flow depth associated with the peak flow rate was added to the channel design.

Information derived from the Hydraflow Express output files includes channel flow depth and peak velocity at the peak flow conditions. The respective Hydraflow Express output files for each of the perimeter channels are included in Attachment E-4.

2.2.4 Detention Basin Outlet Structures

As part of this permit modification application, the surface water drainage system for the NELF will now have two detention ponds (South Pond and Southeast Pond) in series located to the south of the existing C&D disposal area. The South Pond will discharge to Southeast Pond via two (2), 24-inch diameter corrugated metal pipes (CMPs). The Southeast Pond is a zero-discharge pond during the design storm event. Two detention ponds (North Pond and Northwest Pond) in series will be located on the north side of the proposed landfill. The North pond will discharge to the Northwest Pond with three (3), 36-inch diameter concrete culverts. The Northwest Pond has one discharge point, where it will discharge to a location to the northwest of the landfill (i.e., Point of Discharge, POD-1) via seven (7), 30-inch concrete culverts.

Elevation-area-discharge relationships were developed for each detention basin based on varying hydraulic heads on each specific outlet structure configuration. These elevation-area-discharge relationships were input into the HEC-HMS model for routing runoff through the detention basins and ultimately to offsite discharge location. The discharge relationships for each detention basin are provided in Attachment E-1 of this Appendix. Permit Drawing No. 24 depicts the detention basin outlet structure, including each outlet elevation and dimensions. This information is also summarized in Section 4 of this attachment.

2.3 SOIL LOSS ANALYSIS METHODS

The Universal Soil Loss Equation (USLE)/Revised Universal Soil Loss Equation (RUSLE) was used to calculate the soil loss resulting from precipitation contacting the final cover. The estimated soil loss was compared to the permissible soil loss for final cover, in accordance with published literature. The USLE/RUSLE is an empirical equation which estimates soil losses from rainfall and runoff. The USLE was developed by statistical analysis of many plot-years of rainfall, runoff, and sediment loss data from many small plots located around the country. The USLE is supported by the National Resource Conservation Service (NRCS). The Universal Soil Loss Equation is:

$$A=RKLSCP$$

Where A = average annual soil loss (tons/acre/ year)

R = rainfall and runoff erosivity index for a given location

K = soil erodibility factor

L = slope length factor

S = slope steepness factor

C = cover and management factor

P = erosion control practice factor

The input parameters into the USLE/RUSLE and soil loss calculations for are presented in Attachment E-4 of this appendix.

The purpose of calculating the soil loss from final cover is to evaluate the frequency (i.e., spacing between drainage swales) at which the drainage swales must be installed to maintain soil loss at less than or equal to 3 tons/acre/year (maximum permissible soil loss recommended for final cover slopes). The analysis for the topslope is based on the greatest flow length on the 4 percent topslope. Drainage swales on final cover sideslopes will be installed at a maximum spacing of 160 horizontal feet or 40 vertical feet, assuming a 4H:1V sideslope. Soil loss calculations for final cover were based on the assumption that vegetation would be established following application of final cover, and that the vegetation would provide approximately 90 percent ground coverage. Based on the results, the maximum erosion potential of the final cover was estimated to be 0.20 tons/acre/year and 1.8 tons/acre/year on the topslope and sideslope, respectively.

3.0 PRE-DEVELOPMENT CONDITIONS

The pre-development conditions are defined as existing drainage patterns associated with the upstream drainage areas of adjacent properties that contribute run-on to the permit boundary property, and the existing permitted landfill, including drainage areas, drainage swales/downchutes, and channels, consistent with the previously approved Tier I Permit Modification, Vertical Expansion of the Northeast C&D Landfill, dated June 2013 prepared by Shepard Engineering.

Surface water from the southern portion of the existing disposal area flows into one existing pond located to the south of the disposal area. According to the previously approved Tier 1 Permit Modification, the existing pond of the C&D disposal area was designed with 2-feet freeboard and no discharge structures. As such, the South Pond was designed to be a zero-discharge pond. Therefore, the majority of the southern portion of the existing landfill area does not contribute to the pre-development flow discharging to POD-2. Drainage area, Pre_A_South, is an area south of the existing C&D disposal area that sheet flows off the property to POD-2.

Surface water from the existing C&D disposal areas, including northern drainage areas, areas discharging to the eastern perimeter channels, portion of the western perimeter channels, and the entire expansion area (i.e, north of the existing C&D disposal area) flows into a natural stream within the expansion area footprint. This natural stream flows from east to northwest across the property discharging to POD-1 and then flows towards the nearby Cutcho Creek. There are five off-site run-on areas that are adjacent to the proposed expansion area that discharge to the stream within the expansion area. OFS-A1-North and OFS-A2-North, each to the north of the proposed expansion area, are direct run-on areas to the on-site stream. OFS-A-East area flow enters the proposed expansion through a 36-in by 48-in elliptical corrugated metal culvert, and discharges to the on-site stream. OFS-B1-East and OFS-B2-East areas each sheet flow into the expansion area, and discharge to the on-site stream.

Pre-development conditions, including on- and off-site drainage areas and POD-1 and 2 locations are depicted on Drawing E1.

4.0 POST-DEVELOPMENT CONDITIONS

Post-development conditions with delineated drainage areas and direction of surface water flow to each detention basin and POD are depicted on Drawing E2. Additionally, a general layout of the post-development drainage system, including perimeter drainage channels and detention basins, is also presented on Drawing E2. As shown, rainfall contacting the landfill topslope and sideslopes will be collected as runoff in drainage swales located at set intervals (see Section 2.2.2) on the 4H:1V sideslopes. Runoff will flow within the drainage swales, roughly parallel to the slope, into downchutes that will convey runoff to the toe of the landfill and into the perimeter drainage channels or discharge directly into detention basins.

The perimeter drainage channels discharge into one of three detention basins: South Pond, North Pond, and Northwest Pond. East perimeter channels discharge into the North Pond, which discharges to the Northwest Pond with three (3), 36-inch diameter concrete culverts. West perimeter channels primarily discharge into the Northwest Pond, with exception to a small section of the west perimeter channels which discharge into the South Pond. The Northwest Pond discharges through the basin outlet structure, comprised of seven (7), 30-inch diameter concrete culverts, towards POD-1. The south perimeter channels and a portion of the west perimeter channels discharge into the South Pond. The existing South Pond of the C&D disposal area has been modified as two separate larger South and Southeast Ponds, in series, as part of this permit application. The South and Southeast Ponds have been designed to control the corresponding final cover area consistent with the drainage areas depicted on Drawing E2. The South Pond will discharge to Southeast Pond via two (2), 24-inch diameter CMP culverts. There is no outlet structure for the Southeast Pond, as this is a zero-discharge pond consistent with the pre-development conditions.

4.1 PERIMETER CHANNEL DESIGN

The channels were designed to have peak flow velocities of less than 6 feet per second where only vegetation is proposed for the channel lining. For velocities greater than approximately 6 feet per second, the channels were designed with either rip rap lining, gabions, or TRM. The hydraulic analysis of the perimeter drainage channels is described in Subsection 2.2.3. As described in this subsection, the peak flow rates in the channels were determined from the HEC-HMS output for the respective contributing drainage areas. The peak velocity and flow depth within each channel were calculated using HydraFlow Express, based on the proposed channel geometry. A summary of the channel design parameters, which were incorporated into HEC-HMS and HydraFlow Express, are included in Attachment E-1. Additionally, the HydraFlow output files for each channel are included in Attachment E-4. A typical cross-section is presented on Permit Drawing No.23.

4.2 DETENSION BASIN DESIGN

The South and Southeast Ponds have been designed to control the corresponding final cover area consistent with the drainage areas depicted on Drawing E2. The South Pond will discharge to Southeast Pond via two (2), 24-inch diameter CMP culverts. There is no outlet structure for the Southeast Pond, as this is a zero-discharge pond. The North Pond and Northwest Pond have been designed for storm water routed from the proposed C&D landfill based on the post-development runoff characteristics modeled in HEC-HMS, as described in Section 2 of this attachment. The North Pond will discharge to Northwest Pond via three (3), 36-inch diameter concrete culverts. The outlet structure of the Northwest Pond will be comprised of seven, 30-inch diameter concrete culverts discharging to POD-1. Additionally, each detention basin has been designed with a minimum 1-foot of freeboard to prevent overtopping during the design storm event.

Elevation-area-discharge relationships for the basins are presented in Attachment E-1. HEC-HMS output for the detention basins, including the peak discharge, storage, and pool depth associated with the 25-year, 24-hour storm event is presented in Attachment E-3. This information also has been summarized in Table E-1. Detention basin layout plans are depicted on Permit Drawing No. 22.

4.3 BASIN OUTLET STRUCTURE DESIGN

The South Pond discharges into the Southeast Pond, which has no discharge consistent with the current Storm Water Drainage Design Plan for the C&D Landfill (Permit No. 3555050) and as shown in post-development HEC-HMS output file (Attachment E-3). The North Pond discharges into the Northwest Pond, which discharge to off-site at POD-1. Peak discharge rates were calculated for North and Northwest Pond's detention basin outlet structures, as described in Subsection 2.2.4 of this submittal. As previously described, the peak discharge rates were incorporated into the elevation-area-discharge relationships used in the HEC-HMS model, as provided in Attachment E-1. Design details for the culverts are shown on Permit Drawing No. 24. Additionally, Table E-2 describes the culvert outlet dimensions/elevations.

Table E-1. Detention Basin Peak Storage and Discharge

Detention Basin	Discharge Points	Peak Storage (acre-feet)	Peak Pool Depth (ft msl)	Peak Discharge (cfs)
North Pond	Northwest Pond	6.6	1199.0	211.0
Northwest Pond	POD-1	7.4	1175.7	260.2
South Pond	Southeast Pond	4.9	1200.5	8.7
Southeast Pond	N/A	4.0	1201.0	0.0

Table E-2. Culvert Outlet Configuration Summary

Detention Basin	Discharge Points	Basin Invert Elevation (ft msl)	Diameter of Pipe (inches)	Number of Culverts	Downstream Invert Elevation (ft msl)	Culvert Length (ft)
North Pond	Northwest Pond	1191.0	36	3	1176.0	250
Northwest Pond	POD-1	1167.0	30	7	1166.0	100
South Pond	Southeast Pond	1194	24	2	1199.0	80

4.4 NORTH OFF-SITE RUN-ON CONTROL CHANNEL

A run-on control channel was designed along the north property boundary of the C&D expansion, which will convey run-on from drainage areas OFS_A_North, OFS_A_East, and OFS_B_East to POD-1 consistent with pre-development drainage conditions. This run-on control channel allows the diversion of stormwater from these off-site drainage areas without impacting the proposed landfill surface water management system design. The North Run-on Control Channel will have peak flow velocities of less than 6 feet per second during the design storm event, as such vegetation is proposed for the channel lining. The hydraulic analysis of the North Run-on Control Channel is included in Attachment E-4.

5.0 SUMMARY OF RESULTS

The pre-development subbasins, as described in Section 3, are presented on Drawing E1. Input parameters for the HEC-HMS modeling performed for pre-development conditions are presented in tables included in Attachment E-1. The results of HEC-HMS modeling of the pre-development conditions are included in Attachment E-2.

Post-development conditions are represented by the fully developed landfill, with final closure having been completed, and all drainage features in-place and operational, as described in Section 4 and presented on Drawing E2. The post-development discharge conditions were analyzed at the same POD as pre-development conditions. Input parameters for the HEC-HMS modeling performed for post-development conditions are presented in tables included in Attachment E-1. The results of HEC-HMS modeling of the post-development conditions are included in Attachment E-3.

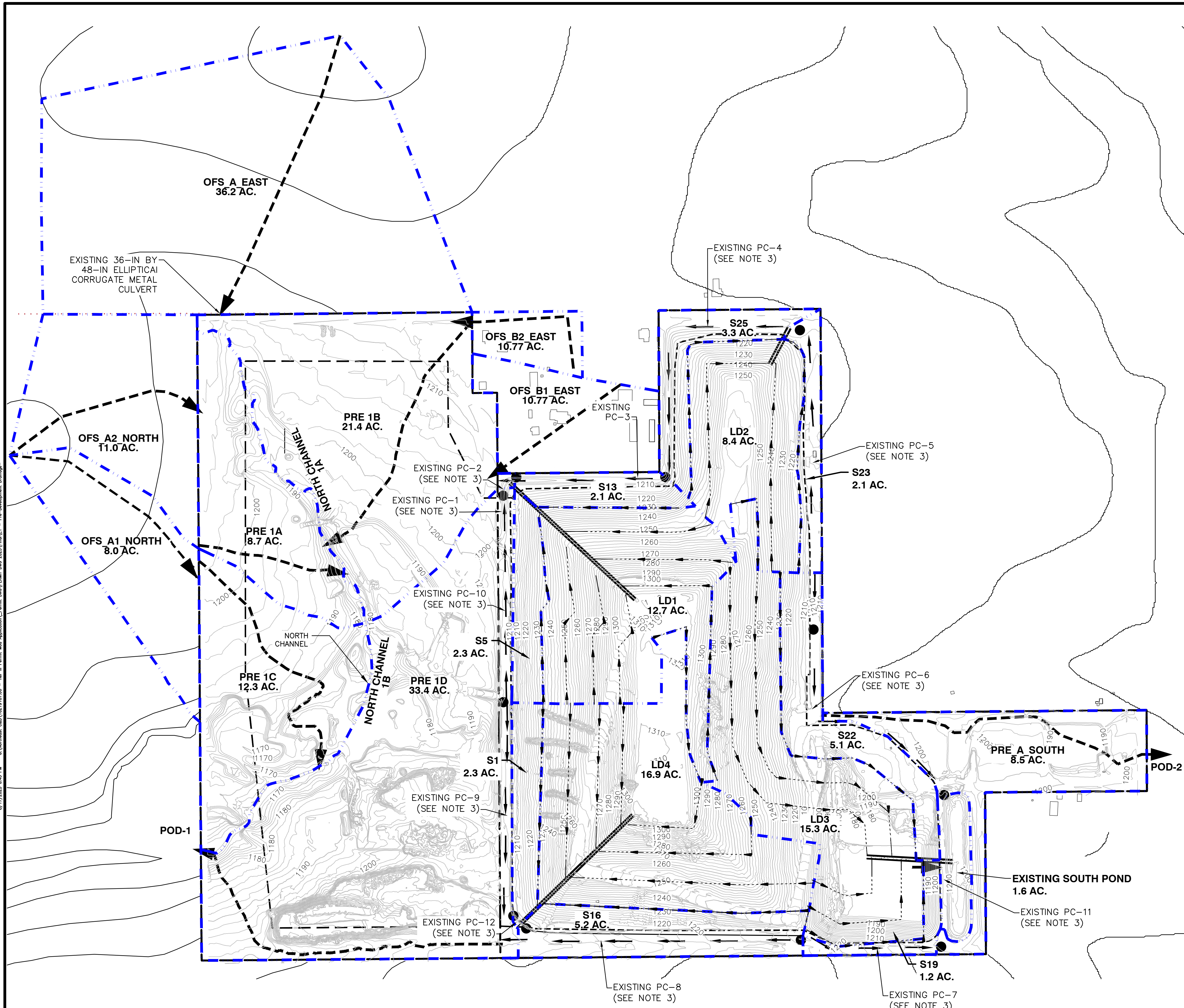
The pre- and post-development peak discharge rates are summarized in Table E-3. As shown in this table, the landfill development will not result in significant increases in peak discharge rates at the PODs as demonstrated by comparison of the pre- and post-development conditions. Therefore, no adverse impact to existing drainage patterns will result from the proposed landfill development.

Discharge velocities from the property will be below the 6 feet per second threshold, which typically is considered the threshold for erosion damage. This will be accomplished by dissipating discharge velocities at the basin outlet structures prior to off-site discharge. Velocity dissipation from the outlet structures will be provided by either rip rap blankets, dissipation blocks or stilling basins installed at the outlet of each structure.

Table E-3. Comparison of Pre- and Post-Development Peak Discharge Rates

Discharge Point	Peak Pre-Development Discharge Rate (cfs)	Peak Post-Development Discharge Rate (cfs)
POD-1	487.5	396.4
POD-2	13.2	10.9

DRAWINGS



LEGEND

- CURRENT PERMIT BOUNDARY
- CURRENT LIMITS OF WASTE
- PROPOSED PERMIT BOUNDARY
- PROPOSED LIMITS OF WASTE
- 1210 EXISTING CONTOUR (SEE NOTE 1)
- EXISTING ROADS
- PERMITTED DOWNCHUTES
- PERMITTED DRAINAGE SWALE
- DRAINAGE AREA BOUNDARY
- CHANNEL SECTION

NOTES:

1. EXISTING CONTOURS ARE FROM AERIAL PHOTOGRAPHY PERFORMED BY COOPER AERIAL SURVEYS CO. ON 01/23/2023, AND USGS TOPO SURVEY (2017).
2. PRE-DEVELOPMENT CONDITIONS ASSUME THE EXISTING PERMITTED LANDFILL IS CONSTRUCTED CONSISTENT WITH PERMIT NO. 3555050.
3. THE STORMWATER MANAGEMENT SYSTEM FOR THE EXISTING PERMITTED LANDFILL, INCLUDING DRAINAGE AREAS, DRAINAGE SWALES/DOWNCHUTES, AND CHANNELS IS CONSISTENT WITH PREVIOUSLY APPROVED TIER I PERMIT MODIFICATION APPLICATION PREPARED BY SHEPARD ENGINEERING, DATED SEPTEMBER 12, 2012.

RYAN KUNTZ
26326
LICENSED PROFESSIONAL ENGINEER
OKLAHOMA
8/18/2023

FOR PERMITTING PURPOSES ONLY

REV	DATE	DESCRIPTION	BY

DRAWING TITLE: PRE-DEVELOPMENT CONDITION

PROJECT TITLE: NORTHEAST LANDFILL TIER III PERMIT MODIFICATION APPLICATION

CLIENT: N.E. LAND FILL, LLC
NORTHEAST LANDFILL
2601 NORTH MIDWEST BLVD.
SPENCER, OK 73084

SCS ENGINEERS
STEARNS, CONRAD AND SCHMIDT
CONSULTING ENGINEERS
1901 CENTRAL DRIVE, SUITE 550, BEDFORD, TX 76021
PH (817) 571-2288 FAX NO. (817) 571-2188

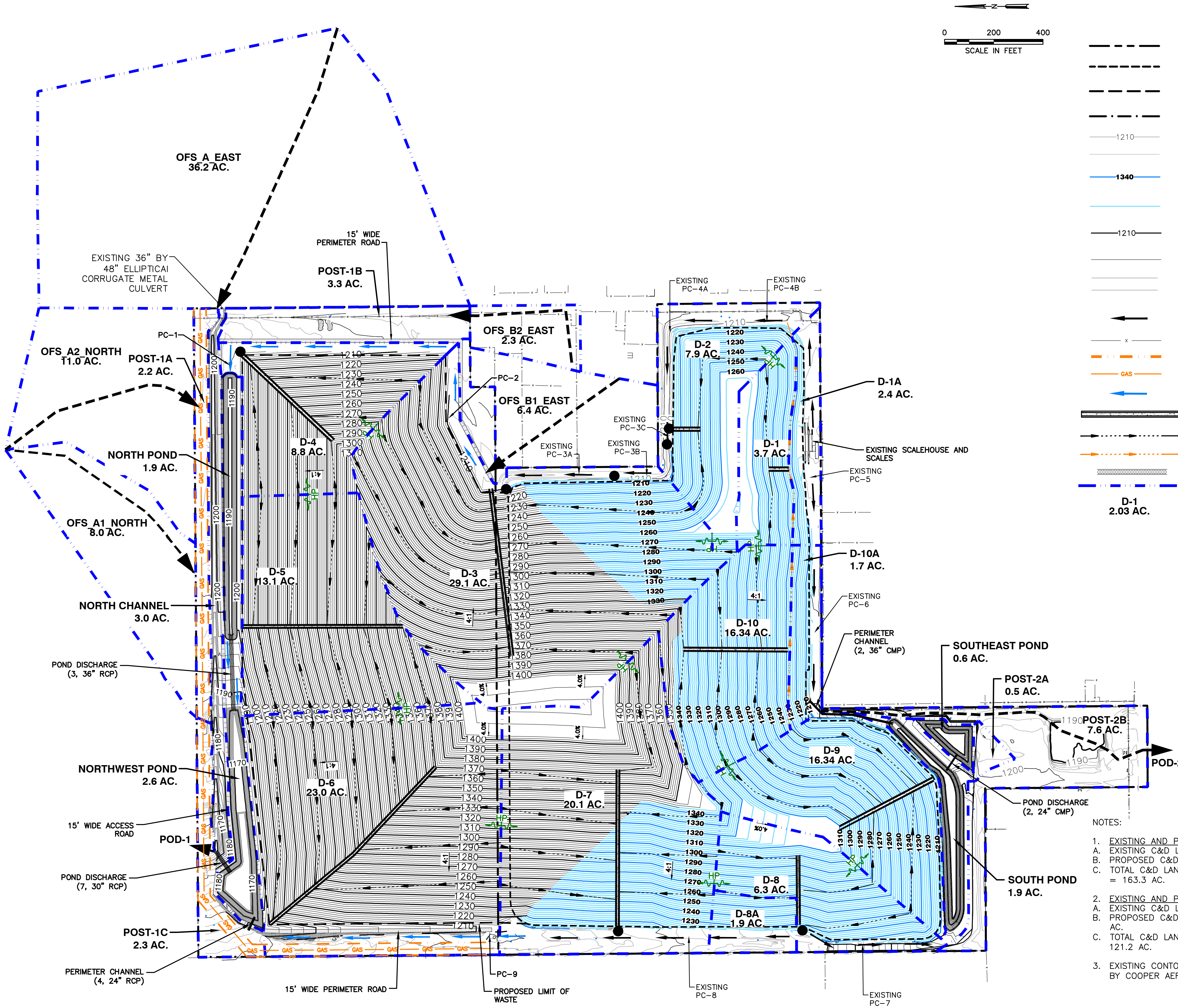
PROJ. NO. 16219107.00 | DSN. BY: SS | DWN. BY: DS | CHK. BY: SDS | Q/A RVW BY: SS | APP. BY: RRK

CADD FILE: E1 – PRE-DEVELOPMENT DRAINAGE-

DATE: 08/2023

SCALE: AS SHOWN

DRAWING NO. E1



LEGEND

- EXISTING C&D LANDFILL PERMIT BOUNDARY (SEE NOTE 1)
- EXISTING C&D LANDFILL LIMITS OF WASTE (SEE NOTE 2)
- PROPOSED C&D LANDFILL EXPANSION PERMIT BOUNDARY (SEE NOTE 1)
- PROPOSED C&D EXPANSION AREA LIMITS OF WASTE (SEE NOTE 2)
- 1210 — EXISTING 10' CONTOUR (SEE NOTE 3)
- EXISTING 2' CONTOUR (SEE NOTE 3)
- 1340 — 10' FINAL GRADES IN PERMITTED C&D DISPOSAL AREA
- 2' FINAL GRADES IN PERMITTED C&D DISPOSAL AREA
- 1210 — PROPOSED 10' FINAL GRADES (C&D DISPOSAL AREA)
- PROPOSED 2' FINAL GRADES (C&D DISPOSAL AREA)
- EXISTING ROADS
- EXISTING CHANNEL AND FLOW DIRECTION
- EXISTING FENCE
- PROPOSED EASEMENT
- GAS — PROPOSED GAS LINE
- PROPOSED CHANNEL AND FLOW DIRECTION
- PROPOSED DOWNCHUTES
- PROPOSED DRAINAGE SWALE (TYPE A)
- PROPOSED DRAINAGE SWALE (TYPE B)
- PROPOSED PERIMETER ROAD
- DRAINAGE AREA BOUNDARY
- D-1 2.03 AC. — DRAINAGE AREA

NOTES:

1. EXISTING AND PROPOSED C&D LANDFILL PERMIT BOUNDARY AREA:
   A. EXISTING C&D LANDFILL PERMIT BOUNDARY AREA = 90.1 AC.
   B. PROPOSED C&D LANDFILL PERMIT BOUNDARY AREA = 73.2 AC.
   C. TOTAL C&D LANDFILL PERMIT BOUNDARY (EXISTING AND EXPANSION) = 163.3 AC.
2. EXISTING AND PROPOSED C&D WASTE DISPOSAL BOUNDARY AREA:
   A. EXISTING C&D LANDFILL DISPOSAL AREA = 67.7 AC.
   B. PROPOSED C&D EXPANSION LANDFILL WASTE DISPOSAL AREA = 53.5 AC.
   C. TOTAL C&D LANDFILL DISPOSAL AREA (EXISTING AND EXPANSION) = 121.2 AC.
3. EXISTING CONTOURS ARE FROM AERIAL PHOTOGRAPHY PERFORMED BY COOPER AERIAL SURVEYS CO. ON 01/23/2023.

RYAN KUNTZ 26326 LICENSED PROFESSIONAL ENGINEER OKLAHOMA 8/18/2023

FOR PERMITTING PURPOSES ONLY

REV. | DATE | DESCRIPTION | BY

DRAWING TITLE: **POST-DEVELOPMENT CONDITION**

PROJECT TITLE: **NORTHEAST LANDFILL TIER III PERMIT MODIFICATION APPLICATION**

CLIENT: **N.E. LAND FILL, LLC NORTHEAST LANDFILL 2601 NORTH MIDWEST BLVD. SPENCER, OK 73084**

SCS ENGINEERS
STEARNS, CONRAD AND SCHMIDT CONSULTING ENGINEERS
1901 CENTRAL DRIVE, SUITE 550, BEDFORD, TX 76021
PH (817) 571-2288 FAX NO. (817) 571-2188

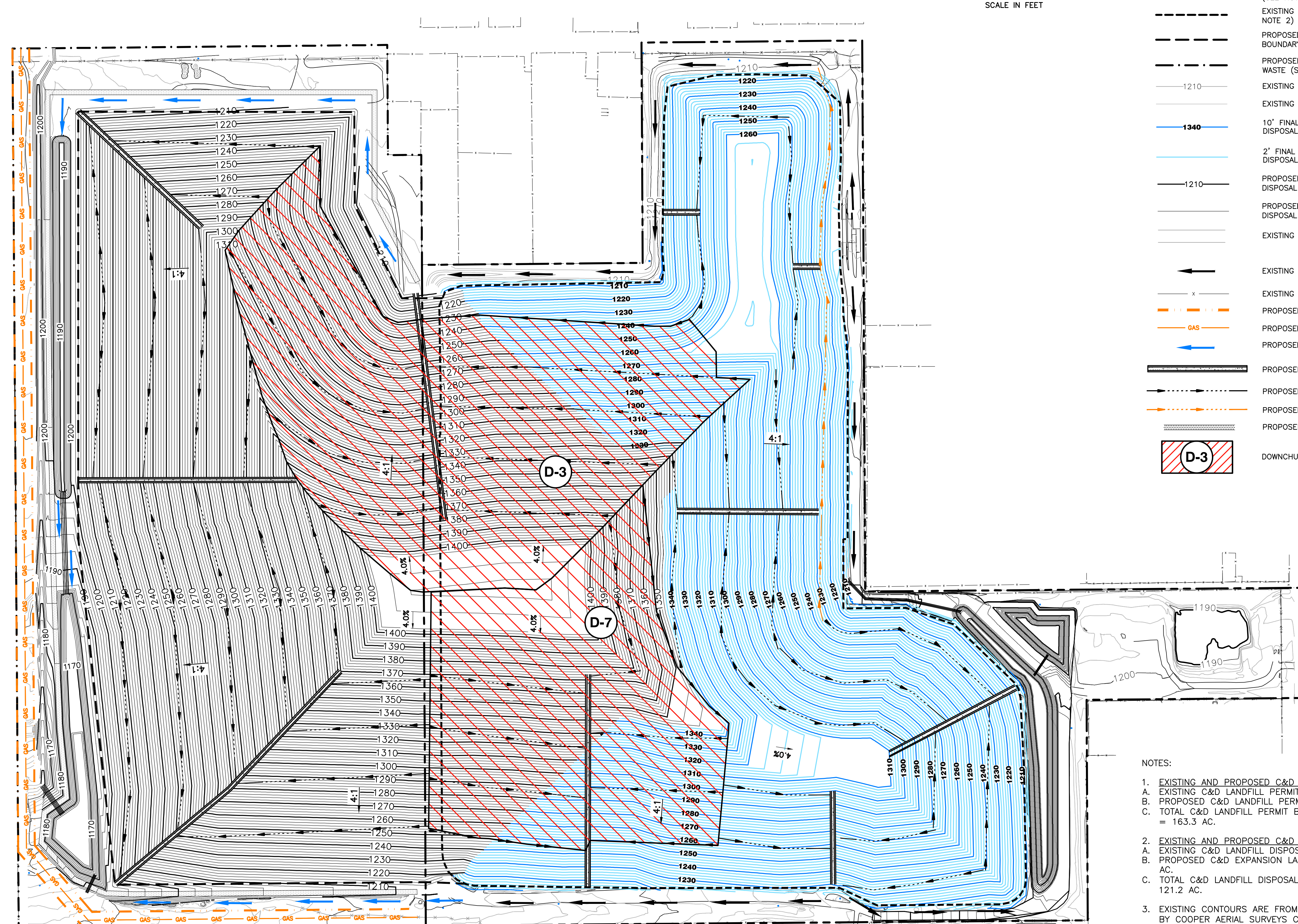
PROJ. NO. 16219107.00 | DSN. BY: SS | DWN. BY: DS | CHK. BY: SDS | Q/A RVW BY: SS | APP. BY: RRK

CADD FILE: E2 - POST DEVELOPMENT CONDITIONS (UPDATED FINAL COVER)

DATE: 08/2023

SCALE: AS SHOWN

DRAWING NO. **E2**



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LEGEND

- EXISTING C&D LANDFILL PERMIT BOUNDARY (SEE NOTE 1)
- EXISTING C&D LANDFILL LIMITS OF WASTE (SEE NOTE 2)
- PROPOSED C&D LANDFILL EXPANSION PERMIT BOUNDARY (SEE NOTE 1)
- PROPOSED C&D EXPANSION AREA LIMITS OF WASTE (SEE NOTE 2)
- 1210 — EXISTING 10' CONTOUR (SEE NOTE 3)
- EXISTING 2' CONTOUR (SEE NOTE 3)
- 1340 — 10' FINAL GRADES IN PERMITTED C&D DISPOSAL AREA
- 2' FINAL GRADES IN PERMITTED C&D DISPOSAL AREA
- 1210 — PROPOSED 10' FINAL GRADES (C&D DISPOSAL AREA)
- PROPOSED 2' FINAL GRADES (C&D DISPOSAL AREA)
- EXISTING ROADS
- EXISTING CHANNEL AND FLOW DIRECTION
- EXISTING FENCE
- PROPOSED EASEMENT
- GAS — PROPOSED GAS LINE
- PROPOSED CHANNEL AND FLOW DIRECTION
- PROPOSED DOWNCHUTES
- PROPOSED DRAINAGE SWALE (TYPE A)
- PROPOSED DRAINAGE SWALE (TYPE B)
- PROPOSED PERIMETER ROAD
- D-3 DOWNCHUTE DRAINAGE AREA

LICENSED PROFESSIONAL ENGINEER
RYAN KUNTZ
26326
OKLAHOMA
8/18/2023

NOTES:

1. EXISTING AND PROPOSED C&D LANDFILL PERMIT BOUNDARY AREA:
A. EXISTING C&D LANDFILL PERMIT BOUNDARY AREA = 90.1 AC.
B. PROPOSED C&D LANDFILL PERMIT BOUNDARY AREA = 73.2 AC.
C. TOTAL C&D LANDFILL PERMIT BOUNDARY (EXISTING AND EXPANSION) = 163.3 AC.

2. EXISTING AND PROPOSED C&D WASTE DISPOSAL BOUNDARY AREA:
A. EXISTING C&D LANDFILL DISPOSAL AREA = 67.7 AC.
B. PROPOSED C&D EXPANSION LANDFILL WASTE DISPOSAL AREA = 53.5 AC.
C. TOTAL C&D LANDFILL DISPOSAL AREA (EXISTING AND EXPANSION) = 121.2 AC.

3. EXISTING CONTOURS ARE FROM AERIAL PHOTOGRAPHY PERFORMED BY COOPER AERIAL SURVEYS CO. ON 01/23/2023.

FOR PERMITTING PURPOSES ONLY

REV	DATE	DESCRIPTION	BY

DRAWING TITLE: POST-DEVELOPMENT DOWNCHUTE AREAS

PROJECT TITLE: NORTHEAST LANDFILL TIER III PERMIT MODIFICATION APPLICATION

CLIENT: N.E. LAND FILL, LLC
NORTHEAST LANDFILL
2601 NORTH MIDWEST BLVD.
SPENCER, OK 73084

SCS ENGINEERS
STEARNS, CONRAD AND SCHMIDT
CONSULTING ENGINEERS
1901 CENTRAL DRIVE, SUITE 550, BEDFORD, TX 76021
PH (817) 571-2288 FAX NO. (817) 571-2188

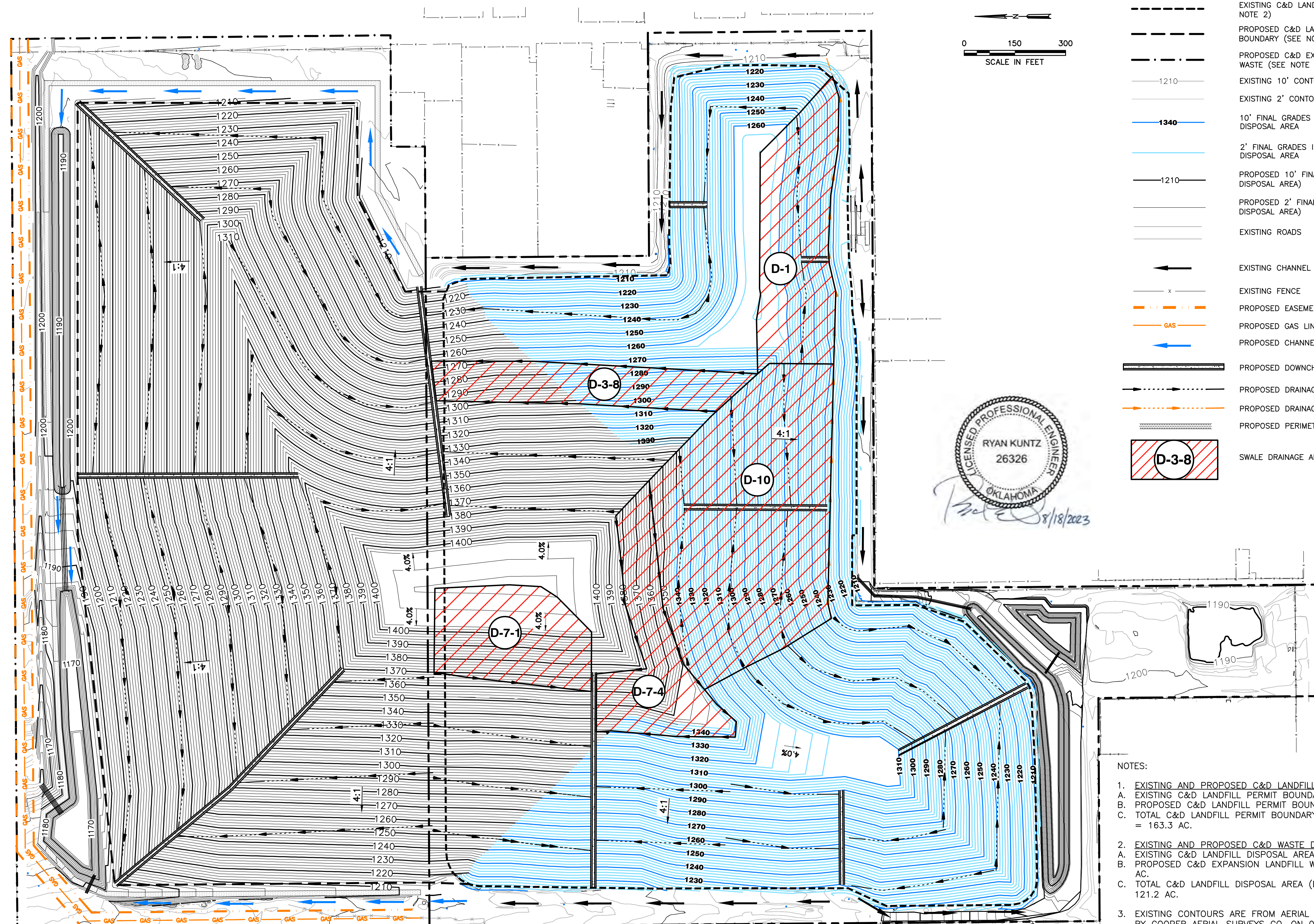
PROJ. NO. 16219107.00 | DSN. BY: SS | DWN. BY: DS | CHK. BY: SDS | Q/A RVW BY: SS | APP. BY: RRK

CADD FILE: E2 – POST DEVELOPMENT CONDITIONS (UPDATED FINAL COVER)

DATE: 08/2023

SCALE: AS SHOWN

DRAWING NO. **E3**



LEGEND

- EXISTING C&D LANDFILL PERMIT BOUNDARY (SEE NOTE 1)
- EXISTING C&D LANDFILL LIMITS OF WASTE (SEE NOTE 2)
- PROPOSED C&D LANDFILL EXPANSION PERMIT BOUNDARY (SEE NOTE 1)
- PROPOSED C&D EXPANSION AREA LIMITS OF WASTE (SEE NOTE 2)
- 1210 — EXISTING 10' CONTOUR (SEE NOTE 3)
- EXISTING 2' CONTOUR (SEE NOTE 3)
- 1340 — 10' FINAL GRADES IN PERMITTED C&D DISPOSAL AREA
- 2' FINAL GRADES IN PERMITTED C&D DISPOSAL AREA
- 1210 — PROPOSED 10' FINAL GRADES (C&D DISPOSAL AREA)
- PROPOSED 2' FINAL GRADES (C&D DISPOSAL AREA)
- EXISTING ROADS
- EXISTING CHANNEL AND FLOW DIRECTION
- EXISTING FENCE
- PROPOSED EASEMENT
- GAS — PROPOSED GAS LINE
- PROPOSED CHANNEL AND FLOW DIRECTION
- PROPOSED DOWNCHUTES
- PROPOSED DRAINAGE SWALE (TYPE A)
- PROPOSED DRAINAGE SWALE (TYPE B)
- PROPOSED PERIMETER ROAD
- D-3-8 SWALE DRAINAGE AREA

NOTES:

1. <u>EXISTING AND PROPOSED C&D LANDFILL PERMIT BOUNDARY AREA:</u>
   A. EXISTING C&D LANDFILL PERMIT BOUNDARY AREA = 90.1 AC.
   B. PROPOSED C&D LANDFILL PERMIT BOUNDARY AREA = 73.2 AC.
   C. TOTAL C&D LANDFILL PERMIT BOUNDARY (EXISTING AND EXPANSION) = 163.3 AC.
2. <u>EXISTING AND PROPOSED C&D WASTE DISPOSAL BOUNDARY AREA:</u>
   A. EXISTING C&D LANDFILL DISPOSAL AREA = 67.7 AC.
   B. PROPOSED C&D EXPANSION LANDFILL WASTE DISPOSAL AREA = 53.5 AC.
   C. TOTAL C&D LANDFILL DISPOSAL AREA (EXISTING AND EXPANSION) = 121.2 AC.
3. EXISTING CONTOURS ARE FROM AERIAL PHOTOGRAPHY PERFORMED BY COOPER AERIAL SURVEYS CO. ON 01/23/2023.

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REV	DATE	DESCRIPTION	BY

DRAWING TITLE: POST-DEVELOPMENT DRAINAGE SWALE AREAS

PROJECT TITLE: NORTHEAST LANDFILL TIER III PERMIT MODIFICATION APPLICATION

CLIENT: N.E. LAND FILL, LLC NORTHEAST LANDFILL 2601 NORTH MIDWEST BLVD. SPENCER, OK 73084

SCS ENGINEERS
STEARNS, CONRAD AND SCHMIDT
CONSULTING ENGINEERS
1901 CENTRAL DRIVE, SUITE 550, BEDFORD, TX 76021
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PROJ. NO. 16219107.00 | DSN. BY: SS | DWN. BY: DS | CHK. BY: SDS | Q/A RVW BY: SS | APP. BY: RRK

CADD FILE: E2 – POST DEVELOPMENT CONDITIONS (UPDATED FINAL COVER)

DATE: 08/2023

SCALE: AS SHOWN

DRAWING NO. E4

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ATTACHMENT E-1

HEC-HMS INPUT PARAMETERS

- Pre-development Subbasins
- Post-development Subbasins
- Perimeter Drainage Channels
- Post-Development Detention Basins (Elevation-Area-Discharge Relationships)
- Precipitation Data
- NRCS Curve Numbers
- Manning's Coefficients
- Kinematic Wave Method – Roughness Factors
- Permissible Non-erosive Velocities

PRE-DEVELOPMENT SUBBASINS

SCS METHOD INPUT PARAMETERS

2-yr, 24-hr Rainfall Depth = 3.75 inches

Discharge Study Point	Contributing Drainage Areas	Drainage Areas		Curve Number (CN)	Sheet Flow				Shallow Concentrated Flow				Open Channel Flow								Time of Concentration (Tc)				Total Lag Time
					Surface Description	Length	Slope	Surface Roughness	Surface Description	Length	Slope	Avg. Velocity	Surface Description	Length	Slope	Manning n	Cross-sectional Area	Wetted Perimeter	Hydraulic Radius	Avg. Velocity	Sheet Flow T_c	Shallow Concentrated Flow T_c	Channel Flow T_c	Total T_c	
		(acres)	(sq. miles)			(feet)	(ft/ft)			(feet)	(ft/ft)	(ft/s)		(feet)	(ft/ft)		(ft2)	(ft)	(ft)	(ft/s)	(min)	(min)	(min)	(min)	(min)
POD-1	OFS_A_East	36.2	0.0566	69.0	Grass	300	0.013	0.15	Grass	927	0.019	1.0	-	-	-	-	-	-	-	-	26	16	-	42	25
	OFS_B1_East	6.4	0.0099	65.0	Grass	300	0.008	0.15	Grass	316	0.015	1.2	-	-	-	-	-	-	-	-	31	4	-	35	21
	OFS_B2_East	2.3	0.0035	65.0	Grass	300	0.001	0.15	Grass	306	0.003	0.6	-	-	-	-	-	-	-	-	72	9	-	81	49
	OFS_A1_North	8.0	0.0125	69.0	Grass	300	0.010	0.41	Grass	686	0.016	0.9	-	-	-	-	-	-	-	-	64	13	-	77	46
	OFS_A2_North	11.0	0.0172	69.0	Grass	300	0.010	0.41	Grass	660	0.024	1.1	-	-	-	-	-	-	-	-	64	10	-	74	45
	S1	2.3	0.0036	80.0	Grass	120	0.250	0.15	-	-	-	-	-	-	-	-	-	-	-	-	4	-	-	4	2
	S5	2.3	0.0036	80.0	Grass	113	0.250	0.15	-	-	-	-	-	-	-	-	-	-	-	-	4	-	-	4	2
	S13	2.1	0.0033	80.0	Grass	103	0.250	0.15	-	-	-	-	-	-	-	-	-	-	-	-	3	-	-	3	2
	S16	5.2	0.0080	80.0	Grass	180	0.250	0.15	-	-	-	-	-	-	-	-	-	-	-	-	5	-	-	5	3
	S23	2.1	0.0033	80.0	Grass	103	0.250	0.15	-	-	-	-	-	-	-	-	-	-	-	-	3	-	-	3	2
	S25	3.3	0.0052	80.0	Grass	103	0.250	0.15	-	-	-	-	-	-	-	-	-	-	-	-	3	-	-	3	2
	Pre-1A	8.7	0.0137	62.0	Grass	300	0.016	0.15	Grass	308	0.058	1.7	-	-	-	-	-	-	-	-	24	3	-	27	16
	Pre-1B	21.4	0.0335	62.0	Grass	300	0.031	0.15	Grass	811	0.030	1.2	-	-	-	-	-	-	-	-	18	11	-	29	18
	Pre-1C	12.3	0.0192	62.0	Grass	300	0.020	0.15	Grass	972	0.031	1.2	-	-	-	-	-	-	-	-	22	13	-	35	21
	Pre-1D	33.4	0.0521	62.0	Grass	300	0.007	0.15	Grass	1179	0.041	1.4	-	-	-	-	-	-	-	-	34	14	-	48	29
POD-2	S22	5.1	0.0079	62.0	Grass	113	0.250	0.15	-	-	-	-	-	-	-	-	-	-	-	-	4	-	-	4	2
	S19	1.2	0.0018	62.0	Grass	103	0.250	0.15	-	-	-	-	-	-	-	-	-	-	-	-	3	-	-	3	2
	PRE_A_South	8.9	0.0139	68.3	Grass	300	0.037	0.41	Grass	1030	0.005	0.5	-	-	-	-	-	-	-	-	38	35	-	74	44
	Existing South Pond	1.7	0.0026	99.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1

EXISTING CHANNEL INPUT PARAMETERS

	Receiving POD		Channel Length (ft)	Bottom Slope (ft/ft)	Manning Coefficient	Bottom Width (ft)	Side Slope
North Channel 1A	POD-1	North Channel 1B	1615	0.02	0.027	10	4
North Channel 1B	POD-1	-	1303	0.01	0.027	10	4
PC-1	POD-1	Junction-2	150	0.005	0.027	6	2
PC-2	POD-1	PC-1	200	0.005	0.027	6	2
PC-3	POD-1	PC-2	693	0.005	0.027	3	2
PC-4	POD-1	PC-3	1122	0.005	0.027	3	2
PC-5	POD-1	PC-4	1047	0.005	0.027	5	2
PC-6	POD-2	PC-11		0.005	0.027	2	2
PC-7	POD-2	PC-11		0.005	0.027	2	2
PC-8	POD-1	PC-12	1180	0.005	0.027	5	2
PC-9	POD-1	Junction-1	900	0.005	0.027	5	2
PC-10	POD-1	PC-1	856	0.005	0.027	2	2
PC-11	POD-2	South Pond		0.005	0.027	8	2
PC-12	POD-1	Junction-1	100	0.005	0.027	6	2

KINEMATIC WAVE METHOD INPUT PARAMETERS

Discharge Study Point	Contributing Drainage Areas	Drainage Plane			Collector							Main Channel					Area (sq. mi.)	Curve Number (CN)
		Length	Slope	Roughness	Area	No. of Collectors	Length	Slope	Manning's Coefficient	Width	Sideslope	Length	Slope	Manning's Coefficient	Width	Sideslope		
		(ft)	(ft/ft)		(sq. mil.)		(ft)	(ft/ft)		(ft)	xH:1V	(ft)	(ft/ft)		(ft)	xH:1V		
POD-1	LD1	160	0.25	0.15	0.00249	8	434	0.02	0.027	0	3	695	0.25	0.033	15	2	0.020	80.0
	LD2	160	0.25	0.15	0.00326	4	569	0.02	0.027	0	3	268	0.25	0.033	15	2	0.013	80.0
	LD4	160	0.25	0.15	0.00331	8	576	0.02	0.027	0	3	632	0.25	0.033	15	2	0.026	80.0
POD-2	LD3	160	0.250	0.15	0.00398	6	694	0.02	0.027	0	3	400	0.250	0.033	15	2	0.024	80.0

Total Area = **0.279 sq. miles**
Total Area = **178.5 acres**
Permit/Owner Property Total Area = **163.3 acres**

Note:

1. Drainage Areas Pre-10A, Pre-10B, and Pre-11 were not included in the HEC-HMS Model, as these areas do not contribute runoff to pre-development "Points of Demonstration" (POD).

Methodology:

Reference: United States Department of Agriculture. Hydrology National Engineering Handbook, Part 630 (May 2010). Chapter 15, Time of Concentration.

Sheet Flow T_c

$$T_t = \frac{0.007(nl)^{0.8}}{(P_2)^{0.5}S^{0.4}}$$ (ep. 15-8)

where: travel time, h
T_t = Manning's roughness coefficient (0.15, short-grass prairie)
n = sheet flow length, ft
l = 2-year, 24-hour rainfall, in (3.75 inches)
P_2 = slope of land surface, ft/ft
S =

Shallow Concentrated Flow T_c

(Table 15-3 for Short-grass pasture flow type)

$$V = 6.962\ (s)^{0.5}$$

where:
V = Average velocity, ft/s
s = slope of the hydraulic grade line, ft/ft

OFS_B1_East and OFS_B2_East are classified as Nearly bare flow type
(Table 15-3 for Nearly bare flow type)

$$V = 9.965\ (s)^{0.5}$$

where:
V = Average velocity, ft/s
s = slope of the hydraulic grade line, ft/ft

Channel Flow T_c

$$V = \frac{1.49 r^{\frac{2}{3}} s^{\frac{1}{2}}}{n}$$ (eq. 15-10)

where:
V = Average velocity, ft/s
r = hydraulic radius, ft
$= \frac{a}{P_w}$
a = cross-sectional flow area, ft2
P_w = Wetted perimeter, ft
s = slope of the hydraulic grade line, ft/ft
n = Manning's n value for open channel flow (0.027, grass)

Lag time

$$V = 0.6\ T_c$$

where: (eq. 15-3)
L =
T_c = lag, h
time of concentration, h

POST-DEVELOPMENT SUBBASINS

NORTHEAST LANDFILL
SCS METHOD INPUTS
- POST-DEVELOPMENT CONDITIONS -

2-yr, 24-hr Rainfall Depth = 3.75 inches

Discharge Study Point	Contributing Drainage Areas (Subbasins)	Drainage Areas		Curve Number (CN)	Sheet Flow				Shallow Concentrated Flow				Open Channel Flow								Time of Concentration (Tc)				Total Lag Time
					Surface Description	Length	Slope	Surface Roughness	Surface Description	Length	Slope	Avg. Velocity	Surface Description	Length	Slope	Manning n	Cross-sectional Area	Wetted Perimeter	Hydraulic Radius	Avg. Velocity	Sheet Flow T_c	Shallow Concentrated Flow T_c	Channel Flow T_c	Total T_c	
		(acres)	(sq. miles)			(feet)	(ft/ft)			(feet)	(ft/ft)	(ft/s)		(feet)	(ft/ft)		(ft2)	(ft)	(ft)	(ft/s)	(min)	(min)	(min)	(min)	(min)
	North Pond	1.9	0.0029	99.0	Pond	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
	Northwest Pond	2.6	0.0040	99.0	Pond	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
	POST-1A	2.2	0.0035	62.0	Grass	180	0.005	0.15	-	-	-	-	-	-	-	-	-	-	-	-	25	-	-	25	15
	POST-1B	1.8	0.0029	62.0	Grass	57	0.260	0.15	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	2	1
	POST-1C	2.3	0.0036	62.0	Grass	100	0.148	0.15	Grass	651	0.011	0.7	-	-	-	-	-	-	-	-	4	15	-	19	11
	North Channel	3.0	0.0046	62.0	Channel	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
POD-1	OFS_A_East	36.2	0.0566	69.0	Grass	300	0.013	0.15	Grass	800	0.020	1.0	-	-	-	-	-	-	-	-	26	14	-	39	24
	OFS_B1_East	6.4	0.0099	65.0	Grass	300	0.010	0.15	Grass	300	0.016	1.3	-	-	-	-	-	-	-	-	29	4	-	33	20
	OFS_B2_East	2.3	0.0035	65.0	Grass	300	0.010	0.15	Grass	300	0.015	1.2	-	-	-	-	-	-	-	-	29	4	-	33	20
	OFS_A1_North	8.0	0.0125	69.0	Grass	300	0.030	0.41	Grass	400	0.050	1.6	-	-	-	-	-	-	-	-	41	4	-	46	27
	OFS_A2_North	11.0	0.0172	69.0	Grass	300	0.030	0.41	Grass	400	0.040	1.4	-	-	-	-	-	-	-	-	41	5	-	46	28
	D-1A	2.4	0.0037	80.0	Grass	107	0.250	0.15	-	-	-	-	-	-	-	-	-	-	-	-	3	-	-	3	2
	D-8A	1.9	0.0029	80.0	Grass	192	0.250	0.15	-	-	-	-	-	-	-	-	-	-	-	-	6	-	-	6	3
	South Pond	1.9	0.0026	99.0	Pond	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
	Southeast Pond	0.6	0.0001	99.0	Pond	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
POD-2	POST-2A	0.5	0.0007	62.0	Grass	200	0.120	0.15	-	-	-	-	-	-	-	-	-	-	-	-	8	-	-	8	5
	POST-2B	7.6	0.0121	67.0	Grass	300	0.037	0.41	Grass	1074	0.005	0.5	-	-	-	-	-	-	-	-	38	37	-	75	45
	D-10A	1.7	0.0026	80.0	Grass	300	0.250	0.15	Grass	393	0.005	0.5	-	-	-	-	-	-	-	-	8	13	-	21	13

Total Area = 0.146 sq. miles
Total Area = 93.4 acres
Permit/Owner Property Total Area = 163.3 acres

Methodology:

Reference: United States Department of Agriculture. Hydrology National Engineering Handbook, Part 630 (May 2010). Chapter 15, Time of Concentration.

Sheet Flow T_c

$$T_t = \frac{0.007(nl)^{0.8}}{(P_2)^{0.5}S^{0.4}}$$ (ep. 15-8)

where:

T_t = travel time, h
n = Manning's roughness coefficient (0.15, short-grass prairie)
l = sheet flow length, ft
P_2 = 2-year, 24-hour rainfall, in (3.75 inches)
S = slope of land surface, ft/ft

Shallow Concentrated Flow T_c

(Table 15-3 for Short-grass pasture flow type)

$$V = 6.962\ (s)^{0.5}$$

where:

V = Average velocity, ft/s
s = slope of the hydraulic grade line, ft/ft

OFS_B1_East and OFS_B2_East are classified as Nearly bare flow type
(Table 15-3 for Nearly bare flow type)

$$V = 9.965\ (s)^{0.5}$$

where:

V = Average velocity, ft/s
s = slope of the hydraulic grade line, ft/ft

Channel Flow T_c

$$V = \frac{1.49 r^{\frac{2}{3}} s^{\frac{1}{2}}}{n}$$ (eq. 15-10)

where:

V = Average velocity, ft/s
r = hydraulic radius, ft
$= \frac{a}{P_w}$
a = cross-sectional flow area, ft2
P_w = Wetted perimeter, ft
s = slope of the hydraulic grade line, ft/ft
n = Manning's n value for open channel flow (0.027, grass)

Lag time

$$V = 0.6\, T_c$$ (eq. 15-3)

where:

L = lag, h
T_c = time of concentration, h

NORTHEAST LANDFILL
KINEMATIC WAVE INPUT PARAMETERS
- POST-DEVELOPMENT CONDITIONS -

Discharge Study Point	Contributing Drainage Areas (Subbasins)	Drainage Plane			Collector							Main Channel					Area (sq. mi.)	Curve Number (CN)
		Length	Slope	Roughness	Area	No. of Collectors	Length	Slope	Manning's Coefficient	Width	Sideslope	Length	Slope	Manning's Coefficient	Width	Sideslope		
		(ft)	(ft/ft)		(sq. mil.)		(ft)	(ft/ft)		(ft)	xH:1V	(ft)	(ft/ft)		(ft)	xH:1V		
POD-1	D-1	160	0.25	0.15	0.00146	4	255	0.02	0.027	0	3	100	0.25	0.033	15	2	0.0059	80.0
	D-2	160	0.25	0.15	0.00248	5	432	0.02	0.027	0	3	110	0.25	0.033	15	2	0.0124	80.0
	D-3	160	0.25	0.15	0.00379	12	660	0.02	0.027	0	3	700	0.25	0.033	15	2	0.0455	80.0
	D-4	160	0.25	0.15	0.00197	7	342	0.02	0.027	0	3	505	0.25	0.033	15	2	0.0138	80.0
	D-5	160	0.25	0.15	0.00187	11	325	0.02	0.027	0	3	650	0.25	0.033	15	2	0.0205	80.0
	D-6	160	0.25	0.15	0.00300	12	523	0.02	0.027	0	3	930	0.25	0.033	15	2	0.0360	80.0
	D-7	160	0.25	0.15	0.00315	10	548	0.02	0.027	0	3	580	0.25	0.033	15	2	0.0315	80.0
	D-10	160	0.25	0.15	0.00176	8	306	0.02	0.027	0	3	425	0.25	0.033	15	2	0.0140	80.0
POD-2	D-8	160	0.25	0.15	0.00197	5	343	0.02	0.027	0	3	290	0.25	0.033	15	2	0.0098	80.0
	D-9	160	0.25	0.15	0.00408	4	710	0.02	0.027	0	3	450	0.25	0.033	15	2	0.0163	80.0

Total Area = 0.206 sq. miles
Total Area = 131.6 acres
Waste Diposal Total Area = 121.1 acres

Note:
1. *, Drainage areas indicated with an asterisk, include areas modeled using the Velocity method, as described in Pre-Development.
2. Consistent with the current Surfacewater Management Plan, there is no discharge from the South Pond (i.e. POD-2)

PERIMETER DRAINAGE CHANNELS

Channel Name	Receiving Basin	Receiving POD	Channel Length (ft)	Bottom Slope (ft/ft)	Bottom Width (ft)	Internal Sideslope (XH:1V)	External Sideslope (XH:1V)	Depth (ft)	Mannings Coefficient	Lining Material
PC-1	Northwest Pond	POD 1	170	0.0035	10	3	2	5.30	0.033	Rip-Rap/TRM
PC-2	North Pond	POD 1	1,245	0.0025	10	3	2	5.00	0.027	Grass
PC-3A*	North Pond	POD 1	740	0.0025	5	3	2	4.50	0.027	Grass
PC-3B*	North Pond	POD 1	350	0.0150	5	3	2	3.50	0.033	Rip-Rap/TRM
PC-3C*	North Pond	POD 1	65	0.0025	5	3	2	4.50	0.027	Grass
PC-4A*	North Pond	POD 1	620	0.0025	5	3	2	4.00	0.027	Grass
PC-4B*	North Pond	POD 1	300	0.0100	5	3	2	3.50	0.033	Rip-Rap/TRM
PC-7*	South Pond	POD 2	628	0.0050	5	3	2	3.0	0.027	Grass
PC-8*	Northwest Pond	POD 1	743	0.0100	2	3	2	2.0	0.027	Grass
PC-9	Northwest Pond	POD 1	1,507	0.0100	6	3	2	3.3	0.033	Rip-Rap/TRM
NC-1	NC-2	POD 1	155	0.0250	6	2	2	3.1	0.033	Rip-Rap/TRM
NC-2	NC-3	POD 1	985	0.0030	6	2	2	4.3	0.027	Grass
NC-3	NC-4	POD 1	260	0.0200	6	2	2	3.3	0.033	Rip-Rap/TRM
NC-4	POD-1	POD 1	812	0.0400	6	2	2	3.0	0.033	Rip-Rap/TRM

Note:
*Channels indicated with an asterisk are existing channels of the C&D landfill disposal area.
1. TRM = Turf Reinforcing Mat, a permanent reinforcing mat placed below vegetation layer to increase resistance to erosion.
2. South Pond is an existing pond of the C&D landfill area.

POST-DEVELOPMENT DETENTION BASINS

(ELEVATION-AREA-DISCHARGE RELATIONSHIPS)

NORTHEAST LANDFILL
Elevation-Area-Discharge Relationship
- North Basin -

Elevation	Area (sf)	Area (acres)	Head on Culvert (ft)	Culvert Pipe Discharge (cfs)	Number of Culverts	Total Discharge (cfs)	Use
1190	12,539	0.29	0.0	-	3.0	0.0	Basin Invert
1191	16,777	0.39	0.0	-	3.0	0.0	Sediment Control
1192	21,037	0.48	1.0	-	3.0	0.0	Basin Pool
1193	25,318	0.58	2.0	12.6	3.0	37.9	Basin Pool
1194	29,620	0.68	3.0	30.9	3.0	92.7	Basin Pool
1195	33,945	0.78	4.0	41.9	3.0	125.6	Basin Pool
1196	38,290	0.88	5.0	50.5	3.0	151.4	Basin Pool
1197	42,658	0.98	6.0	57.8	3.0	173.5	Basin Pool
1198	47,047	1.08	7.0	64.4	3.0	193.1	Basin Pool
1199	51,334	1.18	8.0	70.3	3.0	210.8	Basin Pool
1200	55,691	1.28	9.0	75.7	3.0	227.2	Basin Pool

Spillway Outlet Pipe Equation was used for the Culvert Pipe Discharge
Where,

$$Q_p = A\sqrt{\frac{2gH}{1+K_e+K_b+K_cL}}$$

Qp = discharge through the principal spillway pipe (cfs)
A = Cross-sectional area of pipe (ft2)
H = Head above center of pipe at the outfall (ft)
Ke = Entrance loss coefficient (1.0)
Kb = Bend loss coefficient (0.5)
Kc = Friction loss coefficient
L = Length of the pipe (ft)

$$K_c = \frac{5087\ n^2}{d^{\frac{4}{3}}}$$

n = Manning's coefficient; and
d= Diameter of the principal spillway pipe

L =	250.0	
Ke =	1.0	
Kb =	0.5	
Kc =	0.006	
n =	0.012	
d =	36.0	in

**Reference: Manning's coefficent and entrance, friction, and bend coefficients came from Design Hydrology and Sedimentology for Small Catchments. Haan, C.T. Academic Press, 1994.*

NORTHEAST LANDFILL
Elevation-Area-Discharge Relationship
- South Basin -

Elevation	Area (sf)	Area (acres)	Head on Culvert (ft)	Culvert Pipe Discharge (cfs)	Number of Culverts	Total Discharge (cfs)	Use
1194	15,615	0.36	0.0	-	2.0	0.0	Basin Invert
1195	21,017	0.48	0.0	-	2.0	0.0	Sediment Control
1196	26,357	0.61	0.0	-	2.0	0.0	Sediment Control
1197	31,765	0.73	0.0	-	2.0	0.0	Basin Pool
1198	37,238	0.85	0.0	-	2.0	0.0	Basin Pool
1199	42,788	0.98	0.0	-	2.0	0.0	Basin Pool
1200	48,390	1.11	1.0	0.0	2.0	0.0	Basin Pool
1201	54,056	1.24	2.0	9.3	2.0	18.6	Basin Pool
1202	59,762	1.37	3.0	13.9	2.0	27.9	Basin Pool

Spillway Outlet Pipe Equation was used for the Culvert Pipe Discharge
Where,

$$Q_p = A\sqrt{\frac{2gH}{1 + K_e + K_b + K_c L}}$$

Qp = discharge through the principal spillway pipe (cfs)
A = Cross-sectional area of pipe (ft2)
H = Head above center of pipe at the outfall (ft)
Ke = Entrance loss coefficient (1.0)
Kb = Bend loss coefficient (0.5)
Kc = Friction loss coefficient
L = Length of the pipe (ft)

$$K_c = \frac{5087\, n^2}{d^{\frac{4}{3}}}$$

L =	80.0	
Ke =	1.0	
Kb =	0.5	
Kc =	0.042	
n =	0.024	
d =	24.0	in

n = Manning's coefficient; and
d= Diameter of the principal spillway pipe

**Reference: Manning's coefficent and entrance, friction, and bend coefficients came from Design Hydrology and Sedimentology for Small Catchments. Haan, C.T. Academic Press, 1994.*

NORTHEAST LANDFILL
Elevation-Area-Discharge Relationship
- Southeast Basin -

Elevation	Area (sf)	Area (acres)	Head on Channel (ft)	Total Discharge (cfs)	Use
1190	6,745	0.15	0.0	0.0	Basin Invert
1191	8,078	0.19	0.0	0.0	Sediment Control
1192	9,501	0.22	0.0	0.0	Sediment Control
1193	11,004	0.25	0.0	0.0	Basin Pool
1194	12,595	0.29	0.0	0.0	Basin Pool
1195	14,278	0.33	0.0	0.0	Basin Pool
1196	16,042	0.37	0.0	0.0	Basin Pool
1197	17,898	0.41	0.0	0.0	Basin Pool
1198	19,838	0.46	0.0	0.0	Basin Pool
1199	21,857	0.50	0.0	0.0	Basin Pool
1200	23,974	0.55	0.0	0.0	Basin Pool
1201	26,175	0.60	0.0	0.0	Basin Pool
1202	28,466	0.65	0.0	0.0	Basin Pool

NORTHEAST LANDFILL
Elevation-Area-Discharge Relationship
- Northwest Basin -

Elevation	Area (sf)	Area (acres)	Head on Culvert (ft)	Culvert Pipe Discharge (cfs)	Number of Culverts	Total Discharge (cfs)	Use
1165	16,596	0.38	0.0	-	7.0	0.0	Basin Invert
1166	18,391	0.42	0.0	-	7.0	0.0	Sediment Control
1167	20,219	0.46	0.0	-	7.0	0.0	Sediment Control
1168	22,081	0.51	1.0	0.0	7.0	0.0	Sediment Control
1169	27,311	0.63	2.0	9.8	7.0	68.8	Basin Pool
1170	32,726	0.75	3.0	17.0	7.0	119.2	Basin Pool
1171	38,005	0.87	4.0	22.0	7.0	153.9	Basin Pool
1172	42,533	0.98	5.0	26.0	7.0	182.1	Basin Pool
1173	46,037	1.06	6.0	29.5	7.0	206.5	Basin Pool
1174	49,574	1.14	7.0	32.6	7.0	228.3	Basin Pool
1175	53,143	1.22	8.0	35.5	7.0	248.2	Basin Pool
1176	56,744	1.30	9.0	38.1	7.0	266.6	Basin Pool
1177	60,377	1.39	10.0	40.5	7.0	283.8	Basin Pool
1178	64,042	1.47	11.0	42.9	7.0	300.1	Basin Pool
1179	67,739	1.56	12.0	45.1	7.0	315.5	Basin Pool
1180	71,469	1.64	13.0	47.2	7.0	330.2	Basin Pool
1181	75,230	1.73	14.0	49.2	7.0	344.2	Basin Pool

Spillway Outlet Pipe Equation was used for the Culvert Pipe Discharge

Where, $$Q_p = A\sqrt{\frac{2gH}{1 + K_e + K_b + K_c L}}$$

Qp = discharge through the principal spillway pipe (cfs)
A = Cross-sectional area of pipe (ft2)
H = Head above center of pipe at the outfall (ft)
Ke = Entrance loss coefficient (1.0)
Kb = Bend loss coefficient (0.5)
Kc = Friction loss coefficient
L = Length of the pipe (ft)

$$K_c = \frac{5087\, n^2}{d^{\frac{4}{3}}}$$

n = Manning's coefficient; and
d= Diameter of the principal spillway pipe

L =	100.0	
Ke =	1.0	
Kb =	0.5	
Kc =	0.008	
n =	0.012	
d =	30.0	in

**Reference: Manning's coefficent and entrance, friction, and bend coefficients came from Design Hydrology and Sedimentology for Small Catchments. Haan, C.T. Academic Press, 1994.*

PRECIPITATION DATA

NOAA Atlas 14, Volume 8, Version 2
Location name: Spencer, Oklahoma, USA*
Latitude: 35.4997°, Longitude: -97.3918°
Elevation: 1199.2 ft**
* source: ESRI Maps
** source: USGS

POINT PRECIPITATION FREQUENCY ESTIMATES

Sanja Perica, Deborah Martin, Sandra Pavlovic, Ishani Roy, Michael St. Laurent, Carl Trypaluk, Dale Unruh, Michael Yekta, Geoffery Bonnin

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches)[1]

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	0.427 (0.332-0.545)	0.497 (0.387-0.635)	0.615 (0.477-0.787)	0.716 (0.552-0.919)	0.858 (0.643-1.14)	0.971 (0.712-1.30)	1.09 (0.772-1.48)	1.21 (0.825-1.68)	1.37 (0.904-1.95)	1.50 (0.963-2.16)
10-min	0.625 (0.486-0.797)	0.728 (0.566-0.930)	0.901 (0.698-1.15)	1.05 (0.808-1.35)	1.26 (0.941-1.66)	1.42 (1.04-1.90)	1.59 (1.13-2.17)	1.77 (1.21-2.46)	2.01 (1.32-2.86)	2.19 (1.41-3.16)
15-min	0.762 (0.593-0.972)	0.888 (0.690-1.13)	1.10 (0.851-1.41)	1.28 (0.985-1.64)	1.53 (1.15-2.03)	1.73 (1.27-2.32)	1.94 (1.38-2.65)	2.15 (1.47-3.01)	2.45 (1.61-3.49)	2.67 (1.72-3.86)
30-min	1.12 (0.868-1.42)	1.30 (1.01-1.66)	1.61 (1.25-2.06)	1.88 (1.45-2.41)	2.26 (1.69-2.98)	2.55 (1.87-3.41)	2.86 (2.03-3.90)	3.18 (2.17-4.43)	3.61 (2.38-5.15)	3.95 (2.54-5.70)
60-min	1.47 (1.14-1.88)	1.72 (1.34-2.19)	2.14 (1.66-2.74)	2.51 (1.93-3.22)	3.04 (2.28-4.02)	3.46 (2.54-4.63)	3.90 (2.77-5.32)	4.36 (2.98-6.08)	4.99 (3.29-7.13)	5.48 (3.53-7.91)
2-hr	1.82 (1.43-2.31)	2.14 (1.68-2.70)	2.67 (2.09-3.39)	3.14 (2.44-3.99)	3.81 (2.89-5.02)	4.36 (3.23-5.80)	4.93 (3.54-6.69)	5.53 (3.82-7.68)	6.36 (4.24-9.04)	7.02 (4.56-10.1)
3-hr	2.04 (1.61-2.56)	2.39 (1.89-3.01)	2.99 (2.36-3.78)	3.53 (2.76-4.47)	4.31 (3.30-5.67)	4.96 (3.70-6.57)	5.63 (4.07-7.63)	6.36 (4.42-8.80)	7.36 (4.94-10.4)	8.16 (5.33-11.7)
6-hr	2.42 (1.93-3.02)	2.83 (2.25-3.52)	3.54 (2.81-4.42)	4.19 (3.31-5.25)	5.16 (3.99-6.75)	5.97 (4.51-7.88)	6.84 (5.00-9.21)	7.78 (5.47-10.7)	9.10 (6.17-12.8)	10.2 (6.70-14.4)
12-hr	2.84 (2.29-3.50)	3.28 (2.64-4.05)	4.08 (3.27-5.05)	4.83 (3.85-6.00)	5.97 (4.68-7.77)	6.95 (5.30-9.11)	8.00 (5.91-10.7)	9.16 (6.51-12.6)	10.8 (7.41-15.2)	12.2 (8.09-17.2)
24-hr	3.27 (2.66-3.99)	3.75 (3.05-4.59)	4.64 (3.76-5.70)	5.49 (4.42-6.76)	6.80 (5.39-8.79)	7.93 (6.12-10.3)	9.16 (6.84-12.2)	10.5 (7.55-14.3)	12.5 (8.62-17.4)	14.1 (9.43-19.7)
2-day	3.73 (3.06-4.51)	4.27 (3.51-5.18)	5.28 (4.33-6.42)	6.23 (5.08-7.60)	7.71 (6.16-9.87)	8.97 (6.99-11.6)	10.3 (7.80-13.7)	11.9 (8.59-16.0)	14.0 (9.79-19.4)	15.8 (10.7-22.0)
3-day	4.05 (3.35-4.87)	4.64 (3.83-5.59)	5.73 (4.72-6.92)	6.74 (5.52-8.17)	8.29 (6.66-10.5)	9.62 (7.53-12.3)	11.1 (8.37-14.5)	12.6 (9.19-17.0)	14.9 (10.4-20.5)	16.7 (11.4-23.2)
4-day	4.32 (3.59-5.18)	4.95 (4.11-5.94)	6.10 (5.04-7.34)	7.15 (5.88-8.64)	8.76 (7.06-11.1)	10.1 (7.95-12.9)	11.6 (8.80-15.1)	13.2 (9.63-17.6)	15.5 (10.9-21.2)	17.3 (11.8-23.9)
7-day	5.01 (4.20-5.96)	5.73 (4.80-6.83)	7.01 (5.84-8.37)	8.15 (6.76-9.77)	9.84 (7.97-12.3)	11.2 (8.88-14.2)	12.7 (9.73-16.4)	14.3 (10.5-19.0)	16.6 (11.7-22.5)	18.4 (12.6-25.2)
10-day	5.62 (4.74-6.66)	6.41 (5.39-7.60)	7.77 (6.51-9.22)	8.95 (7.47-10.7)	10.7 (8.68-13.2)	12.1 (9.59-15.2)	13.6 (10.4-17.4)	15.1 (11.2-20.0)	17.3 (12.3-23.4)	19.0 (13.2-26.1)
20-day	7.37 (6.28-8.64)	8.30 (7.05-9.73)	9.83 (8.33-11.6)	11.1 (9.38-13.1)	13.0 (10.6-15.8)	14.4 (11.5-17.8)	15.9 (12.3-20.1)	17.4 (12.9-22.6)	19.4 (13.9-26.0)	21.0 (14.7-28.6)
30-day	8.79 (7.52-10.2)	9.84 (8.42-11.5)	11.6 (9.87-13.5)	13.0 (11.0-15.3)	15.0 (12.3-18.1)	16.5 (13.3-20.3)	18.0 (14.0-22.7)	19.6 (14.6-25.3)	21.6 (15.6-28.8)	23.2 (16.3-31.4)
45-day	10.5 (9.06-12.2)	11.8 (10.2-13.7)	13.9 (11.9-16.1)	15.5 (13.3-18.2)	17.8 (14.7-21.4)	19.5 (15.8-23.8)	21.2 (16.6-26.5)	22.9 (17.2-29.4)	25.1 (18.1-33.2)	26.7 (18.8-36.0)
60-day	12.0 (10.3-13.8)	13.5 (11.6-15.5)	15.9 (13.7-18.4)	17.8 (15.3-20.7)	20.4 (16.9-24.4)	22.4 (18.1-27.1)	24.3 (19.0-30.2)	26.1 (19.7-33.4)	28.5 (20.6-37.5)	30.2 (21.4-40.6)

[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

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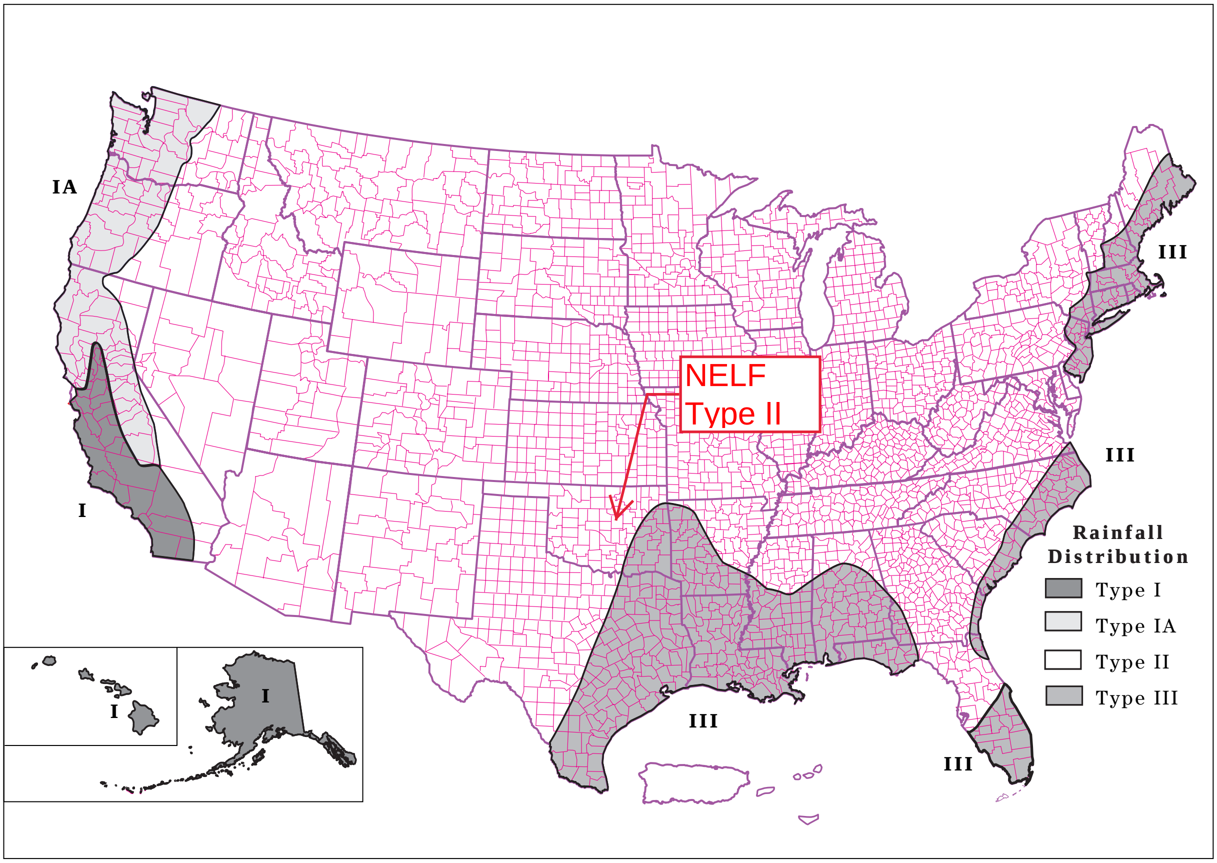
Figure B-2 Approximate geographic boundaries for NRCS (SCS) rainfall distributions



Rainfall data sources

This section lists the most current 24-hour rainfall data published by the National Weather Service (NWS) for various parts of the country. Because NWS Technical Paper 40 (TP-40) is out of print, the 24-hour rainfall maps for areas east of the 105th meridian are included here as figures B-3 through B-8. For the area generally west of the 105th meridian, TP-40 has been superseded by NOAA Atlas 2, the Precipitation-Frequency Atlas of the Western United States, published by the National Ocean and Atmospheric Administration.

East of 105th meridian

Hershfield, D.M. 1961. Rainfall frequency atlas of the United States for durations from 30 minutes to 24 hours and return periods from 1 to 100 years. U.S. Dept. Commerce, Weather Bur. Tech. Pap. No. 40. Washington, DC. 155 p.

West of 105th meridian

Miller, J.F., R.H. Frederick, and R.J. Tracey. 1973. Precipitation-frequency atlas of the Western United States. Vol. I Montana; Vol. II, Wyoming; Vol III, Colorado; Vol. IV, New Mexico; Vol V, Idaho; Vol. VI, Utah; Vol. VII, Nevada; Vol. VIII, Arizona; Vol. IX, Washington; Vol. X, Oregon; Vol. XI, California. U.S. Dept. of Commerce, National Weather Service, NOAA Atlas 2. Silver Spring, MD.

Alaska

Miller, John F. 1963. Probable maximum precipitation and rainfall-frequency data for Alaska for areas to 400 square miles, durations to 24 hours and return periods from 1 to 100 years. U.S. Dept. of Commerce, Weather Bur. Tech. Pap. No. 47. Washington, DC. 69 p.

Hawaii

Weather Bureau. 1962. Rainfall-frequency atlas of the Hawaiian Islands for areas to 200 square miles, durations to 24 hours and return periods from 1 to 100 years. U.S. Dept. Commerce, Weather Bur. Tech. Pap. No. 43. Washington, DC. 60 p.

Puerto Rico and Virgin Islands

Weather Bureau. 1961. Generalized estimates of probable maximum precipitation and rainfall-frequency data for Puerto Rico and Virgin Islands for areas to 400 square miles, durations to 24 hours, and return periods from 1 to 100 years. U.S. Dept. Commerce, Weather Bur. Tech. Pap. No. 42. Washington, DC. 94 P.

NRCS CURVE NUMBERS

Urban Hydrology for Small Watersheds

TR-55

United States Department of Agriculture

Natural Resources Conservation Service

Conservation Engineering Division

Technical Release 55

June 1986

Table 2-2c Runoff curve numbers for other agricultural lands [1]

Pre-Development

Cover description		Curve numbers for hydrologic soil group			
Cover type	Hydrologic condition	A	B	C	D
Pasture, grassland, or range—continuous forage for grazing. [2]	Poor	68	79	86	89
	Fair	49	69	79	84
	Good	39	61	74	80
Meadow—continuous grass, protected from grazing and generally mowed for hay.	—	30	58	71	78
Brush—brush-weed-grass mixture with brush the major element. [3]	Poor	48	67	77	83
	Fair	35	56	70	77
	Good	30 [4]	48	65	73
Woods—grass combination (orchard or tree farm). [5]	Poor	57	73	82	86
	Fair	43	65	76	82
	Good	32	58	72	79
Woods. [6]	Poor	45	66	77	83
	Fair	36	60	73	79
	Good	30 [4]	55	70	77
Farmsteads—buildings, lanes, driveways, and surrounding lots.	—	59	74	82	86

1 Average runoff condition, and $I_a = 0.2S$.

2 *Poor:* <50%) ground cover or heavily grazed with no mulch.
Fair: 50 to 75% ground cover and not heavily grazed.
Good: > 75% ground cover and lightly or only occasionally grazed.

3 *Poor:* <50% ground cover.
Fair: 50 to 75% ground cover.
Good: >75% ground cover.

4 Actual curve number is less than 30; use CN = 30 for runoff computations.

5 CN's shown were computed for areas with 50% woods and 50% grass (pasture) cover. Other combinations of conditions may be computed from the CN's for woods and pasture.

6 *Poor:* Forest litter, small trees, and brush are destroyed by heavy grazing or regular burning.
Fair: Woods are grazed but not burned, and some forest litter covers the soil.
Good: Woods are protected from grazing, and litter and brush adequately cover the soil.

Example Calculation for Pre-1 Area:

Pasture (good cover) = 36 acres
Woods (good cover) = 26 acres
Disturbed Areas (farmsteads) = 14 acres

Weighted Average CN for pre-development= 62

k= 1x10-5 cm/s for erosion layer or equivalent
1x10-5 cm/s: 0.15 in/hr.
(HSG C per TR-55),
Therefore HSG C is used for post-development analysis of the final cover

Table 2-2a Runoff curve numbers for urban areas [1]

Drainage Area, OFS_A_North and East

Post-Development CN = 80 for landfill slopes

Drainage Area, OFS_B_East

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.

MANNING'S COEFFICIENTS

Northeast C&D Landfill
Hydraulic Analysis
Manning's "n" References

Pre-development Conditions

Description	Use	Reference	Mannings "n"
Natural winding streams and creeks.	HEC-HMS Kinematic Wave Method (main channel) and SCS Method (Velocity Method).	See Item 2, Table 4.1, "Design Hydrology and Sedimentology for Small Catchments", Haan et al.	0.040
Straight man-made road side ditches, established channels.	HEC-HMS Kinematic Wave Method (main channel) and SCS Method (Velocity Method).	See Item 1, Table 4.1, "Design Hydrology and Sedimentology for Small Catchments", Haan et al.	0.027

Post-development Conditions

Description	Use	Reference	Mannings "n"
Drainage swales, short grass and some weeds, established channels.	HEC-HMS Kinematic Wave Method model (collector or main channel).	See Item 1, Table 4.1, "Design Hydrology and Sedimentology for Small Catchments", Haan et al.	0.027
Downchutes, geomembrane or hydroturf, established channels.	HEC-HMS Kinematic Wave Method model (main channel).	See Item 1, Table 4.1, "Design Hydrology and Sedimentology for Small Catchments", Haan et al.	0.027
Drainage Channels, short grass and some weeds, established channels	HEC-HMS Muskingum-Cunge Standard model for routing reaches.	See Item 1, Table 4.1, "Design Hydrology and Sedimentology for Small Catchments", Haan et al.	0.027
Drainage Channels, rip rap or TRM lined, established channels.	HEC-HMS Muskingum-Cunge Standard model for routing reaches.	Hydraflow standard default for built-up channels with rip rap. See Item 3, Table 4.1, "Design Hydrology and Sedimentology for Small Catchments", Haan et al.	0.033
CMP channel or detention basin outlet structures	Hydraflow calculations for culverts.	Standard default in Hydraflow program for culverts.	0.024
Concrete detention basin outlet structures	Hydraflow calculations for culverts.	See Item 4, Table 4.1, "Design Hydrology and Sedimentology for Small Catchments", Haan et al.	0.012

Note: Manning's "n" used for drainage swales, downchutes, and culverts were incorporated into HEC-HMS, as well as the Hydraulic Analysis using HydroCalc.

Reference: C.T. Haan, B.J. Barfield, J.C. Hayes. *Design Hydrology and Sedimentology for Small Catchments*. Academic Press. 1994.

Design Hydrology and Sedimentology for Small Catchments

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Academic Press
An Imprint of Elsevier
Amsterdam Boston Heidelberg London New York Oxford
Paris San Diego San Francisco Singapore Sydney Tokyo

An Irish engineer named Manning found that the equation

$$v = KR^{2/3}S^{1/2}$$

fit experimental data quite nicely. This equation is known as Manning's equation and differs from Chezy's equation only in the exponent on R. So that the factor related to the channel roughness would increase as roughness increased, Manning's equation is generally written as

$$v = (1/n)R^{2/3}S^{1/2}$$

in the metric system with v in meters per second and R in meters. The coefficient n is known as Manning's n. In the English system of units, Manning's equation is

$$v = \frac{1.49}{n}R^{2/3}S^{1/2}, \qquad (4.23)$$

where v is in fps, R is in feet, and S is in feet per foot. Tables of Manning's n are widely available. Table 4.1 is such a table taken from several sources, drawing heavily on Schwab *et al.* (1966, 1971). Manning's n is influenced by many factors, including the physical roughness of the channel surface, the irregularity of the channel cross section, channel alignment and bends, vegetation, silting and scouring, and obstruction within the channel. Chow (1959) displays some photographs of typical channels and the associated values for Manning's n.

Figure 4.9 contains some useful relationships for calculating the hydraulic properties of A, P, R, and top width, T, for three common channels. For natural channels, these properties are best determined from measurements based on the actual cross sections of the channel.

Table 4.1 Typical Values for Manning's n

Type and description of conduits	n Values[a] Min.	Design	Max.
Channels, lined			
Asphaltic concrete, machine placed		0.014	
Asphalt, exposed prefabricated		0.015	
Concrete	0.012	0.015	0.018
Concrete, rubble	0.016		0.029
Metal, smooth (flumes)	0.011		0.015
Metal, corrugated	0.021	0.024	0.026
Plastic	0.012		0.014
Shotcrete	0.016		0.017
Wood, planed (flumes)	0.009	0.012	0.016
Wood, unplaned (flumes)	0.011	0.013	0.015
Channels, earth			
Earth bottom, rubble sides	0.028	0.032	0.035
Drainage ditches, large, no vegetation			
(a) < 2.5 hydraulic radius	0.040		0.045
(b) 2.5–4.0 hydraulic radius	0.035		0.040
(c) 4.0–5.0 hydraulic radius	0.030		0.035
(d) > 5.0 hydraulic radius	0.025		0.030
3 Small drainage ditches	0.035	0.040	0.040
Stony bed, weeds on bank	0.025	0.035	0.040
Straight and uniform	0.017	0.0225	0.025
Winding, sluggish	0.0225	0.025	0.030
Channels, vegetated			
(See subsequent discussion)			

Used 0.033

Type and description of conduits	n Values[a] Min.	Design	Max.
Natural Streams			
1 (a) Clean, straight bank, full stage, no rifts or deep pools	0.025	0.027	0.033
(b) Same as (a) but some weeds and stones	0.030		0.040
2 (c) Winding, some pools and shoals, clean	0.035	0.040	0.050
(d) Same as (c), lower stages, more ineffective slopes and sections	0.040		0.055
(e) Same as (c), some weeds and stones	0.033		0.045
(f) Same as (d), stony sections	0.045		0.060
(g) Sluggish river reaches, rather weedy or with very deep pools	0.050		0.080
(h) Very weedy reaches	0.075		0.150
Pipe			
Asbestos cement		0.009	
Cast iron, coated	0.011	0.013	0.014
Cast iron, uncoated	0.012		0.015
Clay or concrete drain tile (4–12 in.)	0.010	0.0108	0.020
4 Concrete	0.010	0.014	0.017
Metal, corrugated	0.021	0.025	0.0255
Steel, riveted and spiral	0.013	0.016	0.017
Vitrified sewer pipe	0.010	0.014	0.017
Wood stave	0.010	0.013	
Wrought iron, black	0.012		0.015
Wrought iron, galvanized	0.013	0.016	0.017

Used 0.012

[a]Selected from numerous sources.

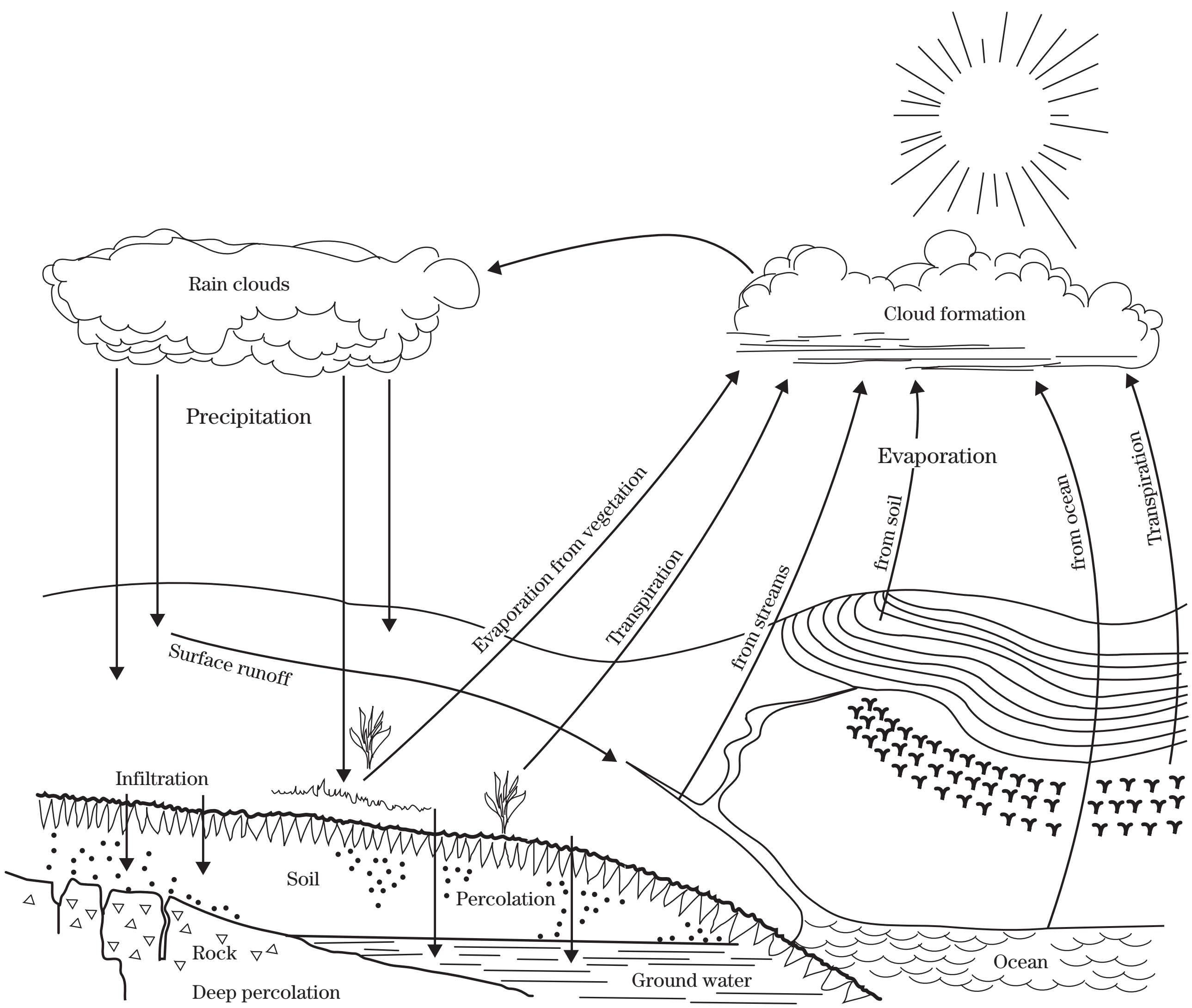
KINEMATIC WAVE METHOD/VELOCITY METHOD – REFERENCE FORMULA

United States
Department of
Agriculture

Natural Resources Conservation Service

Part 630 Hydrology
National Engineering Handbook

Chapter 15 Time of Concentration



Thick mulches in forests are associated with low retardance factors and reflect high degrees of retardance, as well as high infiltration rates. Hay meadows have relatively low retardance factors. Like thick mulches in forests, stem densities in meadows provide a high degree of retardance to overland flow in small watersheds. Conversely, bare surfaces with little retardance to overland flows are represented by high retardance factors.

The retardance factor is approximately the same as the curve number (CN) as defined in NEH630.09, Hydrologic Soil-Cover Complexes. In practical usage, CN is used as a surrogate for cn´, and the CN tables in NEH 630.09 may be used to approximate cn´ in equations 15–4a and 15–4b. A CN of less than 50, or greater than 95 should not be used in the solution of equations 15–4a and 15–4b (Mockus 1961).

Applications and limitations—The watershed lag equation was developed using data from 24 watersheds ranging in size from 1.3 acres to 9.2 square miles, with the majority of the watersheds being less than 2,000 acres in size (Mockus 1961). Folmar and Miller (2000) revisited the development of this equation using additional watershed data and found that a reasonable upper limit may be as much as 19 square miles.

(b) Velocity method

Another method for determining time of concentration normally used within the NRCS is called the velocity method. The velocity method assumes that time of concentration is the sum of travel times for segments along the hydraulically most distant flow path.

$$T_c = T_{t1} + T_{t2} + T_{t3} + \ldots T_{tn} \qquad \text{(eq. 15–7)}$$

where:
T_c = time of concentration, h
T_{tn} = travel time of a segment n, h
n = number of segments comprising the total hydraulic length

The segments used in the velocity method may be of three types: sheet flow, shallow concentrated flow, and open channel flow.

Sheet flow—Sheet flow is defined as flow over plane surfaces. Sheet flow usually occurs in the headwaters of a stream near the ridgeline that defines the watershed boundary. Typically, sheet flow occurs for no more than 100 feet before transitioning to shallow concentrated flow (Merkel 2001).

A simplified version of the Manning's kinematic solution may be used to compute travel time for sheet flow. This simplified form of the kinematic equation was developed by Welle and Woodward (1986) after studying the impact of various parameters on the estimates.

$$T_t = \frac{0.007(n\ell)^{0.8}}{(P_2)^{0.5} S^{0.4}} \qquad \text{(eq. 15–8)}$$

where:
T_t = travel time, h
n = Manning's roughness coefficient (table 15–1)
ℓ = sheet flow length, ft
P_2 = 2-year, 24-hour rainfall, in
S = slope of land surface, ft/ft

Pre-Development,
Grass: Short grass prairie n = 0.15
OFS_A_North, bermudagrass n = 0.41
Post-Development, landfill final cover
Grass: Short grass prairie n = 0.15.

Table 15–1 Manning's roughness coefficients for sheet flow (flow depth generally ≤ 0.1 ft)

Surface description	n [1]
Smooth surface (concrete, asphalt, gravel, or bare soil)	0.011
Fallow (no residue)	0.05
Cultivated soils:	
Residue cover ≤ 20%	0.06
Residue cover > 20%	0.17
Grass:	
Short-grass prairie	0.15
Dense grasses [2]	0.24
Bermudagrass	0.41
Range (natural)	0.13
Woods: [3]	
Light underbrush	0.40
Dense underbrush	0.80

1 The Manning's n values are a composite of information compiled by Engman (1986).
2 Includes species such as weeping lovegrass, bluegrass, buffalo grass, blue grama grass, and native grass mixtures.
3 When selecting n, consider cover to a height of about 0.1 ft. This is the only part of the plant cover that will obstruct sheet flow.

This simplification is based on the following assumptions:

- shallow steady uniform flow
- constant rainfall excess intensity (that part of a rain available for runoff) both temporally and spatially
- 2-year, 24-hour rainfall assuming standard NRCS rainfall intensity-duration relations apply (Types I, II, and III)
- minor effect of infiltration on travel time

For sheet flow, the roughness coefficient includes the effects of roughness and the effects of raindrop impact including drag over the surface; obstacles such as litter, crop ridges, and rocks; and erosion and transport of sediment. These *n* values are only applicable for flow depths of approximately 0.1 foot or less, where sheet flow occurs. Table 15–1 gives roughness coefficient values for sheet flow for various surface conditions.

Kibler and Aron (1982) and others indicated the maximum sheet flow length is less than 100 feet. To support the sheet flow limit of 100 feet, Merkel (2001) reviewed a number of technical papers on sheet flow. McCuen and Spiess (1995) indicated that use of flow length as the limiting variable in the equation 15–8 could lead to less accurate designs, and proposed that the limitation should instead be based on:

$$\ell = \frac{100\sqrt{S}}{n} \qquad \text{(eq. 15–9)}$$

where:
n = Manning's roughness coefficient
ℓ = limiting length of flow, ft
S = slope, ft/ft

Table 15–2 provides maximum sheet flow lengths based on the McCuen-Spiess limiting criteria for various cover type—*n* value—slope combinations.

Table 15–2 Maximum sheet flow lengths using the McCuen-Spiess limitation criterion

Cover type	*n* values	Slope (ft/ft)	Length (ft)
Range	0.13	0.01	77
Grass	0.41	0.01	24
Woods	0.80	0.01	12.5
Range	0.13	0.05	172
Grass	0.41	0.05	55
Woods	0.80	0.05	28

Shallow concentrated flow—After approximately 100 feet, sheet flow usually becomes shallow concentrated flow collecting in swales, small rills, and gullies. Shallow concentrated flow is assumed not to have a well-defined channel and has flow depths of 0.1 to 0.5 feet. It is assumed that shallow concentrated flow can be represented by one of seven flow types. The curves in figure 15–4 were used to develop the information in table 15–3.

To estimate shallow concentrated flow travel time, velocities are developed using figure 15–4, in which average velocity is a function of watercourse slope and type of channel (Kent 1964). For slopes less than 0.005 foot per foot, the equations in table 15–3 may be used.

After estimating average velocity using figure 15–4, use equation 15–1 to estimate travel time for the shallow concentrated flow segment.

Open channel flow— Shallow concentrated flow is assumed to occur after sheet flow ends at shallow depths of 0.1 to 0.5 feet. Beyond that channel flow is assumed to occur. Open channels are assumed to begin where surveyed cross-sectional information has been obtained, where channels are visible on aerial photographs, or where bluelines (indicating streams) appear on U.S. Geological Survey (USGS) quadrangle sheets.

Manning's equation or water surface profile information can be used to estimate average flow velocity. Average flow velocity is usually determined for the bankfull elevation.

Manning's equation is:

$$V = \frac{1.49 r^{\frac{2}{3}} s^{\frac{1}{2}}}{n} \qquad \text{(eq. 15–10)}$$

Figure 15–4 Velocity versus slope for shallow concentrated flow

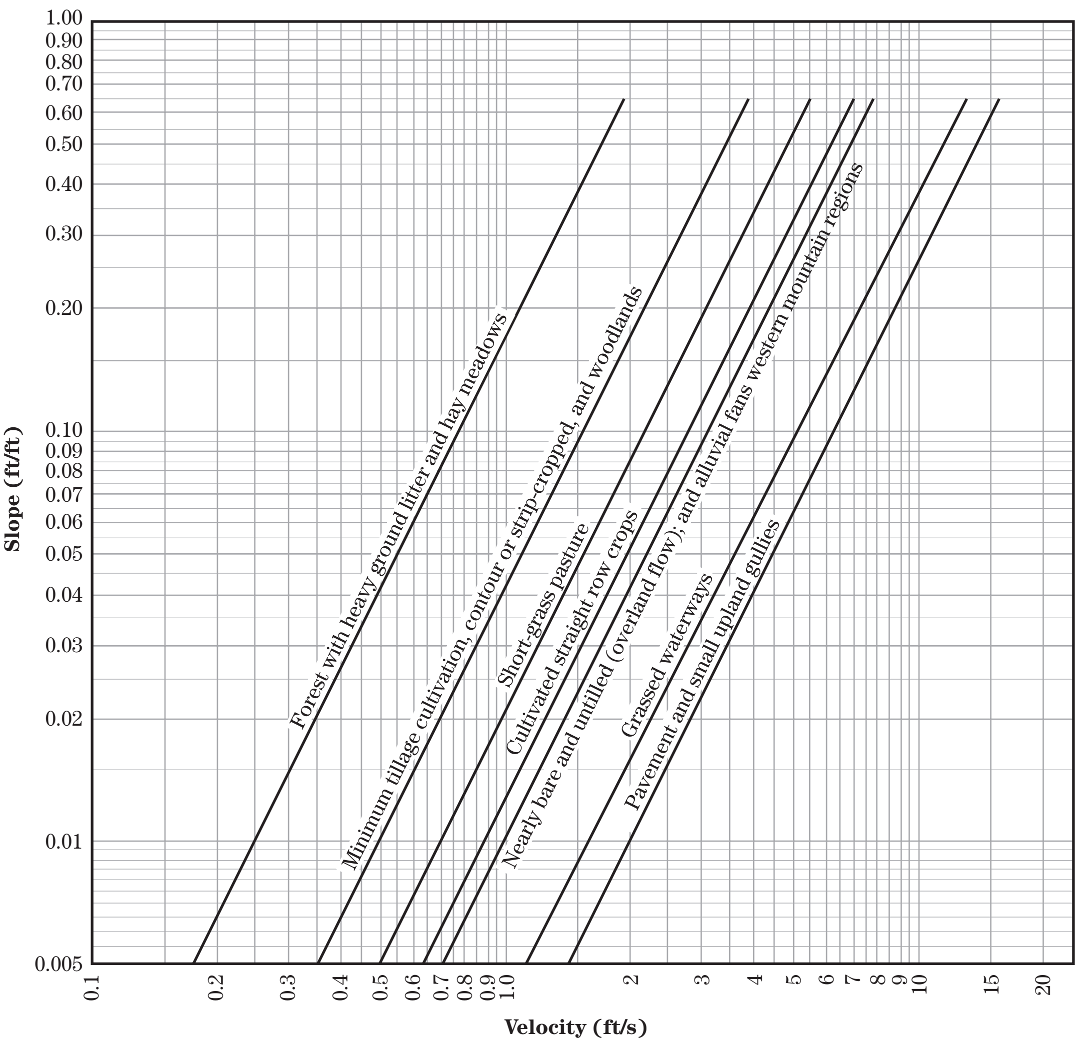


Table 15–3 Equations and assumptions developed from figure 15–4

Flow type	Depth (ft)	Manning's *n*	Velocity equation (ft/s)
Pavement and small upland gullies	0.2	0.025	$V = 20.328(s)^{0.5}$
Grassed waterways	0.4	0.050	$V=16.135(s)^{0.5}$
Nearly bare and untilled (overland flow); and alluvial fans in western mountain regions	0.2	0.051	$V=9.965(s)^{0.5}$
Cultivated straight row crops	0.2	0.058	$V=8.762(s)^{0.5}$
Short-grass pasture	0.2	0.073	$V=6.962(s)^{0.5}$
Minimum tillage cultivation, contour or strip-cropped, and woodlands	0.2	0.101	$V=5.032(s)^{0.5}$
Forest with heavy ground litter and hay meadows	0.2	0.202	$V=2.516(s)^{0.5}$

where:

V = average velocity, ft/s

r = hydraulic radius, ft

$= \frac{a}{P_w}$

a = cross-sectional flow area, ft^2

P_w = wetted perimeter, ft

s = slope of the hydraulic grade line (channel slope), ft/ft

n = Manning's *n* value for open channel flow

Manning's *n* values for open channel flow can be obtained from standard hydraulics textbooks, such as Chow (1959), and Linsley, Kohler, and Paulhus (1982). Publications dealing specifically with Manning's *n* values are Barnes (1967); Arcement and Schneider (1989); Phillips and Ingersoll (1998); and Cowen (1956). For guidance on calculating Manning's *n* values, see NEH630.14, Stage Discharge Relations.

Applications and limitations—The velocity method of computing time of concentration is hydraulically sound and provides the opportunity to incorporate changes in individual flow segments if needed. The velocity method is the best method for calculating time of concentration for an urbanizing watershed or if hydraulic changes to the watercourse are being considered.

Often, the average velocity and valley length of a reach are used to compute travel time through the reach using equation 15–1. If the stream is quite sinuous, the channel length and valley length may be significantly different and it is up to the modeler to determine which is the appropriate length to use for the depth of flow of the event under consideration.

The role of channel and valley storage is important in the development and translation of a flood wave and the estimation of lag. Both the hydraulics and storage may change from storm to storm and the velocity distribution may vary considerably both horizontally and vertically. As a result, actual lag for a watershed may have a large variation. In practice, calculations are typically based on the 2-year frequency discharge event since it is normally assumed that the time of concentration computed using these characteristics is representative of travel time conditions for a wide range of storm events. Welle and Woodward's simplification of Manning's kinematic equation was developed assuming the 2-year, 24-hour precipitation value.

630.1503 Other considerations

(a) Field observations

At the time field surveys to obtain channel data are made, there is a need to observe the channel system and note items that may affect channel efficiency. Observations such as the type of soil materials in the banks and bottoms of the channel; an estimate of Manning's roughness coefficients; the apparent stability or lack of stability of channel; indications of debris flows as evidenced by deposition of coarse sediments adjacent to channels, size of deposited materials, etc., may be significant.

(b) Multiple subarea watersheds

For multiple subarea watersheds, the time of concentration must be computed for each subarea individually, and consideration must be given to the travel time through downstream subareas from upstream subareas. Travel time and attenuation of hydrographs in valley reaches and reservoirs are accounted for using channel and reservoir routing procedures addressed in NEH630.17.

(c) Surface flow

Both of the standard methods for estimating time of concentration, as well as most other methods, assume that flow reaching the channel as surface flow or quick return flow adds directly to the peak of the subarea hydrograph. Locally derived procedures might be developed from data where a major portion of the contributing flow is other than surface flow. This is normally determined by making a site visit to the watershed.

(d) Travel time through bodies of water

The potential for detention is the factor that most strongly influences travel time through a body of water. It is best to divide the watershed such that any potential storage area is modeled as storage.

PERMISSIBLE NON-EROSIVE VELOCITIES

Design Hydrology and Sedimentology for Small Catchments

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Academic Press
An Imprint of Elsevier
Amsterdam Boston Heidelberg London New York Oxford
Paris San Diego San Francisco Singapore Sydney Tokyo

where the value of I is

Retardance	I
A	10.000
B	7.643
C	5.601
D	4.436
E	2.876

This relationship can be used in computer programs to make hydraulic computations for vegetated waterways. The relationships should not be used outside the range of the curves shown in Fig. 4.14.

The graphs of Fig. 4.15 are solutions to Manning's equation using the curves in Fig. 4.14. They can be used as a design aid for solving Manning's equation for all retardance classes.

Example Problem 4.11 Vegetated channel 1

Design a channel to carry 25 cfs on a 4% slope. Use a parabolic channel. The soil is easily eroded, and the grass may be mowed to 2.5 in. or it may be uncut.

Solution: Select Bermuda grass. Bermuda grass is in retardance B if unmowed and retardance D if mowed. The permissible velocity is selected from Table 4.5 as 6 fps. First design for the mowed condition

$$A = Q/v = 25/6 = 4.17\ \text{ft}^2.$$

Table 4.4 Guide to Selection of Vegetal Retardance[a]

Stand	Length of vegetation (in.)	Retardance class
Good	>30	A
	11–24	B
	6–10	C
	2–6	D
	<2	E
Fair	>30	B
	11–24	C
	6–10	D
	2–6	D
	<2	E

[a]Soil Conservation Service (1979) engineering field manual.

Table 4.5 Permissible velocities for Vegetated Channels (Ree, 1949)

	Permissible velocity (fps)					
	Erosion-resistant soils (% slope)			Easily eroded soils (% slope)		
Cover	0–5	5–10	Over 10	0–5	5–10	Over 10
Bermuda grass	8	7	6	6	5	4
Buffalo grass Kentucky bluegrass Smooth brome Blue grama Tall fescue	7	6	5	5	4	3
Lespedeza sericea Weeping lovegrass Kudzu Alfalfa Crabgrass	3.5	NR[a]	NR	2.5	NR	NR
Grass mixture	5	4	NR	4	3	NR
Annuals for temporary protection	3.5	NR	NR	2.5	NR	NR

[a]Not recommended.

Vegetated Perimeter Channels and Drainage Swales

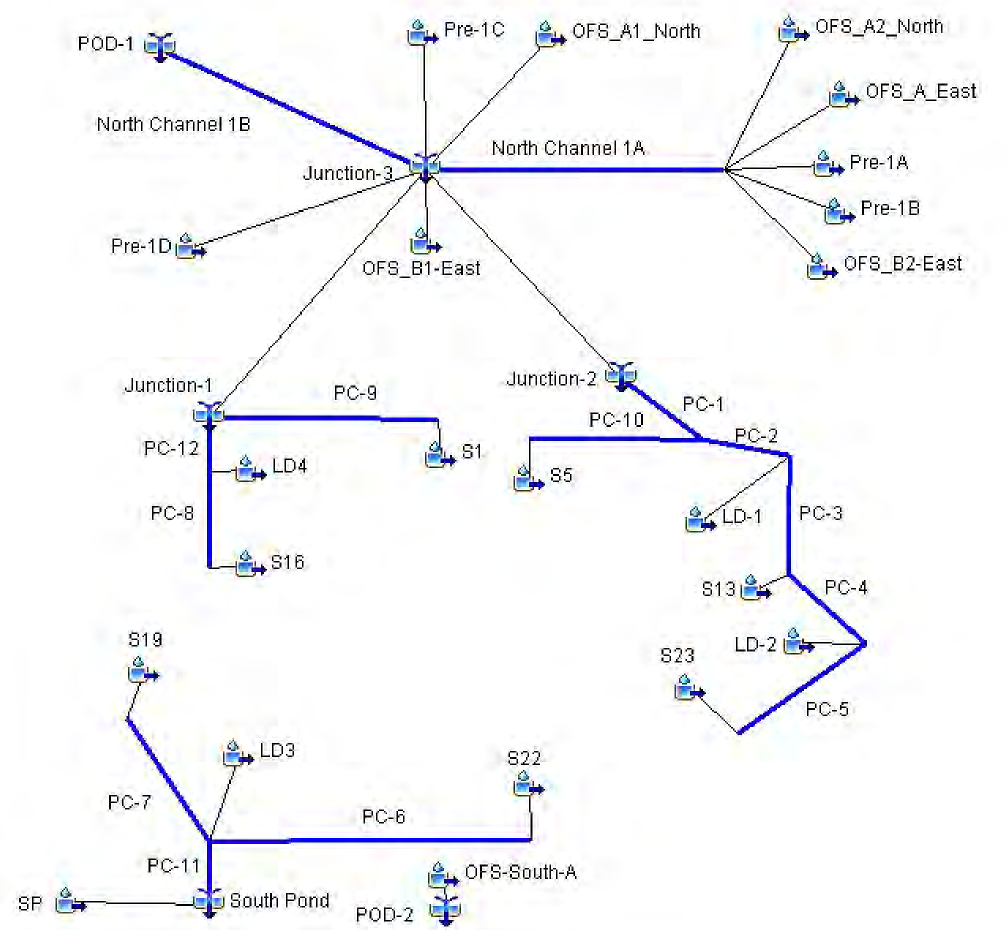
Final Cover Slopes

ATTACHMENT E-2

HEC-HMS PRE-DEVELOPMENT INPUT/OUTPUT FILES

PRE-DEVELOPMENT INPUT FILES

NORTHEAST C&D LANDFILL
HEC-HMS INPUT SCHEMATIC
PRE-DEVELOPMENT CONDITIONS



```
Basin: Pre-Develop (old areas)
     Last Modified Date: 6 June 2023
     Last Modified Time: 22:32:30
     Version: 4.0
     Filepath Separator: \
     Unit System: English
     Missing Flow To Zero: No
     Enable Flow Ratio: No
     Compute Local Flow At Junctions: No

     Enable Sediment Routing: No

     Enable Quality Routing: No
End:

Subbasin: OFS_A_East
     Canvas X: 6660.95670111288
     Canvas Y: 6379.309483306841
     From Canvas X: -2831.517124607006
     From Canvas Y: -4775.213005735265
     Area: 0.0566
     Downstream: North Channel 1A

     Canopy: None
     Plant Uptake Method: None

     Surface: None

     LossRate: SCS
     Percent Impervious Area: 0.0
     Curve Number: 69

     Transform: SCS
     Lag: 25
     Unitgraph Type: STANDARD

     Baseflow: None
End:

Subbasin: Pre-1B
     Canvas X: 6541.896740858507
     Canvas Y: 4135.0932432432455
     From Canvas X: -413.14042960330244
     From Canvas Y: -647.1761069387071
     Area: 0.0333
     Downstream: North Channel 1A

     Canopy: None
     Plant Uptake Method: None
```

```
     Surface: None

     LossRate: SCS
     Percent Impervious Area: 0.0
     Curve Number: 62

     Transform: SCS
     Lag: 1
     Unitgraph Type: STANDARD

     Baseflow: None
End:

Subbasin: OFS_A2_North
     Canvas X: 5671.875
     Canvas Y: 7625.0
     From Canvas X: 4263.482815442561
     From Canvas Y: 2378.556967984933
     Area: 0.0172
     Downstream: North Channel 1A

     Canopy: None
     Plant Uptake Method: None

     Surface: None

     LossRate: SCS
     Percent Impervious Area: 0.0
     Curve Number: 69

     Transform: SCS
     Lag: 46
     Unitgraph Type: STANDARD

     Baseflow: None
End:

Subbasin: Pre-1A
     Canvas X: 6337.062400635934
     Canvas Y: 5031.243481717013
     From Canvas X: -413.14042960330244
     From Canvas Y: -647.1761069387071
     Label X: 0.0
     Label Y: -1.0
     Area: 0.0137
     Downstream: North Channel 1A

     Canopy: None
     Plant Uptake Method: None
```

```
     Surface: None

     LossRate: SCS
     Percent Impervious Area: 0.0
     Curve Number: 62

     Transform: SCS
     Lag: 1
     Unitgraph Type: STANDARD

     Baseflow: None
End:

Subbasin: OFS_B2-East
     Canvas X: 6209.040937996824
     Canvas Y: 3059.712957074723
     From Canvas X: 756.9166571196592
     From Canvas Y: -3029.8378108109223
     Area: 0.0035
     Downstream: North Channel 1A

     Canopy: None
     Plant Uptake Method: None

     Surface: None

     LossRate: SCS
     Percent Impervious Area: 0.0
     Curve Number: 65

     Transform: SCS
     Lag: 1
     Unitgraph Type: STANDARD

     Baseflow: None
End:

Reach: North Channel 1A
     Canvas X: -1478.6478934817187
     Canvas Y: 4942.908672496029
     From Canvas X: 4287.950607469818
     From Canvas Y: 4940.6722059998265
     Label X: -65.0
     Label Y: 11.0
     Downstream: Junction-3

     Route: Muskingum Cunge
     Channel: Trapezoid
     Length: 1615
     Energy Slope: 0.005
```

```
     Width: 10
     Side Slope: 4
     Mannings n: 0.027
     Use Variable Time Step: No
     Channel Loss: None
End:

Subbasin: Pre-1D
     Canvas X: -5985.003378378382
     Canvas Y: 3450.178418124009
     From Canvas X: 5673.19465583059
     From Canvas Y: -2806.0257393589495
     Label X: -64.0
     Label Y: -2.0
     Area: 0.0485
     Downstream: Junction-3

     Canopy: None
     Plant Uptake Method: None

     Surface: None

     LossRate: SCS
     Percent Impervious Area: 0.0
     Curve Number: 62

     Transform: SCS
     Lag: 1
     Unitgraph Type: STANDARD

     Baseflow: None
End:

Subbasin: LD-1
     Canvas X: 3879.050317965024
     Canvas Y: -1805.1026232114482
     Area: 0.020
     Downstream: PC-2

     Canopy 1: None
     Plant Uptake Method: None

     Surface 1: None

     LossRate 1: SCS
     Percent Impervious Area: 0.0
     Curve Number: 80

     Transform: Kinematic Wave
```

```
     Plane: 1
     Plane 1 Length: 160
     Plane 1 Slope: 0.25
     Plane 1 Roughness: 0.15
     Plane 1 Percent of Area: 100
     Plane 1 Number of Steps: 5

     Channel: 2
     Collector Length: 434
     Collector Slope: 0.02
     Collector Mannings N: 0.027
     Shape: Triangle
     Collector Side Slope: 3
     Collector Area: 0.00249
     Collector Number of Steps: 8

     Channel: Main
     Channel Length: 695
     Channel Slope: 0.25
     Channel Mannings N: 0.033
     Shape: Trapezoid
     Channel Width: 15
     Channel Side Slope: 2
     Channel Number of Steps: 5

     Baseflow: None
End:

Subbasin: LD-2
     Canvas X: 5748.163672496028
     Canvas Y: -4160.697535771068
     Label X: -54.0
     Label Y: -4.0
     Area: 0.013
     Downstream: PC-4

     Canopy 1: None
     Plant Uptake Method: None

     Surface 1: None

     LossRate 1: SCS
     Percent Impervious Area: 0.0
     Curve Number: 80

     Transform: Kinematic Wave

     Plane: 1
     Plane 1 Length: 160
     Plane 1 Slope: 0.25
```

```
     Plane 1 Roughness: 0.15
     Plane 1 Percent of Area: 100
     Plane 1 Number of Steps: 5

     Channel: 2
     Collector Length: 569
     Collector Slope: 0.02
     Collector Mannings N: 0.027
     Shape: Triangle
     Collector Side Slope: 3
     Collector Area: 0.00326
     Collector Number of Steps: 5

     Channel: Main
     Channel Length: 268
     Channel Slope: 0.25
     Channel Mannings N: 0.033
     Shape: Trapezoid
     Channel Width: 15
     Channel Side Slope: 2
     Channel Number of Steps: 5

     Baseflow: None
End:

Subbasin: S23
     Canvas X: 3648.611685214628
     Canvas Y: -5056.847774244837
     Label X: -32.0
     Label Y: 18.0
     Area: 0.0034
     Downstream: PC-5

     Canopy: None
     Plant Uptake Method: None

     Surface: None

     LossRate: SCS
     Percent Impervious Area: 0.0
     Curve Number: 80

     Transform: SCS
     Lag: 2
     Unitgraph Type: STANDARD

     Baseflow: None
End:

Reach: PC-5
```

```
     Canvas X: 7054.311327822565
     Canvas Y: -4189.4665655953395
     From Canvas X: 4570.366216216216
     From Canvas Y: -5927.39372019078
     Label X: -10.0
     Label Y: -16.0
     Downstream: PC-4

     Route: Muskingum Cunge
     Channel: Trapezoid
     Length: 1047
     Energy Slope: 0.005
     Width: 5
     Side Slope: 2
     Mannings n: 0.027
     Use Variable Time Step: No
     Channel Loss: None
End:

Reach: PC-4
     Canvas X: 5559.071704202578
     Canvas Y: -2857.7237838563838
     From Canvas X: 7054.311327822565
     From Canvas Y: -4189.4665655953395
     Label X: -14.0
     Label Y: 11.0
     Downstream: PC-3

     Route: Muskingum Cunge
     Channel: Trapezoid
     Length: 1122
     Energy Slope: 0.005
     Width: 3
     Side Slope: 2
     Mannings n: 0.027
     Use Variable Time Step: No
     Channel Loss: None
End:

Subbasin: S13
     Canvas X: 4928.826311605726
     Canvas Y: -3110.921542130368
     Label X: -48.0
     Label Y: -3.0
     Area: 0.0033
     Downstream: PC-3

     Canopy: None
     Plant Uptake Method: None
```

```
    Surface: None

    LossRate: SCS
    Percent Impervious Area: 0.0
    Curve Number: 80

    Transform: SCS
    Lag: 2
    Unitgraph Type: STANDARD

    Baseflow: None
End:

Reach: PC-3
    Canvas X: 5568.933624801271
    Canvas Y: -550.4922893481689
    From Canvas X: 5559.071704202578
    From Canvas Y: -2857.7237838563838
    Label X: -6.0
    Label Y: -2.0
    Downstream: PC-2

    Route: Muskingum Cunge
    Channel: Trapezoid
    Length: 693
    Energy Slope: 0.005
    Width: 3
    Side Slope: 2
    Mannings n: 0.027
    Use Variable Time Step: No
    Channel Loss: None
End:

Reach: PC-2
    Canvas X: 3904.6546104928475
    Canvas Y: -268.84507154213134
    From Canvas X: 5568.933624801271
    From Canvas Y: -550.4922893481689
    Label X: -20.0
    Label Y: 5.0
    Downstream: PC-1

    Route: Muskingum Cunge
    Channel: Trapezoid
    Length: 200
    Energy Slope: 0.005
    Width: 6
    Side Slope: 2
    Mannings n: 0.027
    Use Variable Time Step: No
```

```
     Channel Loss: None
End:

Subbasin: S5
     Canvas X: 550.4922893481707
     Canvas Y: -1011.3695548489677
     Area: 0.0038
     Downstream: PC-10

     Canopy: None
     Plant Uptake Method: None

     Surface: None

     LossRate: SCS
     Percent Impervious Area: 0.0
     Curve Number: 80

     Transform: SCS
     Lag: 2
     Unitgraph Type: STANDARD

     Baseflow: None
End:

Reach: PC-10
     Canvas X: 3904.6546104928475
     Canvas Y: -268.84507154213134
     From Canvas X: 550.4922893481707
     From Canvas Y: -243.24077901430883
     Label X: -30.0
     Label Y: 9.0
     Downstream: PC-1

     Route: Muskingum Cunge
     Channel: Trapezoid
     Length: 856
     Energy Slope: 0.005
     Width: 2
     Side Slope: 2
     Mannings n: 0.027
     Use Variable Time Step: No
     Channel Loss: None
End:

Reach: PC-1
     Canvas X: 2317.1884737678865
     Canvas Y: 934.5566772655011
     From Canvas X: 3904.6546104928475
     From Canvas Y: -268.84507154213134
```

```
     Downstream: Junction-2

     Route: Muskingum Cunge
     Channel: Trapezoid
     Length: 150
     Energy Slope: 0.005
     Width: 6
     Side Slope: 2
     Mannings n: 0.027
     Use Variable Time Step: No
     Channel Loss: None
End:

Junction: Junction-2
     Canvas X: 2317.1884737678865
     Canvas Y: 934.5566772655011
     Label X: -85.0
     Label Y: -3.0
     Downstream: Junction-3
End:

Subbasin: LD4
     Canvas X: -4826.40914149444
     Canvas Y: -832.1395071542147
     Area: 0.026
     Downstream: PC-12

     Canopy 1: None
     Plant Uptake Method: None

     Surface 1: None

     LossRate 1: SCS
     Percent Impervious Area: 0.0
     Curve Number: 80

     Transform: Kinematic Wave

     Plane: 1
     Plane 1 Length: 160
     Plane 1 Slope: 0.25
     Plane 1 Roughness: 0.15
     Plane 1 Percent of Area: 100
     Plane 1 Number of Steps: 5

     Channel: 2
     Collector Length: 576
     Collector Slope: 0.02
     Collector Mannings N: 0.027
     Shape: Triangle
```

```
     Collector Side Slope: 3
     Collector Area: 0.00331
     Collector Number of Steps: 5

     Channel: Main
     Channel Length: 632
     Channel Slope: 0.25
     Channel Mannings N: 0.033
     Shape: Trapezoid
     Channel Width: 15
     Channel Side Slope: 2
     Channel Number of Steps: 5

     Baseflow: None
End:

Subbasin: S16
     Canvas X: -4802.085063593007
     Canvas Y: -2661.5662082670915
     Label X: -1.0
     Label Y: -1.0
     Area: 0.008
     Downstream: PC-8

     Canopy: None
     Plant Uptake Method: None

     Surface: None

     LossRate: SCS
     Percent Impervious Area: 0.0
     Curve Number: 80

     Transform: SCS
     Lag: 3
     Unitgraph Type: STANDARD

     Baseflow: None
End:

Reach: PC-8
     Canvas X: -5638.9559658690705
     Canvas Y: -856.4617194260541
     From Canvas X: -5639.97727012223
     From Canvas Y: -2736.3965277222005
     Label X: -50.0
     Label Y: 1.0
     Downstream: PC-12

     Route: Muskingum Cunge
```

```
     Channel: Trapezoid
     Length: 1200
     Energy Slope: 0.005
     Width: 5
     Side Slope: 2
     Mannings n: 0.027
     Use Variable Time Step: No
     Channel Loss: None
End:

Reach: PC-12
     Canvas X: -5647.026717011133
     Canvas Y: 154.90596979332258
     From Canvas X: -5638.9559658690705
     From Canvas Y: -856.4617194260541
     Label X: -54.0
     Label Y: -5.0
     Downstream: Junction-1

     Route: Muskingum Cunge
     Channel: Trapezoid
     Length: 150
     Energy Slope: 0.005
     Width: 6
     Side Slope: 2
     Mannings n: 0.027
     Use Variable Time Step: No
     Channel Loss: None
End:

Subbasin: S1
     Canvas X: -1171.875
     Canvas Y: -562.5
     Area: 0.0036
     Downstream: PC-9

     Canopy: None
     Plant Uptake Method: None

     Surface: None

     LossRate: SCS
     Percent Impervious Area: 0.0
     Curve Number: 80

     Transform: SCS
     Lag: 2
     Unitgraph Type: STANDARD

     Baseflow: None
```

```
End:

Reach: PC-9
     Canvas X: -5647.026717011133
     Canvas Y: 154.90596979332258
     From Canvas X: -1222.1192505685158
     From Canvas Y: 146.37260369080968
     Label X: -6.0
     Label Y: 13.0
     Downstream: Junction-1

     Route: Muskingum Cunge
     Channel: Trapezoid
     Length: 1000
     Energy Slope: 0.005
     Width: 2
     Side Slope: 2
     Mannings n: 0.027
     Use Variable Time Step: No
     Channel Loss: None
End:

Junction: Junction-1
     Canvas X: -5647.026717011133
     Canvas Y: 154.90596979332258
     Label X: -66.0
     Label Y: 18.0
     Downstream: Junction-3
End:

Subbasin: Pre-1C
     Canvas X: -1500.7012622720904
     Canvas Y: 7587.65778401122
     From Canvas X: 5673.19465583059
     From Canvas Y: -2806.0257393589495
     Area: 0.0192
     Downstream: Junction-3

     Canopy: None
     Plant Uptake Method: None

     Surface: None

     LossRate: SCS
     Percent Impervious Area: 0.0
     Curve Number: 62

     Transform: SCS
     Lag: 1
     Unitgraph Type: STANDARD
```

```
     Baseflow: None
End:

Subbasin: OFS_B1-East
     Canvas X: -1422.318449920509
     Canvas Y: 3562.837305246426
     From Canvas X: 5673.19465583059
     From Canvas Y: -2806.0257393589495
     Label X: -54.0
     Label Y: -19.0
     Area: 0.0099
     Downstream: Junction-3

     Canopy: None
     Plant Uptake Method: None

     Surface: None

     LossRate: SCS
     Percent Impervious Area: 0.0
     Curve Number: 65

     Transform: SCS
     Lag: 21
     Unitgraph Type: STANDARD

     Baseflow: None
End:

Junction: Junction-3
     Canvas X: -1478.6478934817187
     Canvas Y: 4942.908672496029
     Label X: -90.0
     Label Y: -5.0
     Downstream: North Channel 1B
End:

Subbasin: OFS_A1_North
     Canvas X: 970.6808998302222
     Canvas Y: 7560.373769100173
     From Canvas X: 107.23281544256133
     From Canvas Y: 1597.3069679849332
     Area: 0.0125
     Downstream: North Channel 1B

     Canopy: None
     Plant Uptake Method: None

     Surface: None
```

```
     LossRate: SCS
     Percent Impervious Area: 0.0
     Curve Number: 69

     Transform: SCS
     Lag: 45
     Unitgraph Type: STANDARD

     Baseflow: None
End:

Reach: North Channel 1B
     Canvas X: -6577.840112201964
     Canvas Y: 7279.102384291726
     From Canvas X: -1478.6478934817187
     From Canvas Y: 4942.908672496029
     Label X: -137.0
     Label Y: -12.0
     Downstream: POD-1

     Route: Muskingum Cunge
     Channel: Trapezoid
     Length: 1303
     Energy Slope: 0.005
     Width: 10
     Side Slope: 4
     Mannings n: 0.027
     Use Variable Time Step: No
     Channel Loss: None
End:

Junction: POD-1
     Canvas X: -6577.840112201964
     Canvas Y: 7279.102384291726
     From Canvas X: 3416.376148748015
     From Canvas Y: -2200.631705489347
     Label X: -65.0
     Label Y: 1.0
End:

Subbasin: LD3
     Canvas X: -5053.272450532726
     Canvas Y: -6316.590563165906
     Area: 0.024
     Downstream: PC-11

     Canopy 1: None
     Plant Uptake Method: None
```

```
     Surface 1: None

     LossRate 1: SCS
     Percent Impervious Area: 0.0
     Curve Number: 80

     Transform: Kinematic Wave

     Plane: 1
     Plane 1 Length: 160
     Plane 1 Slope: 0.25
     Plane 1 Roughness: 0.15
     Plane 1 Percent of Area: 100
     Plane 1 Number of Steps: 5

     Channel: 2
     Collector Length: 694
     Collector Slope: 0.02
     Collector Mannings N: 0.027
     Shape: Triangle
     Collector Side Slope: 3
     Collector Area: 0.00398
     Collector Number of Steps: 5

     Channel: Main
     Channel Length: 400
     Channel Slope: 0.25
     Channel Mannings N: 0.033
     Shape: Trapezoid
     Channel Width: 15
     Channel Side Slope: 2
     Channel Number of Steps: 5

     Baseflow: None
End:

Subbasin: S22
     Canvas X: 538.8829050822114
     Canvas Y: -6918.091349028406
     Label X: -27.0
     Label Y: 14.0
     Area: 0.0079
     Downstream: PC-6

     Canopy: None
     Plant Uptake Method: None

     Surface: None

     LossRate: SCS
```

```
     Percent Impervious Area: 0.0
     Curve Number: 80

     Transform: SCS
     Lag: 2
     Unitgraph Type: STANDARD

     Baseflow: None
End:

Reach: PC-6
     Canvas X: -5636.423899103143
     Canvas Y: -7995.857159192832
     From Canvas X: 568.0117107623391
     From Canvas Y: -7966.728353512708
     Label X: -18.0
     Label Y: 12.0
     Downstream: PC-11

     Route: Muskingum Cunge
     Channel: Trapezoid
     Length: 1485.9
     Energy Slope: 0.005
     Width: 2
     Side Slope: 2
     Mannings n: 0.027
     Use Variable Time Step: No
     Channel Loss: None
End:

Subbasin: S19
     Canvas X: -6879.756468797566
     Canvas Y: -4703.196347031964
     Label X: -23.0
     Label Y: 17.0
     Area: 0.0019
     Downstream: PC-7

     Canopy: None
     Plant Uptake Method: None

     Surface: None

     LossRate: SCS
     Percent Impervious Area: 0.0
     Curve Number: 80

     Transform: SCS
     Lag: 2
     Unitgraph Type: STANDARD
```

```
     Baseflow: None
End:

Reach: PC-7
     Canvas X: -5636.423899103143
     Canvas Y: -7995.857159192832
     From Canvas X: -7238.508211509721
     From Canvas Y: -5636.423899103143
     Label X: -51.0
     Label Y: -17.0
     Downstream: PC-11

     Route: Muskingum Cunge
     Channel: Trapezoid
     Length: 853
     Energy Slope: 0.005
     Width: 2
     Side Slope: 2
     Mannings n: 0.027
     Use Variable Time Step: No
     Channel Loss: None
End:

Reach: PC-11
     Canvas X: -5636.423899103143
     Canvas Y: -9219.266997757853
     From Canvas X: -5636.423899103143
     From Canvas Y: -7995.857159192832
     Label X: -52.0
     Label Y: 2.0
     Downstream: South Pond

     Route: Muskingum Cunge
     Channel: Trapezoid
     Length: 50
     Energy Slope: 0.005
     Width: 8
     Side Slope: 2
     Mannings n: 0.027
     Use Variable Time Step: No
     Channel Loss: None
End:

Subbasin: SP
     Canvas X: -8296.875
     Canvas Y: -9156.25
     Label X: -47.0
     Label Y: -4.0
     Area: 0.0139
```

```
     Downstream: South Pond

     Canopy: None
     Plant Uptake Method: None

     Surface: None

     LossRate: SCS
     Percent Impervious Area: 0.0
     Curve Number: 80

     Transform: SCS
     Lag: 1
     Unitgraph Type: STANDARD

     Baseflow: None
End:

Junction: South Pond
     Canvas X: -5636.423899103143
     Canvas Y: -9219.266997757853
End:

Subbasin: OFS-South-A
     Canvas X: -1109.375
     Canvas Y: -8687.5
     From Canvas X: 5724.193738229755
     From Canvas Y: -4441.501883239172
     Area: 0.0139
     Downstream: POD-2

     Canopy: None
     Plant Uptake Method: None

     Surface: None

     LossRate: SCS
     Percent Impervious Area: 0.0
     Curve Number: 68.3

     Transform: SCS
     Lag: 44
     Unitgraph Type: STANDARD

     Baseflow: None
End:

Junction: POD-2
     Canvas X: -1079.9438990182334
     Canvas Y: -9382.88920056101
```

```
     From Canvas X: 5724.193738229755
     From Canvas Y: -4441.501883239172
     Label X: -70.0
     Label Y: -4.0
End:

Basin Schematic Properties:
     Last View N: 5000.0
     Last View S: -5000.0
     Last View W: -5000.0
     Last View E: 5000.0
     Maximum View N: 5000.0
     Maximum View S: -5000.0
     Maximum View W: -5000.0
     Maximum View E: 5000.0
     Extent Method: Elements
     Buffer: 0
     Draw Icons: Yes
     Draw Icon Labels: Name
     Draw Map Objects: No
     Draw Gridlines: No
     Draw Flow Direction: No
     Fix Element Locations: No
     Fix Hydrologic Order: No
End:
```

PRE-DEVELOPMENT OUTPUT FILES

Project: Northeast (Pre and Post) Simulation Run: Pre(old areas)

Start of Run: 14Jun2021, 00:00 Basin Model: Pre-Develop (old ar
End of Run: 16Jun2021, 00:00 Meteorologic Model: 25 yr, 24 hr
Compute Time: 06Jun2023, 19:35:02 Control Specifications: 48-HR

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (AC-FT)
Junction-1	0.0376	137.8	14Jun2021, 12:00	9.1
Junction-2	0.0435	146.9	14Jun2021, 12:00	10.6
Junction-3	0.2830	556.2	14Jun2021, 12:00	51.2
LD-1	0.0200	81.4	14Jun2021, 12:00	4.8
LD-2	0.0130	52.8	14Jun2021, 12:00	3.1
LD3	0.0240	97.6	14Jun2021, 12:00	5.8
LD4	0.0260	105.8	14Jun2021, 12:00	6.3
North Channel 1A	0.1243	137.8	14Jun2021, 12:10	20.4
North Channel 1B	0.2955	487.5	14Jun2021, 12:00	53.5
OFS-South-A	0.0139	13.2	14Jun2021, 12:40	2.4
OFS_A_East	0.0566	78.3	14Jun2021, 12:20	10.1
OFS_A1_North	0.0125	12.0	14Jun2021, 12:40	2.2
OFS_A2_North	0.0172	16.2	14Jun2021, 12:40	3.1
OFS_B1-East	0.0099	12.6	14Jun2021, 12:10	1.6
OFS_B2-East	0.0035	8.5	14Jun2021, 12:00	0.6
PC-1	0.0435	146.9	14Jun2021, 12:00	10.6
PC-10	0.0038	11.6	14Jun2021, 12:00	0.9
PC-11	0.0338	124.6	14Jun2021, 12:00	8.2
PC-12	0.0340	127.2	14Jun2021, 12:00	8.2
PC-2	0.0397	138.1	14Jun2021, 12:00	9.6
PC-3	0.0197	60.1	14Jun2021, 12:00	4.8
PC-4	0.0164	54.5	14Jun2021, 12:00	4.0
PC-5	0.0034	9.8	14Jun2021, 12:00	0.8
PC-6	0.0079	22.0	14Jun2021, 12:00	1.9
PC-7	0.0019	5.6	14Jun2021, 12:00	0.5
PC-8	0.0080	23.7	14Jun2021, 12:00	1.9
PC-9	0.0036	10.6	14Jun2021, 12:00	0.9

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Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (AC-FT)
POD-1	0.2955	487.5	14Jun2021, 12:00	53.5
POD-2	0.0139	13.2	14Jun2021, 12:40	2.4
Pre-1A	0.0137	29.7	14Jun2021, 12:00	1.9
Pre-1B	0.0333	72.2	14Jun2021, 12:00	4.7
Pre-1C	0.0192	41.7	14Jun2021, 12:00	2.7
Pre-1D	0.0485	105.2	14Jun2021, 12:00	6.9
South Pond	0.0477	174.8	14Jun2021, 12:00	11.5
SP	0.0139	50.1	14Jun2021, 12:00	3.3
S1	0.0036	13.0	14Jun2021, 12:00	0.9
S13	0.0033	11.9	14Jun2021, 12:00	0.8
S16	0.0080	28.9	14Jun2021, 12:00	1.9
S19	0.0019	6.9	14Jun2021, 12:00	0.5
S22	0.0079	28.5	14Jun2021, 12:00	1.9
S23	0.0034	12.3	14Jun2021, 12:00	0.8
S5	0.0038	13.7	14Jun2021, 12:00	0.9

Project: Northeast (Pre and Post) Simulation Run: Pre(old areas)
Junction: POD-1

Start of Run:	14Jun2021, 00:00	Basin Model:	Pre-Develop (old areas)
End of Run:	16Jun2021, 00:00	Meteorologic Model:	25 yr, 24 hr
Compute Time:	08Jun2023, 09:50:19	Control Specifications:	48-HR

Volume Units: AC-FT

Computed Results

Peak Discharge:	487.5 (CFS)	Date/Time of Peak Discharge:	14Jun2021, 12:00
Volume:	53.5 (AC-FT)		

Project: Northeast (Pre and Post)   Simulation Run: Pre(old areas)
Junction: POD-2

Start of Run:	14Jun2021, 00:00	Basin Model:	Pre-Develop (old areas)
End of Run:	16Jun2021, 00:00	Meteorologic Model:	25 yr, 24 hr
Compute Time:	08Jun2023, 09:50:19	Control Specifications:	48-HR

Volume Units: AC-FT

Computed Results

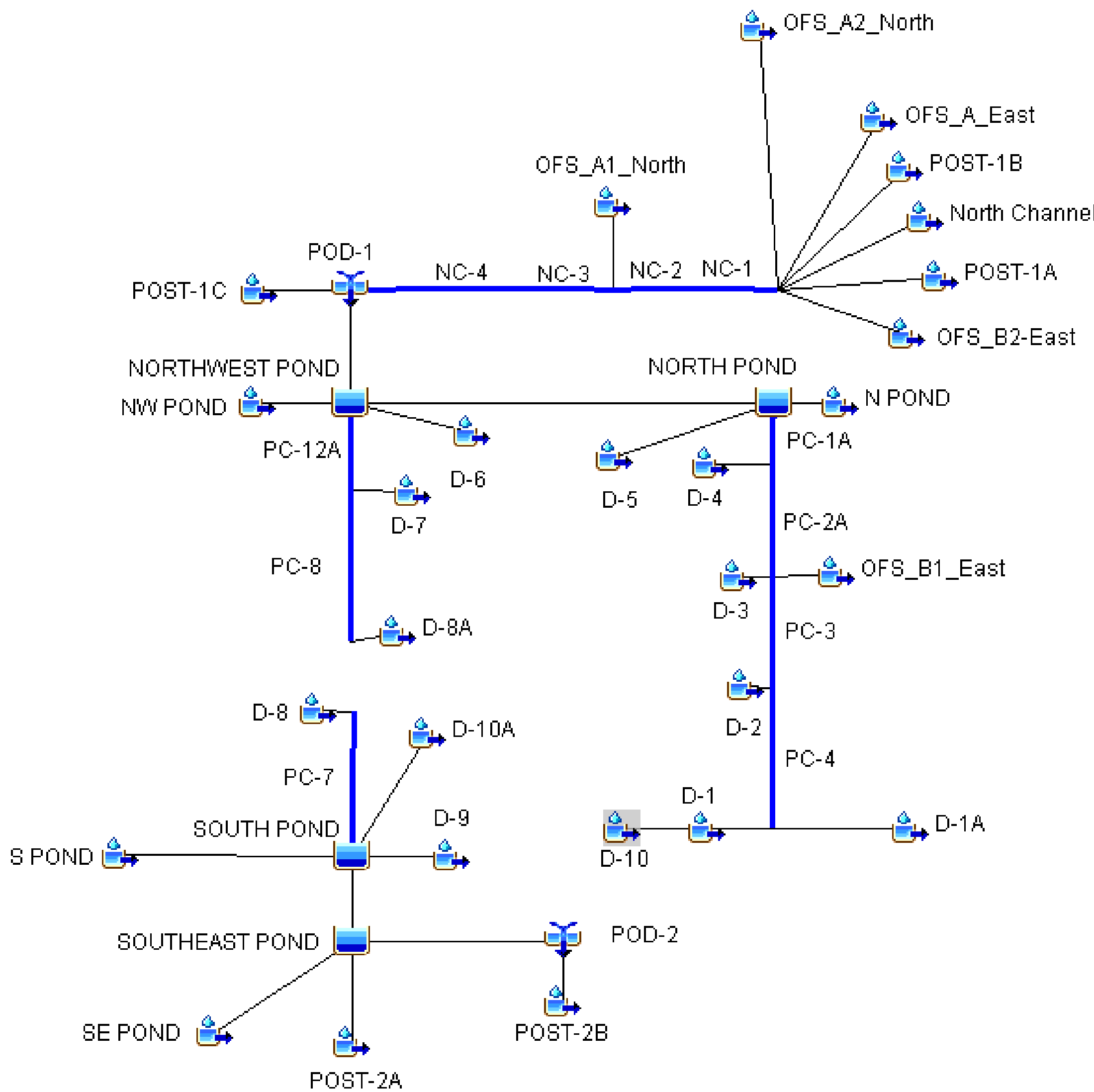
Peak Discharge:	13.2 (CFS)	Date/Time of Peak Discharge:	14Jun2021, 12:40
Volume:	2.4 (AC-FT)		

ATTACHMENT E-3

HEC-HMS POST-DEVELOPMENT INPUT/OUTPUT FILES

HEC-HMS POST-DEVELOPMENT INPUT FILES

NORTHEAST LANDFILL
HEC-HMS INPUT SCHEMATIC
POST-DEVELOPMENT CONDITIONS



```
Basin: Post-Develop (exp)
     Last Modified Date: 7 June 2023
     Last Modified Time: 22:46:57
     Version: 4.0
     Filepath Separator: \
     Unit System: English
     Missing Flow To Zero: No
     Enable Flow Ratio: No
     Compute Local Flow At Junctions: No

     Enable Sediment Routing: No

     Enable Quality Routing: No
End:

Subbasin: D-3
     Canvas X: 1373.4728906151977
     Canvas Y: 1508.9943358389792
     Label X: -27.0
     Label Y: -21.0
     Area: 0.0455
     Downstream: PC-2A

     Canopy 1: None
     Plant Uptake Method: None

     Surface 1: None

     LossRate 1: SCS
     Percent Impervious Area: 0.0
     Curve Number: 80

     Transform: Kinematic Wave

     Plane: 1
     Plane 1 Length: 160
     Plane 1 Slope: 0.25
     Plane 1 Roughness: 0.15
     Plane 1 Percent of Area: 100
     Plane 1 Number of Steps: 5

     Channel: 2
     Collector Length: 536
     Collector Slope: 0.02
     Collector Mannings N: 0.027
     Shape: Triangle
     Collector Side Slope: 3
     Collector Area: 0.00308
     Collector Number of Steps: 5
```

```
     Channel: Main
     Channel Length: 633
     Channel Slope: 0.25
     Channel Mannings N: 0.033
     Shape: Trapezoid
     Channel Width: 15
     Channel Side Slope: 2
     Channel Number of Steps: 5

     Baseflow: None
End:

Subbasin: D-10
     Canvas X: -188.93507170020166
     Canvas Y: -1485.4127610842206
     Label X: -25.0
     Label Y: -19.0
     Area: 0.0140
     Downstream: D-1

     Canopy 1: None
     Plant Uptake Method: None

     Surface 1: None

     LossRate 1: SCS
     Percent Impervious Area: 0.0
     Curve Number: 80

     Transform: Kinematic Wave

     Plane: 1
     Plane 1 Length: 160
     Plane 1 Slope: 0.25
     Plane 1 Roughness: 0.15
     Plane 1 Percent of Area: 100
     Plane 1 Number of Steps: 5

     Channel: 2
     Collector Length: 368
     Collector Slope: 0.02
     Collector Mannings N: 0.027
     Shape: Triangle
     Collector Side Slope: 3
     Collector Area: 0.00211
     Collector Number of Steps: 8

     Channel: Main
     Channel Length: 540
     Channel Slope: 0.25
```

```
     Channel Mannings N: 0.033
     Shape: Trapezoid
     Channel Width: 15
     Channel Side Slope: 2
     Channel Number of Steps: 5

     Baseflow: None
End:

Subbasin: D-1
     Canvas X: 648.2884622183119
     Canvas Y: -1602.5190645094954
     Label X: -27.0
     Label Y: 15.0
     Area: 0.0059
     Downstream: PC-4

     Canopy 1: None
     Plant Uptake Method: None

     Surface 1: None

     LossRate 1: SCS
     Percent Impervious Area: 0.0
     Curve Number: 80

     Transform: Kinematic Wave

     Plane: 1
     Plane 1 Length: 160
     Plane 1 Slope: 0.25
     Plane 1 Roughness: 0.15
     Plane 1 Percent of Area: 100
     Plane 1 Number of Steps: 5

     Channel: 2
     Collector Length: 419
     Collector Slope: 0.02
     Collector Mannings N: 0.027
     Shape: Triangle
     Collector Side Slope: 3
     Collector Area: 0.00241
     Collector Number of Steps: 5

     Channel: Main
     Channel Length: 130
     Channel Slope: 0.25
     Channel Mannings N: 0.033
     Shape: Trapezoid
     Channel Width: 15
```

```
     Channel Side Slope: 2
     Channel Number of Steps: 5
     Route Upstream: Yes

     Baseflow: None
End:

Subbasin: D-1A
     Canvas X: 3643.7321623740827
     Canvas Y: -1786.9518539052588
     From Canvas X: 2391.3781134098645
     From Canvas Y: -421.60345465855426
     Area: 0.0037
     Downstream: PC-4

     Canopy: None
     Plant Uptake Method: None

     Surface: None

     LossRate: SCS
     Percent Impervious Area: 0.0
     Curve Number: 80

     Transform: SCS
     Lag: 1
     Unitgraph Type: STANDARD

     Baseflow: None
End:

Reach: PC-4
     Canvas X: 1829.3051359516612
     Canvas Y: 46.82779456193293
     From Canvas X: 1813.8915004301452
     From Canvas Y: -1776.6851352912363
     Label X: -6.0
     Label Y: -3.0
     Downstream: PC-3

     Route: Muskingum Cunge
     Channel: Trapezoid
     Length: 1122
     Energy Slope: 0.005
     Width: 3
     Side Slope: 2
     Mannings n: 0.027
     Use Variable Time Step: No
     Channel Loss: None
End:
```

```
Subbasin: D-2
     Canvas X: 1483.0786473400804
     Canvas Y: 84.11949841551359
     Label X: -24.0
     Label Y: -25.0
     Area: 0.0124
     Downstream: PC-3

     Canopy 1: None
     Plant Uptake Method: None

     Surface 1: None

     LossRate 1: SCS
     Percent Impervious Area: 0.0
     Curve Number: 80

     Transform: Kinematic Wave

     Plane: 1
     Plane 1 Length: 160
     Plane 1 Slope: 0.25
     Plane 1 Roughness: 0.15
     Plane 1 Percent of Area: 100
     Plane 1 Number of Steps: 5

     Channel: 2
     Collector Length: 540
     Collector Slope: 0.02
     Collector Mannings N: 0.027
     Shape: Triangle
     Collector Side Slope: 5
     Collector Area: 0.00310
     Collector Number of Steps: 5

     Channel: Main
     Channel Length: 225
     Channel Slope: 0.25
     Channel Mannings N: 0.033
     Shape: Trapezoid
     Channel Width: 15
     Channel Side Slope: 2
     Channel Number of Steps: 5

     Baseflow: None
End:

Reach: PC-3
     Canvas X: 1826.2839879154071
```

```
     Canvas Y: 1500.0
     From Canvas X: 1829.3051359516612
     From Canvas Y: 46.82779456193293
     Label X: -6.0
     Label Y: -2.0
     Downstream: PC-2A

     Route: Muskingum Cunge
     Channel: Trapezoid
     Length: 693
     Energy Slope: 0.005
     Width: 3
     Side Slope: 2
     Mannings n: 0.027
     Use Variable Time Step: No
     Channel Loss: None
End:

Subbasin: OFS_B1_East
     Canvas X: 2667.7507979549027
     Canvas Y: 1558.367446915604
     Area: 0.0099
     Downstream: PC-2A

     Canopy: None
     Plant Uptake Method: None

     Surface: None

     LossRate: SCS
     Percent Impervious Area: 0.0
     Curve Number: 65

     Transform: SCS
     Lag: 20
     Unitgraph Type: STANDARD

     Baseflow: None
End:

Reach: PC-2A
     Canvas X: 1820.2416918429008
     Canvas Y: 2978.8519637462227
     From Canvas X: 1826.2839879154071
     From Canvas Y: 1500.0
     Label X: -7.0
     Label Y: -4.0
     Downstream: PC-1A

     Route: Muskingum Cunge
```

```
     Channel: Trapezoid
     Length: 1530
     Energy Slope: 0.0035
     Width: 10
     Side Slope: 2
     Mannings n: 0.027
     Use Variable Time Step: No
     Channel Loss: None
End:

Subbasin: D-4
     Canvas X: 1014.4259818731116
     Canvas Y: 2979.305135951662
     Label X: -26.0
     Label Y: -21.0
     Area: 0.0138
     Downstream: PC-1A

     Canopy 1: None
     Plant Uptake Method: None

     Surface 1: None

     LossRate 1: SCS
     Percent Impervious Area: 0.0
     Curve Number: 80

     Transform: Kinematic Wave

     Plane: 1
     Plane 1 Length: 160
     Plane 1 Slope: 0.25
     Plane 1 Roughness: 0.15
     Plane 1 Percent of Area: 100
     Plane 1 Number of Steps: 5

     Channel: 2
     Collector Length: 406
     Collector Slope: 0.02
     Collector Mannings N: 0.027
     Shape: Triangle
     Collector Side Slope: 3
     Collector Area: 0.00233
     Collector Number of Steps: 7

     Channel: Main
     Channel Length: 527
     Channel Slope: 0.25
     Channel Mannings N: 0.033
     Shape: Trapezoid
```

```
     Channel Width: 15
     Channel Side Slope: 2
     Channel Number of Steps: 5

     Baseflow: None
End:

Reach: PC-1A
     Canvas X: 1833.817068859702
     Canvas Y: 3788.7940757165234
     From Canvas X: 1820.2416918429008
     From Canvas Y: 2978.8519637462227
     Label X: -5.0
     Label Y: -7.0
     Downstream: NORTH POND

     Route: Muskingum Cunge
     Channel: Trapezoid
     Length: 63
     Energy Slope: 0.0035
     Width: 10
     Side Slope: 2
     Mannings n: 0.033
     Use Variable Time Step: No
     Channel Loss: None
End:

Subbasin: D-5
     Canvas X: -236.29654975019184
     Canvas Y: 3073.522584848697
     Label X: -20.0
     Label Y: -26.0
     Area: 0.0205
     Downstream: NORTH POND

     Canopy 1: None
     Plant Uptake Method: None

     Surface 1: None

     LossRate 1: SCS
     Percent Impervious Area: 0.0
     Curve Number: 80

     Transform: Kinematic Wave

     Plane: 1
     Plane 1 Length: 160
     Plane 1 Slope: 0.25
     Plane 1 Roughness: 0.15
```

```
     Plane 1 Percent of Area: 100
     Plane 1 Number of Steps: 5

     Channel: 2
     Collector Length: 326
     Collector Slope: 0.02
     Collector Mannings N: 0.027
     Shape: Triangle
     Collector Side Slope: 3
     Collector Area: 0.00187
     Collector Number of Steps: 11

     Channel: Main
     Channel Length: 660
     Channel Slope: 0.25
     Channel Mannings N: 0.033
     Shape: Trapezoid
     Channel Width: 15
     Channel Side Slope: 2
     Channel Number of Steps: 5

     Baseflow: None
End:

Subbasin: N POND
     Canvas X: 2710.2814684933765
     Canvas Y: 3796.4835711184487
     Area: 0.0029
     Downstream: NORTH POND

     Canopy: None
     Plant Uptake Method: None

     Surface: None

     LossRate: SCS
     Percent Impervious Area: 0.0
     Curve Number: 99

     Transform: SCS
     Lag: 1
     Unitgraph Type: STANDARD

     Baseflow: None
End:

Reservoir: NORTH POND
     Canvas X: 1833.817068859702
     Canvas Y: 3788.7940757165234
     Label X: -81.0
```

```
     Label Y: 17.0
     Downstream: NORTHWEST POND

     Route: Modified Puls
     Routing Curve: Elevation-Area-Outflow
     Initial Elevation: 1190
     Elevation-Area Table: NORTH POND
     Elevation-Outflow Table: NORTH POND
     Primary Table: Elevation-Outflow
End:

Subbasin: D-6
     Canvas X: -2111.9901732360486
     Canvas Y: 3394.213351506949
     Label X: -25.0
     Label Y: -28.0
     Area: 0.0365
     Downstream: NORTHWEST POND

     Canopy 1: None
     Plant Uptake Method: None

     Surface 1: None

     LossRate 1: SCS
     Percent Impervious Area: 0.0
     Curve Number: 80

     Transform: Kinematic Wave

     Plane: 1
     Plane 1 Length: 160
     Plane 1 Slope: 0.25
     Plane 1 Roughness: 0.15
     Plane 1 Percent of Area: 100
     Plane 1 Number of Steps: 5

     Channel: 2
     Collector Length: 525
     Collector Slope: 0.02
     Collector Mannings N: 0.027
     Shape: Triangle
     Collector Side Slope: 3
     Collector Area: 0.00302
     Collector Number of Steps: 5

     Channel: Main
     Channel Length: 897
     Channel Slope: 0.25
     Channel Mannings N: 0.033
```

```
     Shape: Trapezoid
     Channel Width: 15
     Channel Side Slope: 2
     Channel Number of Steps: 5

     Baseflow: None
End:

Subbasin: D-7
     Canvas X: -2879.230470310222
     Canvas Y: 2626.973054432776
     Label X: -25.0
     Label Y: -21.0
     Area: 0.0317
     Downstream: PC-12A

     Canopy 1: None
     Plant Uptake Method: None

     Surface 1: None

     LossRate 1: SCS
     Percent Impervious Area: 0.0
     Curve Number: 80

     Transform: Kinematic Wave

     Plane: 1
     Plane 1 Length: 160
     Plane 1 Slope: 0.25
     Plane 1 Roughness: 0.15
     Plane 1 Percent of Area: 100
     Plane 1 Number of Steps: 5

     Channel: 2
     Collector Length: 585
     Collector Slope: 0.02
     Collector Mannings N: 0.027
     Shape: Triangle
     Collector Side Slope: 3
     Collector Area: 0.00335
     Collector Number of Steps: 5

     Channel: Main
     Channel Length: 740
     Channel Slope: 0.25
     Channel Mannings N: 0.033
     Shape: Trapezoid
     Channel Width: 15
     Channel Side Slope: 2
```

```
     Channel Number of Steps: 5

     Baseflow: None
End:

Subbasin: D-8A
     Canvas X: -3064.586140558633
     Canvas Y: 775.5372923168397
     Area: 0.0029
     Downstream: PC-8

     Canopy: None
     Plant Uptake Method: None

     Surface: None

     LossRate: SCS
     Percent Impervious Area: 0.0
     Curve Number: 80

     Transform: SCS
     Lag: 1
     Unitgraph Type: STANDARD

     Baseflow: None
End:

Reach: PC-8
     Canvas X: -3706.9486404833833
     Canvas Y: 2641.9939577039277
     From Canvas X: -3709.9380664652563
     From Canvas Y: 661.6631419939572
     Label X: -56.0
     Label Y: -3.0
     Downstream: PC-12A

     Route: Muskingum Cunge
     Channel: Trapezoid
     Length: 743
     Energy Slope: 0.01
     Width: 2
     Side Slope: 2
     Mannings n: 0.027
     Use Variable Time Step: No
     Channel Loss: None
End:

Reach: PC-12A
     Canvas X: -3712.234221419325
     Canvas Y: 3788.7940757165234
```

```
     From Canvas X: -3706.9486404833833
     From Canvas Y: 2641.9939577039277
     Label X: -60.0
     Label Y: -5.0
     Downstream: NORTHWEST POND

     Route: Muskingum Cunge
     Channel: Trapezoid
     Length: 1507
     Energy Slope: 0.01
     Width: 6
     Side Slope: 2
     Mannings n: 0.027
     Use Variable Time Step: No
     Channel Loss: None
End:

Subbasin: NW POND
     Canvas X: -4917.897545393025
     Canvas Y: 3788.7940757165234
     Label X: -87.0
     Label Y: -5.0
     Area: 0.0042
     Downstream: NORTHWEST POND

     Canopy: None
     Plant Uptake Method: None

     Surface: None

     LossRate: SCS
     Percent Impervious Area: 0.0
     Curve Number: 99

     Transform: SCS
     Lag: 1
     Unitgraph Type: STANDARD

     Baseflow: None
End:

Reservoir: NORTHWEST POND
     Canvas X: -3712.234221419325
     Canvas Y: 3788.7940757165234
     Label X: -133.0
     Label Y: 16.0
     Downstream: POD-1

     Route: Modified Puls
     Routing Curve: Elevation-Area-Outflow
```

```
     Initial Elevation: 1167
     Elevation-Area Table: NORTHWEST POND
     Elevation-Outflow Table: NORTHWEST POND
     Primary Table: Elevation-Outflow
End:

Subbasin: OFS_A_East
     Canvas X: 3223.3076818637055
     Canvas Y: 7517.977656119105
     From Canvas X: 7318.291309947112
     From Canvas Y: 3765.8533325773724
     Label X: 1.0
     Label Y: -1.0
     Area: 0.0566
     Downstream: NC-1

     Canopy: None
     Plant Uptake Method: None

     Surface: None

     LossRate: SCS
     Percent Impervious Area: 0.0
     Curve Number: 69

     Transform: SCS
     Lag: 24
     Unitgraph Type: STANDARD

     Baseflow: None
End:

Subbasin: OFS_A2_North
     Canvas X: 1657.6473726661734
     Canvas Y: 8704.84918083336
     From Canvas X: 9337.179028612707
     From Canvas Y: 3569.3273059101657
     Area: 0.0172
     Downstream: NC-1

     Canopy: None
     Plant Uptake Method: None

     Surface: None

     LossRate: SCS
     Percent Impervious Area: 0.0
     Curve Number: 69

     Transform: SCS
```

```
     Lag: 28
     Unitgraph Type: STANDARD

     Baseflow: None
End:

Subbasin: North Channel
     Canvas X: 3829.369737036941
     Canvas Y: 6204.843203243757
     Area: 0.0065
     Downstream: NC-1

     Canopy: None
     Plant Uptake Method: None

     Surface: None

     LossRate: SCS
     Percent Impervious Area: 0.0
     Curve Number: 62

     Transform: SCS
     Lag: 1
     Unitgraph Type: STANDARD

     Baseflow: None
End:

Subbasin: POST-1B
     Canvas X: 3551.5912950825405
     Canvas Y: 6861.410429681431
     Area: 0.0052
     Downstream: NC-1

     Canopy: None
     Plant Uptake Method: None

     Surface: None

     LossRate: SCS
     Percent Impervious Area: 0.0
     Curve Number: 99

     Transform: SCS
     Lag: 1
     Unitgraph Type: STANDARD

     Baseflow: None
End:
```

```
Subbasin: OFS_B2-East
     Canvas X: 3576.8438807147577
     Canvas Y: 4689.688065310664
     From Canvas X: 5830.612870289804
     From Canvas Y: -1839.0674728856898
     Label X: 3.0
     Label Y: -4.0
     Area: 0.0045
     Downstream: NC-1

     Canopy: None
     Plant Uptake Method: None

     Surface: None

     LossRate: SCS
     Percent Impervious Area: 0.0
     Curve Number: 65

     Transform: SCS
     Lag: 20
     Unitgraph Type: STANDARD

     Baseflow: None
End:

Subbasin: POST-1A
     Canvas X: 4031.390422094686
     Canvas Y: 5422.0130486449925
     Area: 0.0035
     Downstream: NC-1

     Canopy: None
     Plant Uptake Method: None

     Surface: None

     LossRate: SCS
     Percent Impervious Area: 0.0
     Curve Number: 62.0

     Transform: SCS
     Lag: 15
     Unitgraph Type: STANDARD

     Baseflow: None
End:

Reach: NC-1
     Canvas X: 659.0668541618415
```

```
     Canvas Y: 5278.9943300549585
     From Canvas X: 1882.3309551128496
     From Canvas Y: 5269.523807729589
     Label X: -28.0
     Label Y: 8.0
     Downstream: NC-2

     Route: Muskingum Cunge
     Channel: Trapezoid
     Length: 155
     Energy Slope: 0.0250
     Width: 6
     Side Slope: 2
     Mannings n: 0.033
     Use Variable Time Step: No
     Channel Loss: None
End:

Reach: NC-2
     Canvas X: -266.3144195189652
     Canvas Y: 5272.047745452739
     From Canvas X: 659.0668541618415
     From Canvas Y: 5278.9943300549585
     Label X: -23.0
     Label Y: 7.0
     Downstream: NC-3

     Route: Muskingum Cunge
     Channel: Trapezoid
     Length: 985
     Energy Slope: 0.0030
     Width: 6
     Side Slope: 2
     Mannings n: 0.027
     Use Variable Time Step: No
     Channel Loss: None
End:

Subbasin: OFS_A1_North
     Canvas X: -257.80956779294684
     Canvas Y: 6390.098860568967
     From Canvas X: 6829.5672543786695
     From Canvas Y: 140.766059599644
     Label X: -55.0
     Label Y: 18.0
     Area: 0.0125
     Downstream: NC-3

     Canopy: None
     Plant Uptake Method: None
```

```
     Surface: None

     LossRate: SCS
     Percent Impervious Area: 0.0
     Curve Number: 69

     Transform: SCS
     Lag: 27
     Unitgraph Type: STANDARD

     Baseflow: None
End:

Reach: NC-3
     Canvas X: -1287.502338438424
     Canvas Y: 5275.024853139405
     From Canvas X: -266.3144195189652
     From Canvas Y: 5272.047745452739
     Label X: -33.0
     Label Y: 5.0
     Downstream: NC-4

     Route: Muskingum Cunge
     Channel: Trapezoid
     Length: 260
     Energy Slope: 0.02
     Width: 6
     Side Slope: 2
     Mannings n: 0.033
     Use Variable Time Step: No
     Channel Loss: None
End:

Reach: NC-4
     Canvas X: -3712.234221419325
     Canvas Y: 5257.511215829942
     From Canvas X: -1287.502338438424
     From Canvas Y: 5275.024853139405
     Label X: -17.0
     Label Y: 6.0
     Downstream: POD-1

     Route: Muskingum Cunge
     Channel: Trapezoid
     Length: 812
     Energy Slope: 0.04
     Width: 6
     Side Slope: 2
     Mannings n: 0.033
```

```
     Use Variable Time Step: No
     Channel Loss: None
End:

Subbasin: POST-1C
     Canvas X: -4882.772306078346
     Canvas Y: 5270.497534851683
     Label X: -82.0
     Label Y: -3.0
     Area: 0.0036
     Downstream: POD-1

     Canopy: None
     Plant Uptake Method: None

     Surface: None

     LossRate: SCS
     Percent Impervious Area: 0.0
     Curve Number: 62

     Transform: SCS
     Lag: 11
     Unitgraph Type: STANDARD

     Baseflow: None
End:

Junction: POD-1
     Canvas X: -3712.234221419325
     Canvas Y: 5257.511215829942
     Label X: -36.0
     Label Y: 18.0
End:

Subbasin: D-9
     Canvas X: -2168.9629899324154
     Canvas Y: -2486.8061909947646
     Label X: -23.0
     Label Y: 18.0
     Area: 0.0162
     Downstream: SOUTH POND

     Canopy 1: None
     Plant Uptake Method: None

     Surface 1: None

     LossRate 1: SCS
     Percent Impervious Area: 0.0
```

```
     Curve Number: 80

     Transform: Kinematic Wave

     Plane: 1
     Plane 1 Length: 160
     Plane 1 Slope: 0.25
     Plane 1 Roughness: 0.15
     Plane 1 Percent of Area: 100
     Plane 1 Number of Steps: 5

     Channel: 2
     Collector Length: 747
     Collector Slope: 0.02
     Collector Mannings N: 0.027
     Shape: Triangle
     Collector Side Slope: 3
     Collector Area: 0.00429
     Collector Number of Steps: 5

     Channel: Main
     Channel Length: 412
     Channel Slope: 0.25
     Channel Mannings N: 0.033
     Shape: Trapezoid
     Channel Width: 15
     Channel Side Slope: 2
     Channel Number of Steps: 5

     Baseflow: None
End:

Subbasin: D-8
     Canvas X: -4106.814945628899
     Canvas Y: -244.69777175913077
     Label X: -49.0
     Label Y: -4.0
     Area: 0.0098
     Downstream: PC-7

     Canopy 1: None
     Plant Uptake Method: None

     Surface 1: None

     LossRate 1: SCS
     Percent Impervious Area: 0.0
     Curve Number: 80

     Transform: Kinematic Wave
```

```
     Plane: 1
     Plane 1 Length: 160
     Plane 1 Slope: 0.25
     Plane 1 Roughness: 0.15
     Plane 1 Percent of Area: 100
     Plane 1 Number of Steps: 5

     Channel: 2
     Collector Length: 322
     Collector Slope: 0.02
     Collector Mannings N: 0.027
     Shape: Triangle
     Collector Side Slope: 3
     Collector Area: 0.00185
     Collector Number of Steps: 5

     Channel: Main
     Channel Length: 300
     Channel Slope: 0.25
     Channel Mannings N: 0.033
     Shape: Trapezoid
     Channel Width: 15
     Channel Side Slope: 2
     Channel Number of Steps: 5

     Baseflow: None
End:

Reach: PC-7
     Canvas X: -3671.0531347982314
     Canvas Y: -2145.422067161626
     From Canvas X: -3655.302781608393
     From Canvas Y: -249.55340460792013
     Label X: -50.0
     Label Y: 1.0
     Downstream: SOUTH POND

     Route: Muskingum Cunge
     Channel: Trapezoid
     Length: 628
     Energy Slope: 0.005
     Width: 5
     Side Slope: 2
     Mannings n: 0.027
     Use Variable Time Step: No
     Channel Loss: None
End:

Subbasin: S POND
```

```
     Canvas X: -6697.9923661187395
     Canvas Y: -2122.66312557275
     Label X: -73.0
     Label Y: -4.0
     Area: 0.0026
     Downstream: SOUTH POND

     Canopy: None
     Plant Uptake Method: None

     Surface: None

     LossRate: SCS
     Percent Impervious Area: 0.0
     Curve Number: 99

     Transform: SCS
     Lag: 1
     Unitgraph Type: STANDARD

     Baseflow: None
End:

Subbasin: D-10A
     Canvas X: -2677.65242844406
     Canvas Y: -546.9946920001421
     From Canvas X: 7740.41257381245
     From Canvas Y: 768.3817862337237
     Area: 0.0026
     Downstream: SOUTH POND

     Canopy: None
     Plant Uptake Method: None

     Surface: None

     LossRate: SCS
     Percent Impervious Area: 0.0
     Curve Number: 80

     Transform: SCS
     Lag: 23
     Unitgraph Type: STANDARD

     Baseflow: None
End:

Reservoir: SOUTH POND
     Canvas X: -3671.0531347982314
     Canvas Y: -2145.422067161626
```

```
     Label X: -99.0
     Label Y: 12.0
     Downstream: SOUTHEAST POND

     Route: Modified Puls
     Routing Curve: Elevation-Area-Outflow
     Initial Elevation: 1194
     Elevation-Area Table: SOUTH POND
     Elevation-Outflow Table: SOUTH POND
     Primary Table: Elevation-Outflow
End:

Subbasin: SE POND
     Canvas X: -5475.393609795796
     Canvas Y: -4438.105990201982
     Label X: -85.0
     Label Y: -3.0
     Area: 0.0011
     Downstream: SOUTHEAST POND

     Canopy: None
     Plant Uptake Method: None

     Surface: None

     LossRate: SCS
     Percent Impervious Area: 0.0
     Curve Number: 99

     Transform: SCS
     Lag: 1
     Unitgraph Type: STANDARD

     Baseflow: None
End:

Subbasin: POST-2A
     Canvas X: -3668.3919187293723
     Canvas Y: -4585.085738064456
     Label X: -36.0
     Label Y: -23.0
     Area: 0.0007
     Downstream: SOUTHEAST POND

     Canopy: None
     Plant Uptake Method: None

     Surface: None

     LossRate: SCS
```

```
     Percent Impervious Area: 0.0
     Curve Number: 62

     Transform: SCS
     Lag: 5
     Unitgraph Type: STANDARD

     Baseflow: None
End:

Reservoir: SOUTHEAST POND
     Canvas X: -3671.0531347982314
     Canvas Y: -3260.61020501655
     Label X: -140.0
     Label Y: -3.0
     Downstream: POD-2

     Route: Modified Puls
     Routing Curve: Elevation-Area-Outflow
     Initial Elevation: 1190
     Elevation-Area Table: SOUTHWEST POND
     Elevation-Outflow Table: SOUTHWEST POND
     Primary Table: Elevation-Outflow
End:

Subbasin: POST-2B
     Canvas X: -962.7390857219871
     Canvas Y: -4307.521518104846
     Label X: -39.0
     Label Y: -19.0
     Area: 0.0121
     Downstream: POD-2

     Canopy: None
     Plant Uptake Method: None

     Surface: None

     LossRate: SCS
     Percent Impervious Area: 0.0
     Curve Number: 67.2

     Transform: SCS
     Lag: 45
     Unitgraph Type: STANDARD

     Baseflow: None
End:

Junction: POD-2
```

```
     Canvas X: -906.3268492623465
     Canvas Y: -3247.8955060208955
     Label X: 13.0
     Label Y: 1.0
End:

Basin Schematic Properties:
     Last View N: 5000.0
     Last View S: -5000.0
     Last View W: -5000.0
     Last View E: 5000.0
     Maximum View N: 7436.2150582362765
     Maximum View S: -3738.6706948640476
     Maximum View W: -4663.617824773413
     Maximum View E: 6994.061730449253
     Extent Method: Elements
     Buffer: 0
     Draw Icons: Yes
     Draw Icon Labels: Name
     Draw Map Objects: No
     Draw Gridlines: No
     Draw Flow Direction: No
     Fix Element Locations: No
     Fix Hydrologic Order: No
End:
```

HEC-HMS OUTPUT FILES

Project: Northeast (Pre and Post) Simulation Run: POST-DEVELOP EXP

Start of Run: 14Jun2021, 00:00 Basin Model: Post-Develop (exp)
End of Run: 16Jun2021, 00:00 Meteorologic Model: 25 yr, 24 hr
Compute Time: 08Jun2023, 09:39:47 Control Specifications: 48-HR

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (AC-FT)
D-1	0.0199	80.5	14Jun2021, 12:00	4.8
D-1A	0.0037	13.3	14Jun2021, 12:00	0.9
D-10	0.0140	57.0	14Jun2021, 12:00	3.4
D-10A	0.0026	5.0	14Jun2021, 12:20	0.6
D-2	0.0124	50.4	14Jun2021, 12:00	3.0
D-3	0.0455	185.0	14Jun2021, 12:00	11.0
D-4	0.0138	56.2	14Jun2021, 12:00	3.3
D-5	0.0205	83.4	14Jun2021, 12:00	5.0
D-6	0.0365	148.5	14Jun2021, 12:00	8.8
D-7	0.0317	129.0	14Jun2021, 12:00	7.7
D-8	0.0098	39.8	14Jun2021, 12:00	2.4
D-8A	0.0029	10.5	14Jun2021, 12:00	0.7
D-9	0.0162	65.9	14Jun2021, 12:00	3.9
NC-1	0.0935	118.9	14Jun2021, 12:20	17.2
NC-2	0.0935	118.3	14Jun2021, 12:20	17.2
NC-3	0.1060	134.4	14Jun2021, 12:20	19.4
NC-4	0.1060	133.3	14Jun2021, 12:20	19.4
NORTHWEST POND	0.2039	260.2	14Jun2021, 12:20	48.6
North Channel	0.0065	14.1	14Jun2021, 12:00	0.9
NORTH POND	0.1286	211.0	14Jun2021, 12:10	29.9
NW POND	0.0042	19.0	14Jun2021, 12:00	1.5
N POND	0.0029	13.1	14Jun2021, 12:00	1.0
OFS_A_East	0.0566	79.5	14Jun2021, 12:20	10.1
OFS_A1_North	0.0125	16.5	14Jun2021, 12:20	2.2
OFS_A2_North	0.0172	22.2	14Jun2021, 12:20	3.1
OFS_B1_East	0.0099	13.3	14Jun2021, 12:10	1.6
OFS_B2-East	0.0045	6.0	14Jun2021, 12:10	0.7

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (AC-FT)
PC-1A	0.1052	325.7	14Jun2021, 12:00	24.7
PC-12A	0.0346	124.0	14Jun2021, 12:00	8.4
PC-2A	0.0914	273.1	14Jun2021, 12:00	21.4
PC-3	0.0360	124.3	14Jun2021, 12:00	8.8
PC-4	0.0236	83.4	14Jun2021, 12:00	5.7
PC-7	0.0098	36.9	14Jun2021, 12:00	2.4
PC-8	0.0029	9.3	14Jun2021, 12:00	0.7
POD-1	0.3135	396.4	14Jun2021, 12:20	68.6
POD-2	0.0451	10.9	14Jun2021, 12:40	2.0
POST-1A	0.0035	4.9	14Jun2021, 12:10	0.5
POST-1B	0.0052	23.5	14Jun2021, 12:00	1.9
POST-1C	0.0036	5.2	14Jun2021, 12:10	0.5
POST-2A	0.0007	1.5	14Jun2021, 12:00	0.1
POST-2B	0.0121	10.9	14Jun2021, 12:40	2.0
SE POND	0.0011	5.0	14Jun2021, 12:00	0.4
SOUTHEAST POND	0.0330	0.0	14Jun2021, 00:00	0.0
SOUTH POND	0.0312	8.7	14Jun2021, 13:00	3.5
S POND	0.0026	11.8	14Jun2021, 12:00	0.9

Project: Northeast (Pre and Post) Simulation Run: POST-DEVELOP EXP
Junction: POD-1

Start of Run:	14Jun2021, 00:00	Basin Model:	Post-Develop (exp)
End of Run:	16Jun2021, 00:00	Meteorologic Model:	25 yr, 24 hr
Compute Time:	08Jun2023, 09:45:41	Control Specifications:	48-HR

Volume Units: AC-FT

Computed Results

Peak Discharge:	396.4 (CFS)	Date/Time of Peak Discharge:	14Jun2021, 12:20
Volume:	68.6 (AC-FT)		

Project: Northeast (Pre and Post) Simulation Run: POST-DEVELOP EXP
Junction: POD-2

Start of Run:	14Jun2021, 00:00	Basin Model:	Post-Develop (exp)
End of Run:	16Jun2021, 00:00	Meteorologic Model:	25 yr, 24 hr
Compute Time:	08Jun2023, 09:45:41	Control Specifications:	48-HR

Volume Units: AC-FT

Computed Results

Peak Discharge:	10.9 (CFS)	Date/Time of Peak Discharge:	14Jun2021, 12:40
Volume:	2.0 (AC-FT)		

Project: Northeast (Pre and Post) Simulation Run: POST-DEVELOP EXP
Reservoir: NORTH POND

Start of Run:	14Jun2021, 00:00	Basin Model:	Post-Develop (exp)
End of Run:	16Jun2021, 00:00	Meteorologic Model:	25 yr, 24 hr
Compute Time:	08Jun2023, 09:45:41	Control Specifications:	48-HR

Volume Units: AC-FT

Computed Results

Peak Inflow:	422.2 (CFS)	Date/Time of Peak Inflow:	14Jun2021, 12:00
Peak Discharge:	211.0 (CFS)	Date/Time of Peak Discharge:	14Jun2021, 12:10
Inflow Volume:	30.7 (AC-FT)	Peak Storage:	6.6 (AC-FT)
Discharge Volume:	29.9 (AC-FT)	Peak Elevation:	1199.0 (FT)

Project: Northeast (Pre and Post) Simulation Run: POST-DEVELOP EXP
Reservoir: NORTHWEST POND

Start of Run:	14Jun2021, 00:00	Basin Model:	Post-Develop (exp)
End of Run:	16Jun2021, 00:00	Meteorologic Model:	25 yr, 24 hr
Compute Time:	08Jun2023, 09:45:41	Control Specifications:	48-HR

Volume Units: AC-FT

Computed Results

Peak Inflow:	473.3 (CFS)	Date/Time of Peak Inflow:	14Jun2021, 12:00
Peak Discharge:	260.2 (CFS)	Date/Time of Peak Discharge:	14Jun2021, 12:20
Inflow Volume:	48.6 (AC-FT)	Peak Storage:	7.4 (AC-FT)
Discharge Volume:	48.6 (AC-FT)	Peak Elevation:	1175.7 (FT)

Project: Northeast (Pre and Post) Simulation Run: POST-DEVELOP EXP
Reservoir: SOUTHEAST POND

Start of Run:	14Jun2021, 00:00	Basin Model:	Post-Develop (exp)
End of Run:	16Jun2021, 00:00	Meteorologic Model:	25 yr, 24 hr
Compute Time:	08Jun2023, 09:45:41	Control Specifications:	48-HR

Volume Units: AC-FT

Computed Results

Peak Inflow:	9.2 (CFS)	Date/Time of Peak Inflow:	14Jun2021, 13:00
Peak Discharge:	0.0 (CFS)	Date/Time of Peak Discharge:	14Jun2021, 00:00
Inflow Volume:	4.0 (AC-FT)	Peak Storage:	4.0 (AC-FT)
Discharge Volume:	0.0 (AC-FT)	Peak Elevation:	1201.0 (FT)

Project: Northeast (Pre and Post)   Simulation Run: POST-DEVELOP EXP
Reservoir: SOUTH POND

Start of Run:	14Jun2021, 00:00	Basin Model:	Post-Develop (exp)
End of Run:	16Jun2021, 00:00	Meteorologic Model:	25 yr, 24 hr
Compute Time:	08Jun2023, 09:45:41	Control Specifications:	48-HR

Volume Units: AC-FT

Computed Results

Peak Inflow:	117.7 (CFS)	Date/Time of Peak Inflow:	14Jun2021, 12:00
Peak Discharge:	8.7 (CFS)	Date/Time of Peak Discharge:	14Jun2021, 13:00
Inflow Volume:	7.9 (AC-FT)	Peak Storage:	4.9 (AC-FT)
Discharge Volume:	3.5 (AC-FT)	Peak Elevation:	1200.5 (FT)

ATTACHMENT E-4

HYDRAULIC ANALYSIS

- Drainage Swale Flow Analysis
- Downchute Flow Analysis
- Perimeter Channel Flow Analysis (HydraFlow Express Output Files)
- Soil Loss Analysis
- Hydraulic Analysis References

DRAINAGE SWALE FLOW ANALYSIS

NORTHEAST LANDFILL
FINAL COVER - DRAINAGE SWALE FLOW ANALYSIS

Required: Calculate the flow velocity and normal depth for sizing drainage swales installed on final cover.

Method:

1. Determine peak discharge rate associated with the 25 - year, 24 - hour storm event for the swale contributing drainage areas, as shown on the attached drawing, using the Rational Method .
2. Determine Mannings "n" and runoff coefficient "C" (see Attachment E-4).
3. Using the specified channel geometry, evaluate the peak velocity and flow depth using Hydraflow Express program.
4. Compare the worst case flow velocity with the permissible velocity of 5 fps.

Solution:

Rational Method Calculations for Typical Swale Contributing Areas

Worst Cases

Drainage Area [2]	Runoff Coef. Cf	Runoff Coef. C[3]	Rainfall Int. I, (in/hr)[4]	Area (acres)	Peak Discharge (cfs)
D-3-8	1.1	0.70	7.4	2.5	14.01
D-7-4	1.1	0.70	7.4	2.8	16.11
D-7-1	1.1	0.70	7.4	2.8	16.06
D-10	1.1	0.70	7.4	9.0	49.39
D-1	1.1	0.70	7.4	12.7	70.50

$I =$ 7.4 in/hr
$t_c =$ 10 min
(ODOT Roadway Drainage Manual, Zone 5)

Typical Swale Summary Calculations[1]

Worst Cases

Drainage Area [2]	Flow Rate (cfs)	Bottom Slope(ft/ft)	Manning's n[3]	Side Slope (left)	Side Slope (right)	Bottom Width (ft)	Normal Depth (ft)	Flow Vel. (fps)
D-3-8	14.01	0.020	0.027	2	4	0.0	1.00	4.67
D-7-4	16.11	0.020	0.027	2	4	0.0	1.05	4.87
D-7-1	16.06	0.020	0.027	2	4	0.0	1.05	4.86
D-10	49.39	0.005	0.027	2	4	5.0	1.43	3.72
D-1	70.50	0.005	0.027	2	4	5.0	1.70	4.11

Conclusions: From above drainage swale summary calculations, the greatest calculated flow velocity in a sideslope swale is 4.98 fps , which is less than the permissible velocity of 5 fps. Drainage swales installed on the final cover sideslope will be constructed with a minimum depth of 2.5 feet with slope of 2% and 3.5 feet with slope of 0.5%. Both types of swales will have at least 1 foot freeboard. See Permit Drawings for drainage swale details.

Notes:

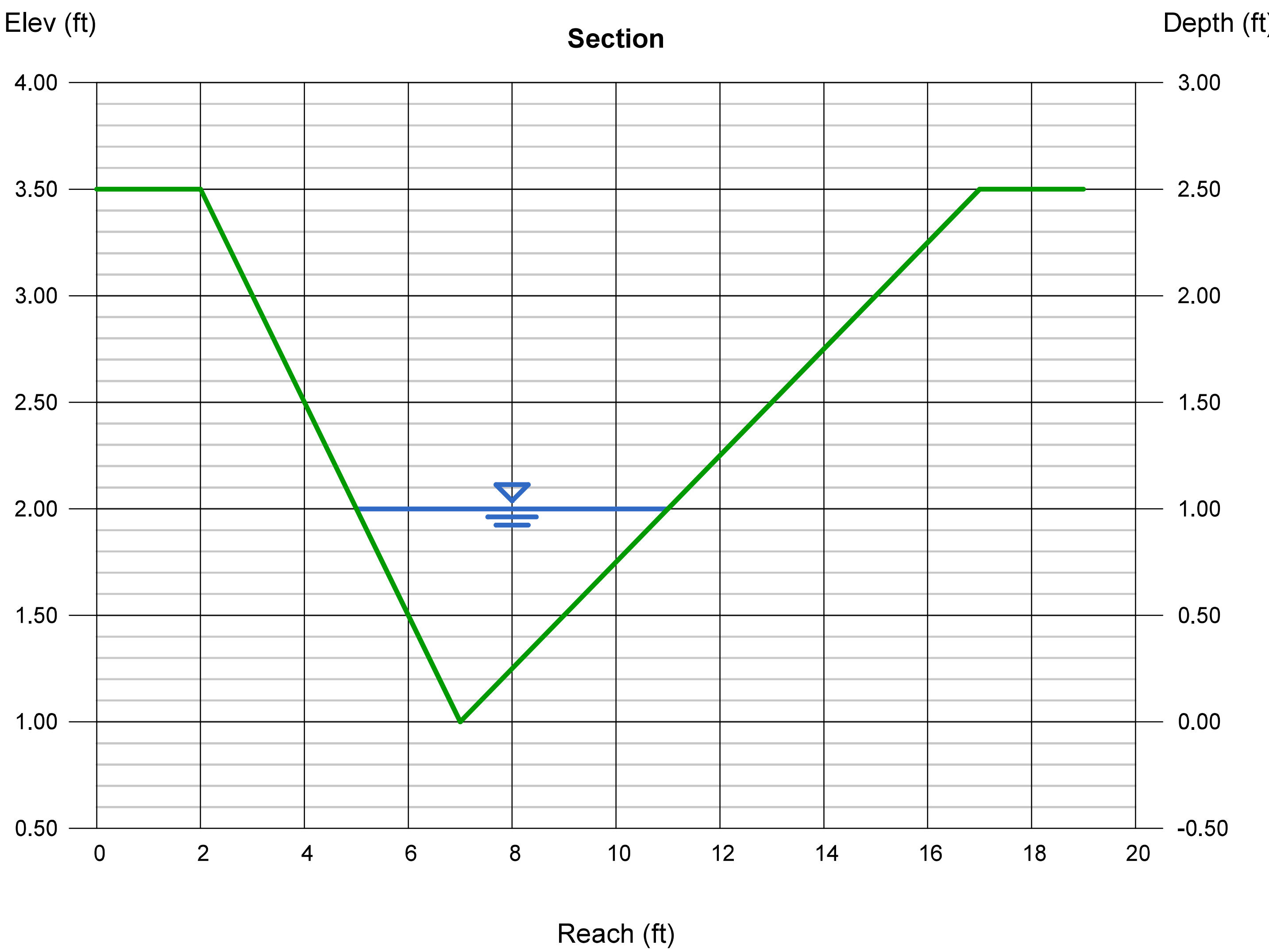
1. Calculations were performed using the Hydraflow Express.
2. Contributing drainage areas are depicted on Drawing E4.
3. Refer to Hydraulic Calculation References for Mannings "n" and runoff coefficient, C, references.
4. Rainfal Intensity (I) calculated for tc = 10 min, using equation for rainfall intensity shown above.

Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Tuesday, May 9 2023

D-3-8

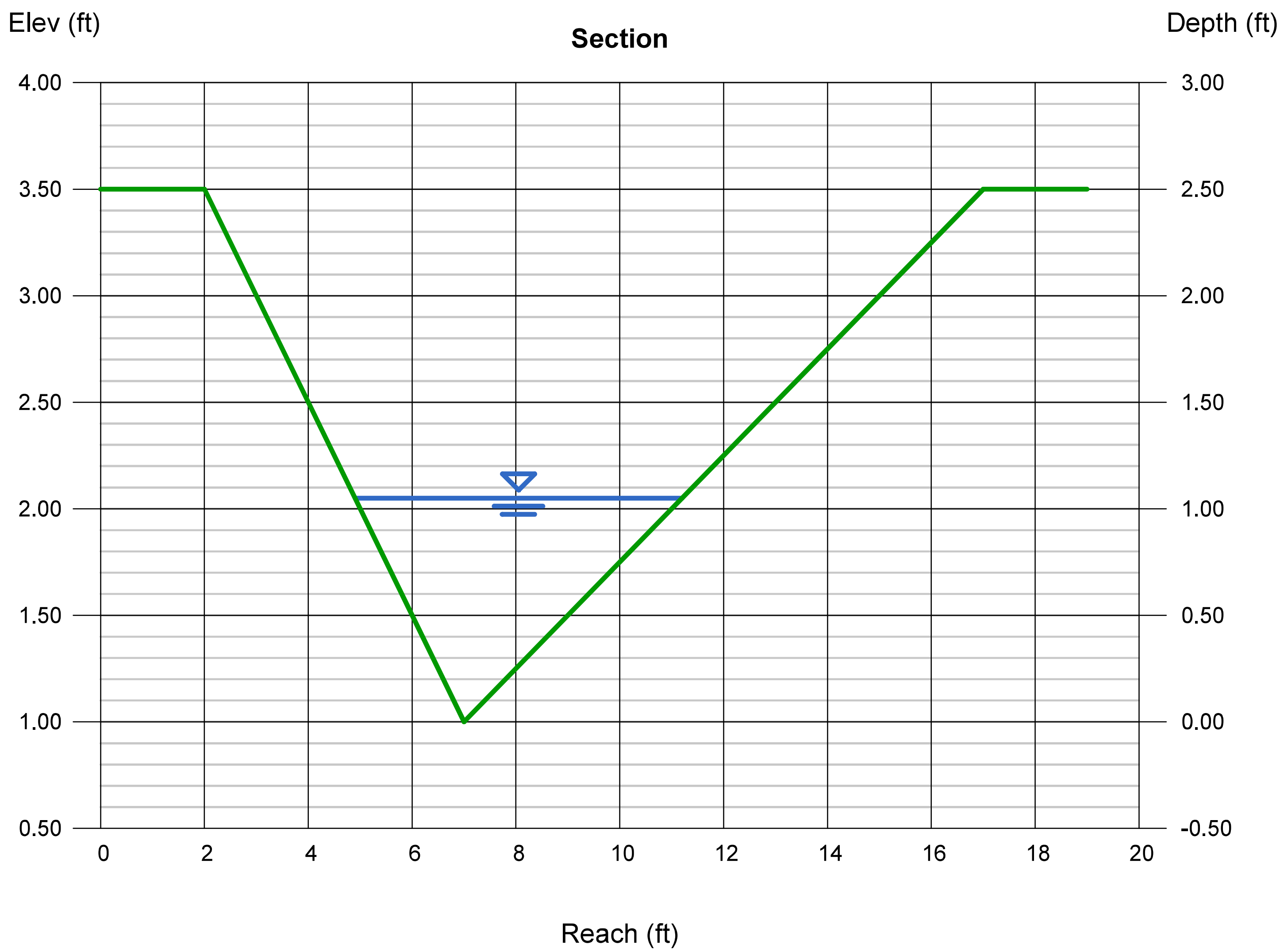
Triangular		**Highlighted**	
Side Slopes (z:1)	= 2.00, 4.00	Depth (ft)	= 1.00
Total Depth (ft)	= 2.50	Q (cfs)	= 14.01
		Area (sqft)	= 3.00
Invert Elev (ft)	= 1.00	Velocity (ft/s)	= 4.67
Slope (%)	= 2.00	Wetted Perim (ft)	= 6.36
N-Value	= 0.027	Crit Depth, Yc (ft)	= 1.07
		Top Width (ft)	= 6.00
Calculations		EGL (ft)	= 1.34
Compute by:	Known Q		
Known Q (cfs)	= 14.01		



Channel Report

D-7-1

Triangular		**Highlighted**	
Side Slopes (z:1)	= 2.00, 4.00	Depth (ft)	= 1.05
Total Depth (ft)	= 2.50	Q (cfs)	= 16.06
		Area (sqft)	= 3.31
Invert Elev (ft)	= 1.00	Velocity (ft/s)	= 4.86
Slope (%)	= 2.00	Wetted Perim (ft)	= 6.68
N-Value	= 0.027	Crit Depth, Yc (ft)	= 1.13
		Top Width (ft)	= 6.30
Calculations		EGL (ft)	= 1.42
Compute by:	Known Q		
Known Q (cfs)	= 16.06		

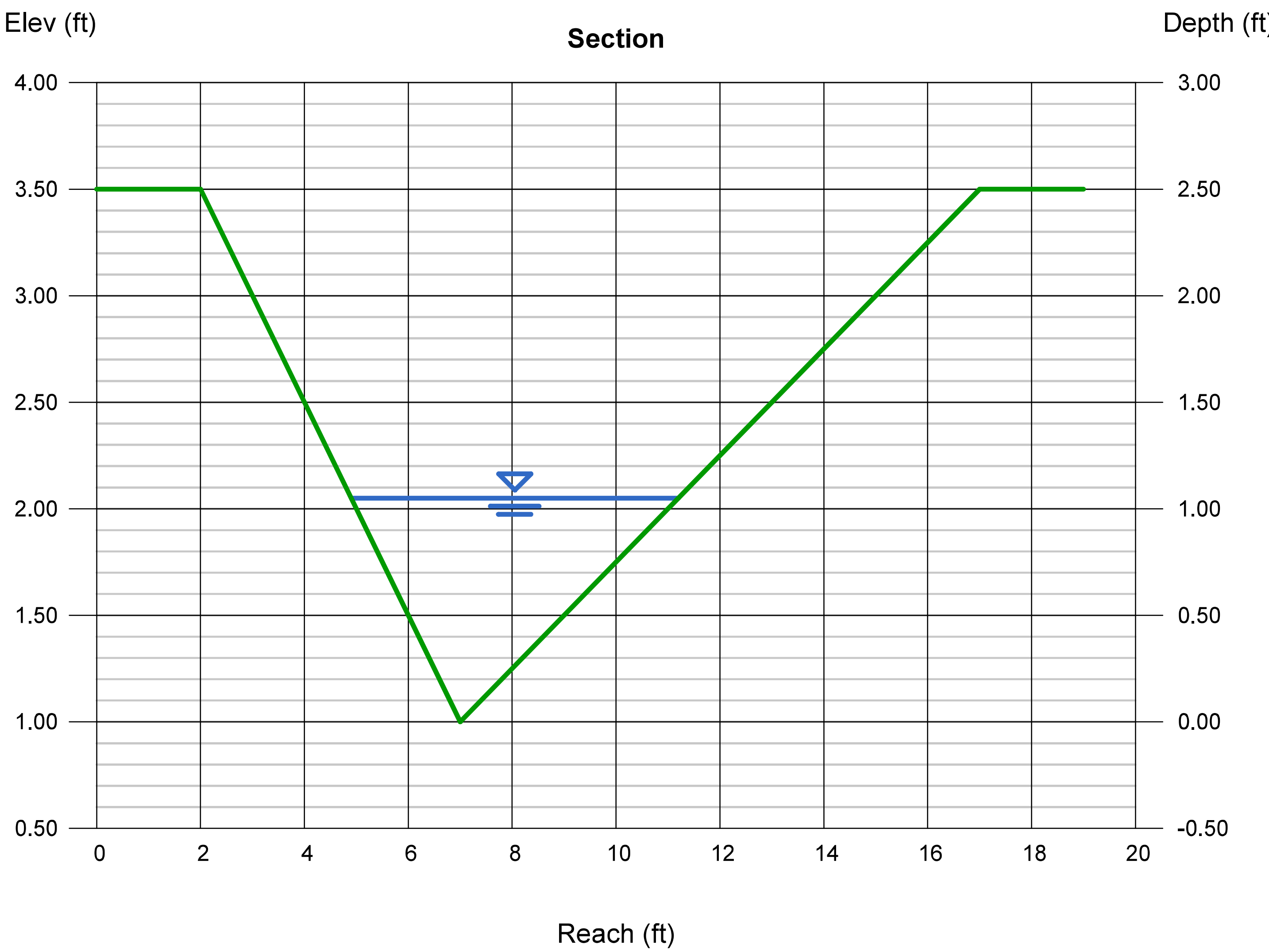


Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. — Tuesday, May 9 2023

D-7-4

Triangular		**Highlighted**	
Side Slopes (z:1)	= 2.00, 4.00	Depth (ft)	= 1.05
Total Depth (ft)	= 2.50	Q (cfs)	= 16.11
		Area (sqft)	= 3.31
Invert Elev (ft)	= 1.00	Velocity (ft/s)	= 4.87
Slope (%)	= 2.00	Wetted Perim (ft)	= 6.68
N-Value	= 0.027	Crit Depth, Yc (ft)	= 1.13
		Top Width (ft)	= 6.30
Calculations		EGL (ft)	= 1.42
Compute by:	Known Q		
Known Q (cfs)	= 16.11		

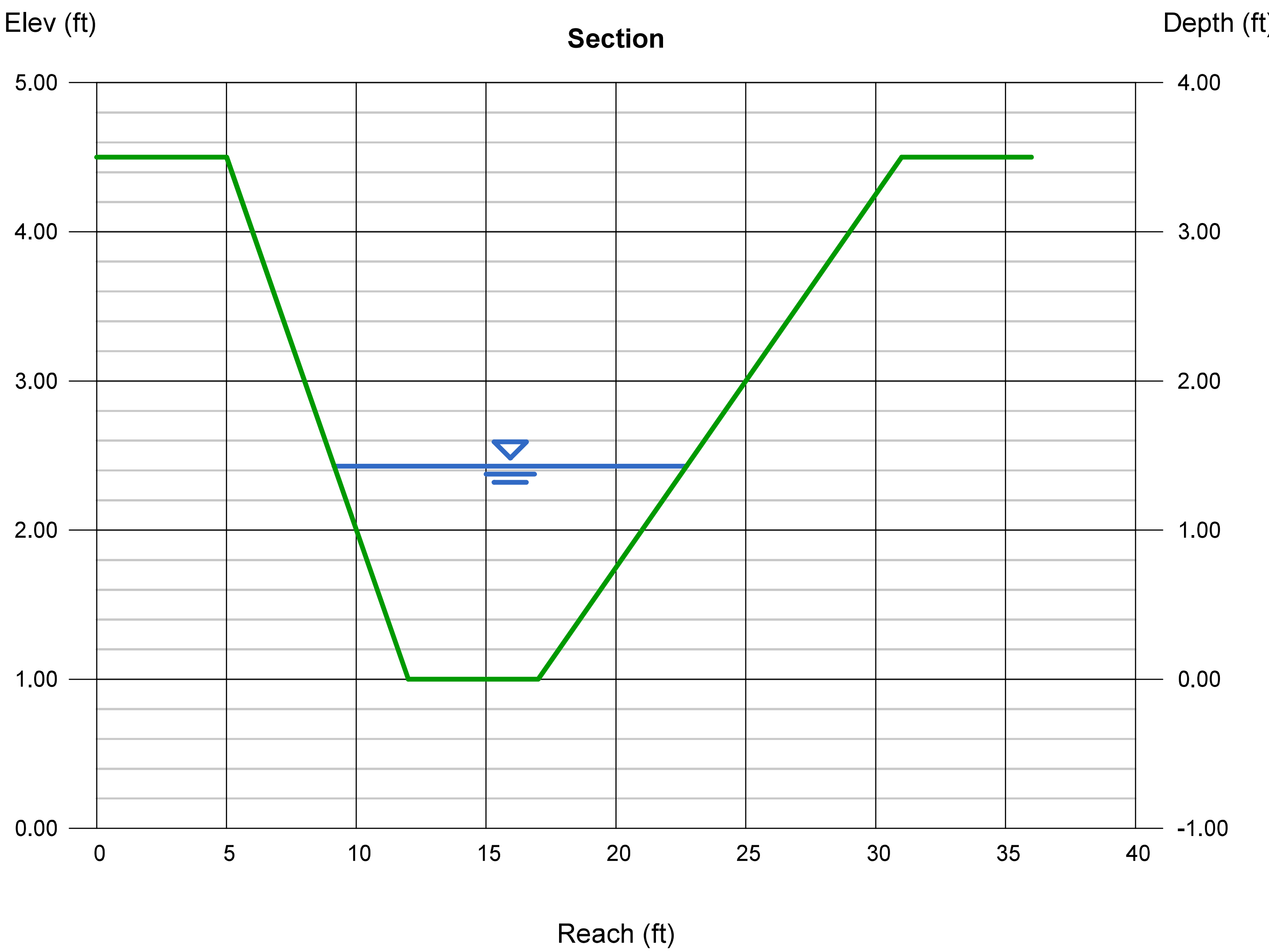


Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Wednesday, Aug 2 2023

D-10

Trapezoidal		**Highlighted**	
Bottom Width (ft)	= 5.00	Depth (ft)	= 1.43
Side Slopes (z:1)	= 2.00, 4.00	Q (cfs)	= 49.39
Total Depth (ft)	= 3.50	Area (sqft)	= 13.28
Invert Elev (ft)	= 1.00	Velocity (ft/s)	= 3.72
Slope (%)	= 0.50	Wetted Perim (ft)	= 14.09
N-Value	= 0.027	Crit Depth, Yc (ft)	= 1.15
		Top Width (ft)	= 13.58
Calculations		EGL (ft)	= 1.64
Compute by:	Known Q		
Known Q (cfs)	= 49.39		

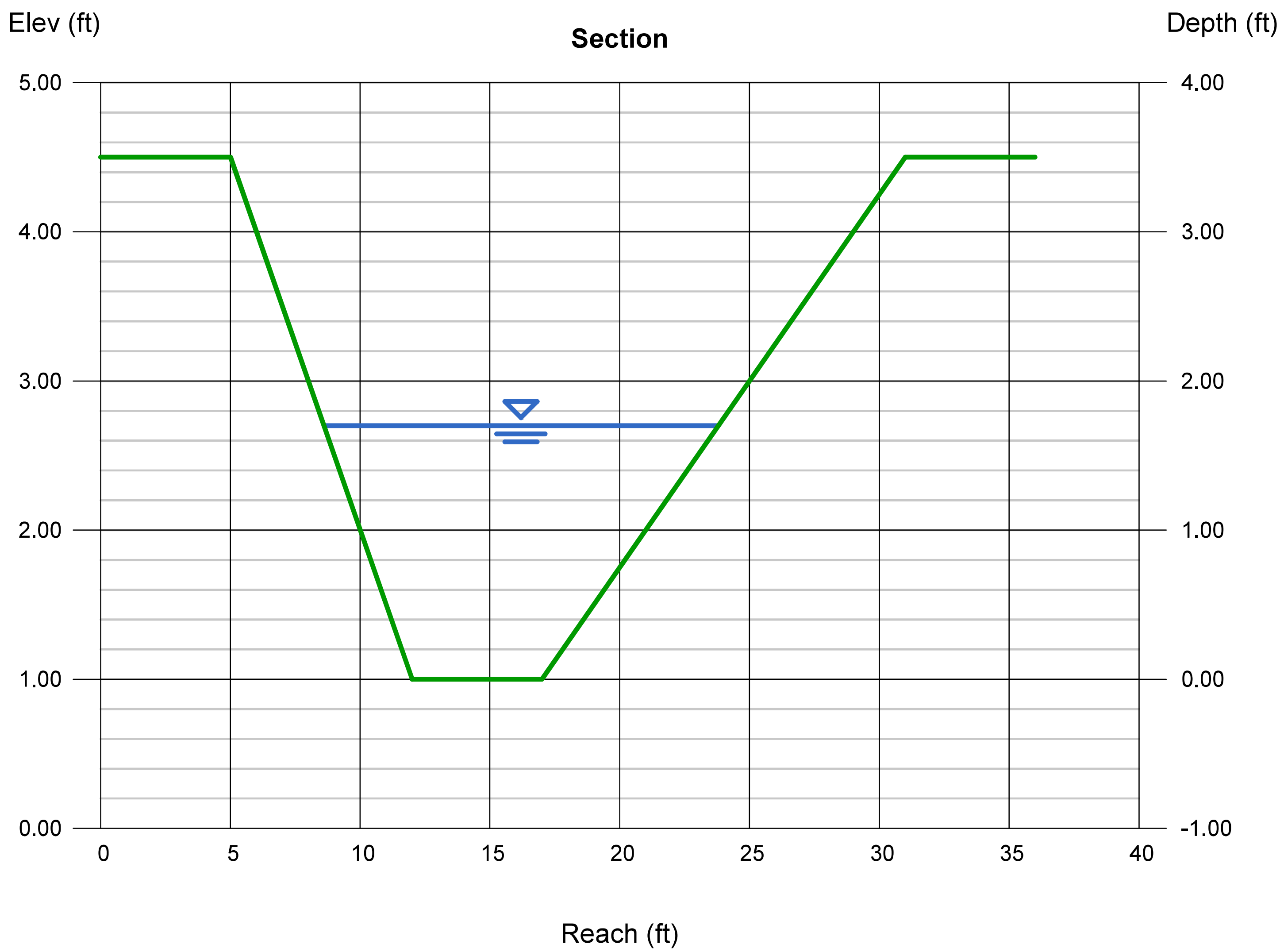


Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Wednesday, Aug 2 2023

D-1

Trapezoidal		**Highlighted**	
Bottom Width (ft)	= 5.00	Depth (ft)	= 1.70
Side Slopes (z:1)	= 2.00, 4.00	Q (cfs)	= 70.50
Total Depth (ft)	= 3.50	Area (sqft)	= 17.17
Invert Elev (ft)	= 1.00	Velocity (ft/s)	= 4.11
Slope (%)	= 0.50	Wetted Perim (ft)	= 15.81
N-Value	= 0.027	Crit Depth, Yc (ft)	= 1.39
		Top Width (ft)	= 15.20
Calculations		EGL (ft)	= 1.96
Compute by:	Known Q		
Known Q (cfs)	= 70.50		



DOWNCHUTE FLOW ANALYSIS

NORTHEAST LANDFILL
FINAL COVER - DOWNCHUTE FLOW ANALYSIS

Required: Calculate the peak flow depth for sizing downchutes installed on **final cover**.

Method:

1. Determine peak discharge rate associated with the 25 - year, 24 - hour storm event for downchute contributing drainage areas using the Rational Method.
2. Determine Mannings "n" and runoff coefficient "C" (see Attachment E-4).
3. Using the specified channel geometry, evaluate the peak velocity and flow depth using Hydraflow Express program.

Solution:

Rational Method Calculations for Typical Swale Contributing Areas

Drainage Area [2]	Runoff Coef. Cf	Runoff Coef. C[3]	Rainfall Int. I, (in/hr)[4]	Area (acres)	Peak Discharge (cfs)
D-3	1.1	0.70	7.4	23.0	131.1
D-7	1.1	0.70	7.4	15.3	86.9

I = 7.40
t_c = 10 min
(ODOT Roadway Drainage Manual, Zone 5)

Typical Swale Summary Calculations[1]

Drainage Area [2]	Flow Rate (cfs)	Bottom Slope(ft/ft)	Manning's n[3]	Sideslope (left)	Sideslope (right)	Bottom Width (ft)	Normal Depth (ft)	Flow Vel. (fps)
D-3	131.1	0.25	0.027	2	2	15.0	0.50	16.39
D-7	86.9	0.25	0.027	2	2	15.0	0.40	13.75

Conclusions:

Based on the greatest contributing drainage areas shown on Drawing E4-2, downchutes installed on final cover will be constructed 2 feet deep (assuming min. 1-foot of freeboard), with a 10-foot bottom width, and 2H:1V sideslopes. Gabions, rip rap, or dissipation blocks will be installed at the toe of the landfill berm with the perimeter channels to dissipate the peak velocity. Typcial details for downchutes are depicted on Permit Drawings.

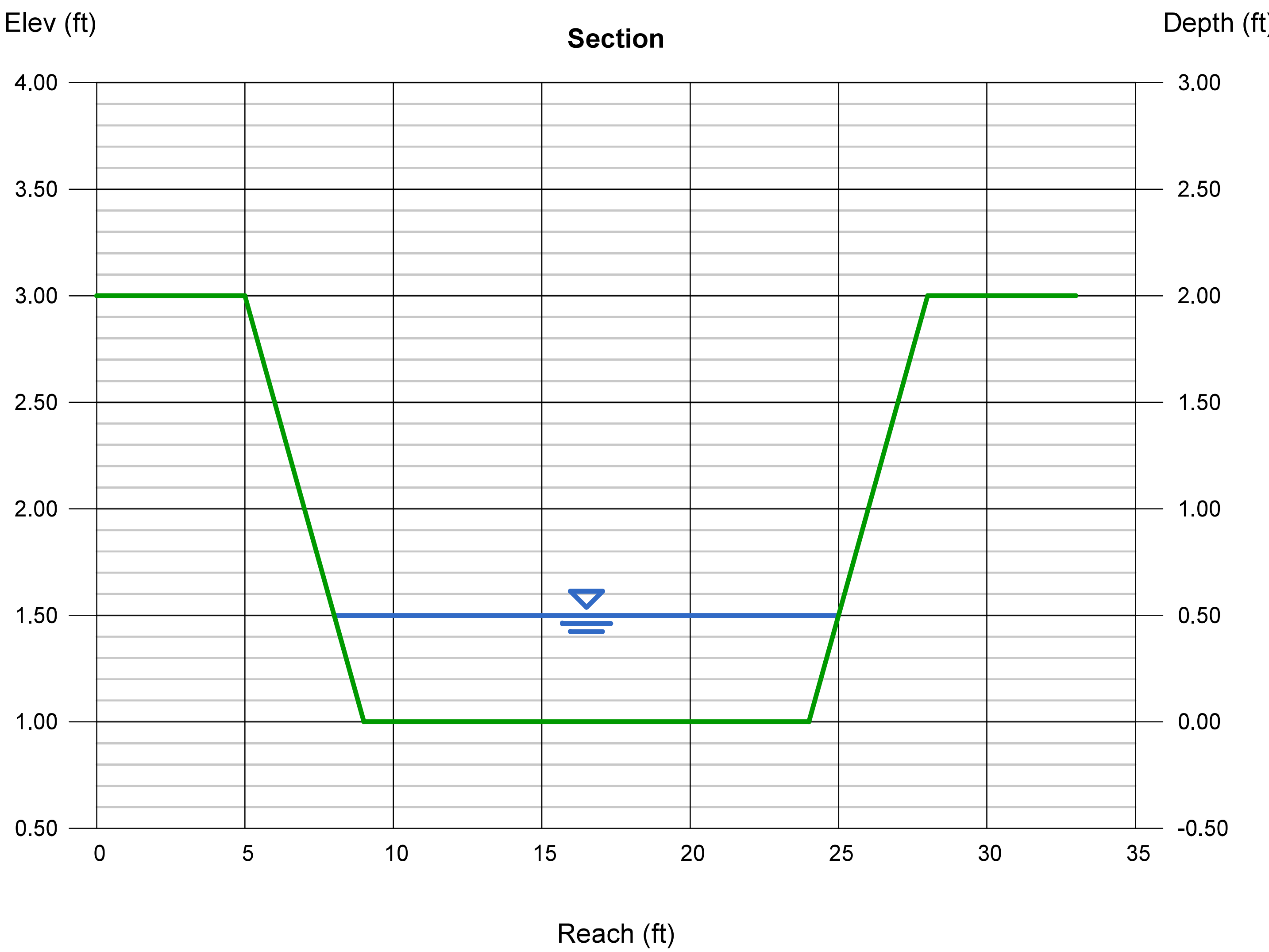
Notes:

1. Calculations were performed using the Hydraflow Express.
2. Contributing drainage areas are depicted on Drawing E3.
3. Refer to Hydraulic Calculation References for Mannings "n" and runoff coefficient, C, references.
4. Rainfal Intensity (I) calculated for tc = 10 min, as shown above. Refer to Hydraulic Calculation References.

Channel Report

D-3

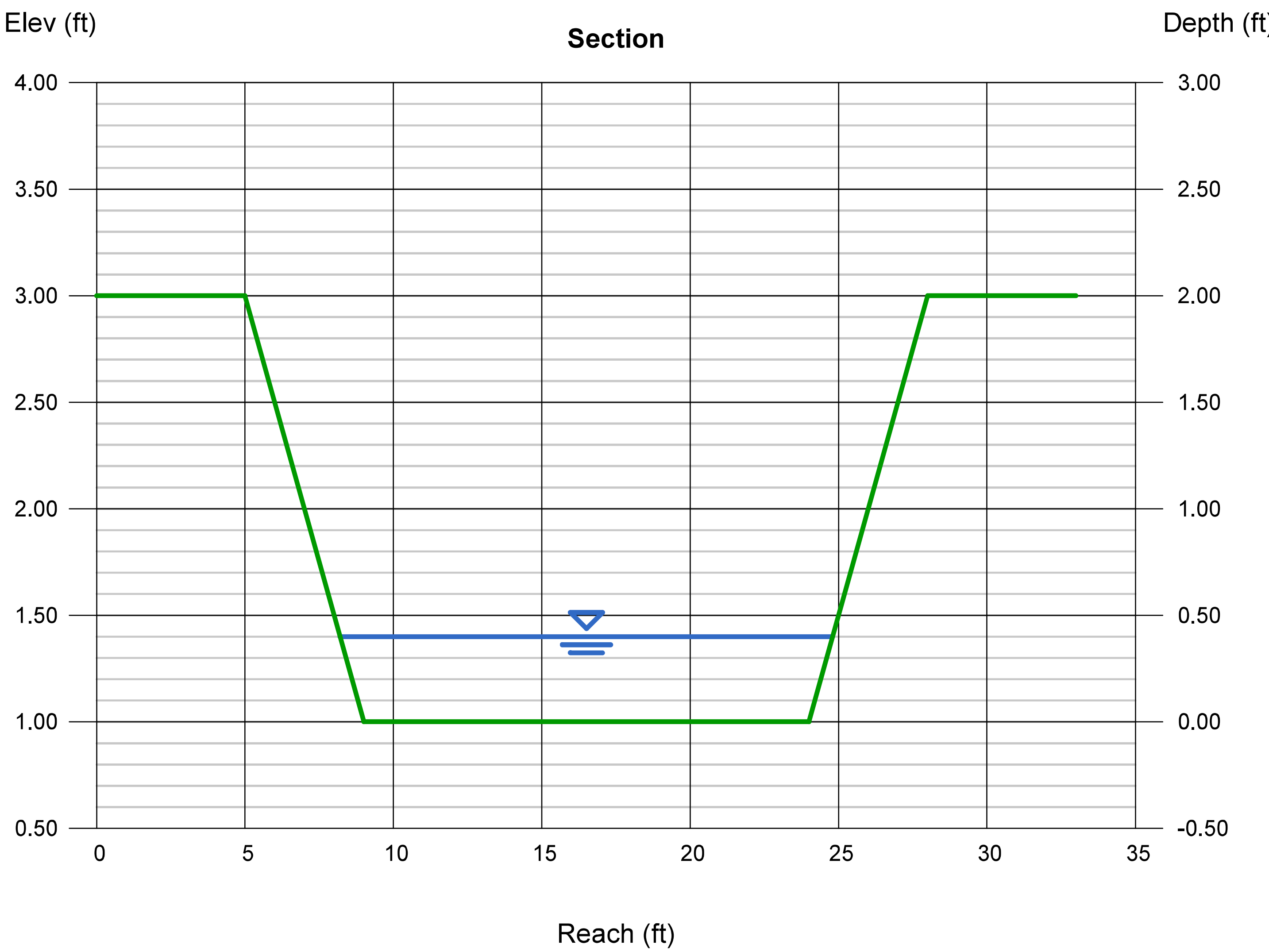
Trapezoidal		**Highlighted**	
Bottom Width (ft)	= 15.00	Depth (ft)	= 0.50
Side Slopes (z:1)	= 2.00, 2.00	Q (cfs)	= 131.10
Total Depth (ft)	= 2.00	Area (sqft)	= 8.00
Invert Elev (ft)	= 1.00	Velocity (ft/s)	= 16.39
Slope (%)	= 25.00	Wetted Perim (ft)	= 17.24
N-Value	= 0.027	Crit Depth, Yc (ft)	= 1.26
		Top Width (ft)	= 17.00
Calculations		EGL (ft)	= 4.68
Compute by:	Known Q		
Known Q (cfs)	= 131.10		



Channel Report

D-7

Trapezoidal		**Highlighted**	
Bottom Width (ft)	= 15.00	Depth (ft)	= 0.40
Side Slopes (z:1)	= 2.00, 2.00	Q (cfs)	= 86.90
Total Depth (ft)	= 2.00	Area (sqft)	= 6.32
Invert Elev (ft)	= 1.00	Velocity (ft/s)	= 13.75
Slope (%)	= 25.00	Wetted Perim (ft)	= 16.79
N-Value	= 0.027	Crit Depth, Yc (ft)	= 0.97
		Top Width (ft)	= 16.60
Calculations		EGL (ft)	= 3.34
Compute by:	Known Q		
Known Q (cfs)	= 86.90		



PERIMETER CHANNEL FLOW ANALYSIS

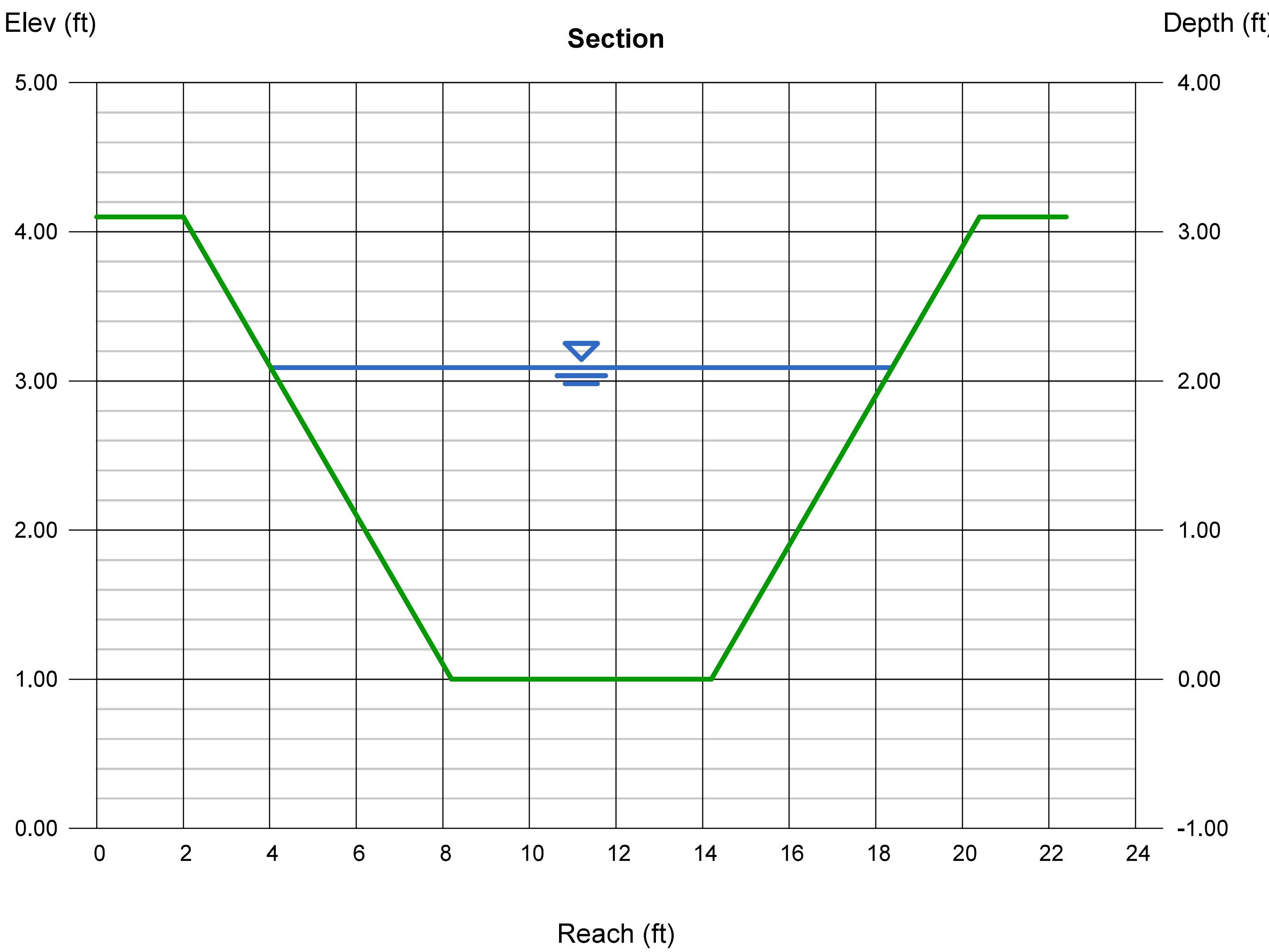
(HYDRAFLOW EXPRESS OUTPUT FILES)

Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Wednesday, May 10 2023

NC-1

Trapezoidal		**Highlighted**	
Bottom Width (ft)	= 6.00	Depth (ft)	= 2.09
Side Slopes (z:1)	= 2.00, 2.00	Q (cfs)	= 188.00
Total Depth (ft)	= 3.10	Area (sqft)	= 21.28
Invert Elev (ft)	= 1.00	Velocity (ft/s)	= 8.84
Slope (%)	= 2.50	Wetted Perim (ft)	= 15.35
N-Value	= 0.033	Crit Depth, Yc (ft)	= 2.39
		Top Width (ft)	= 14.36
Calculations		EGL (ft)	= 3.30
Compute by:	Known Q		
Known Q (cfs)	= 188.00		

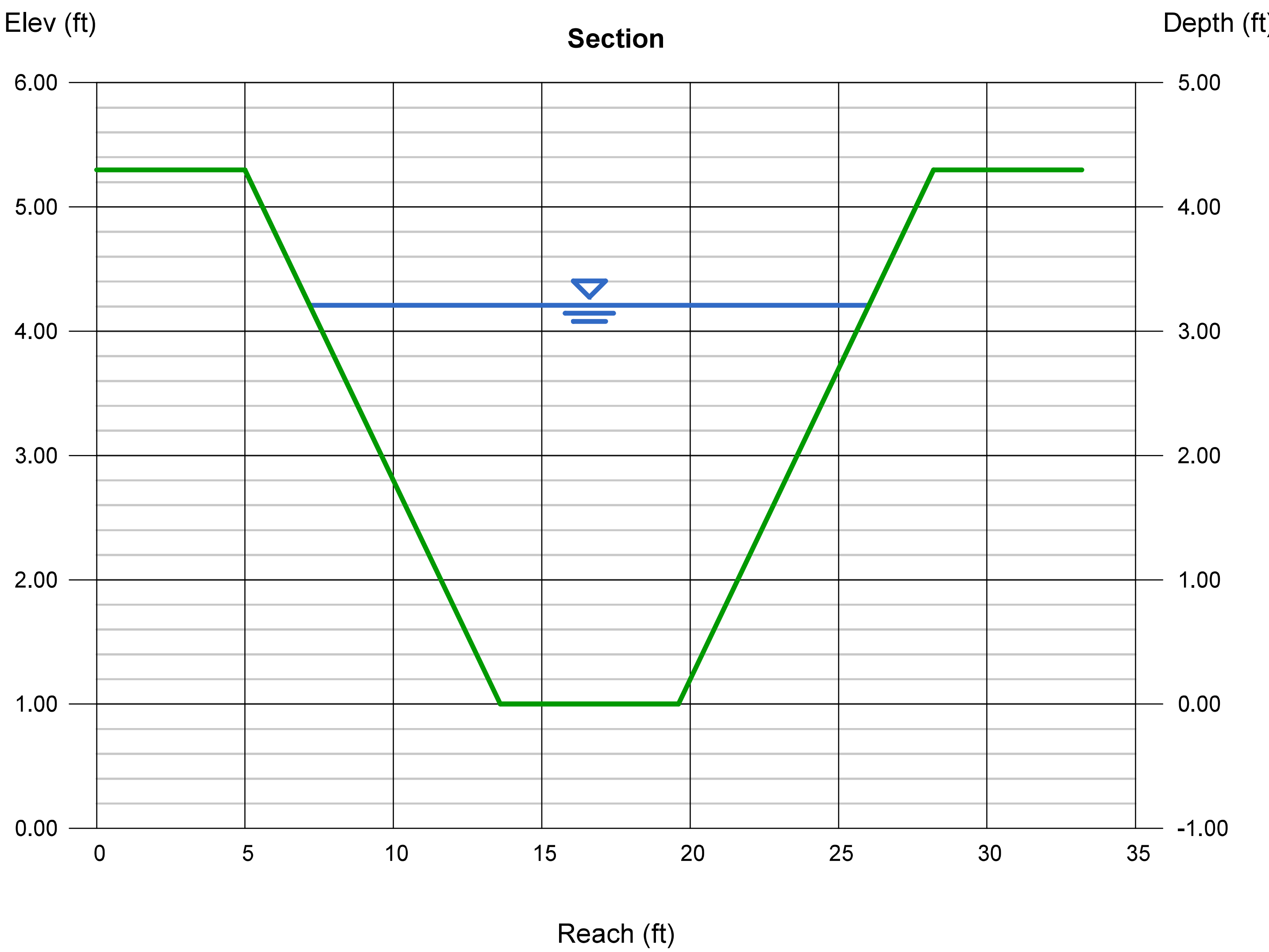


Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Wednesday, May 10 2023

NC-2

Trapezoidal		**Highlighted**	
Bottom Width (ft)	= 6.00	Depth (ft)	= 3.21
Side Slopes (z:1)	= 2.00, 2.00	Q (cfs)	= 188.00
Total Depth (ft)	= 4.30	Area (sqft)	= 39.87
Invert Elev (ft)	= 1.00	Velocity (ft/s)	= 4.72
Slope (%)	= 0.30	Wetted Perim (ft)	= 20.36
N-Value	= 0.027	Crit Depth, Yc (ft)	= 2.39
		Top Width (ft)	= 18.84
Calculations		EGL (ft)	= 3.56
Compute by:	Known Q		
Known Q (cfs)	= 188.00		

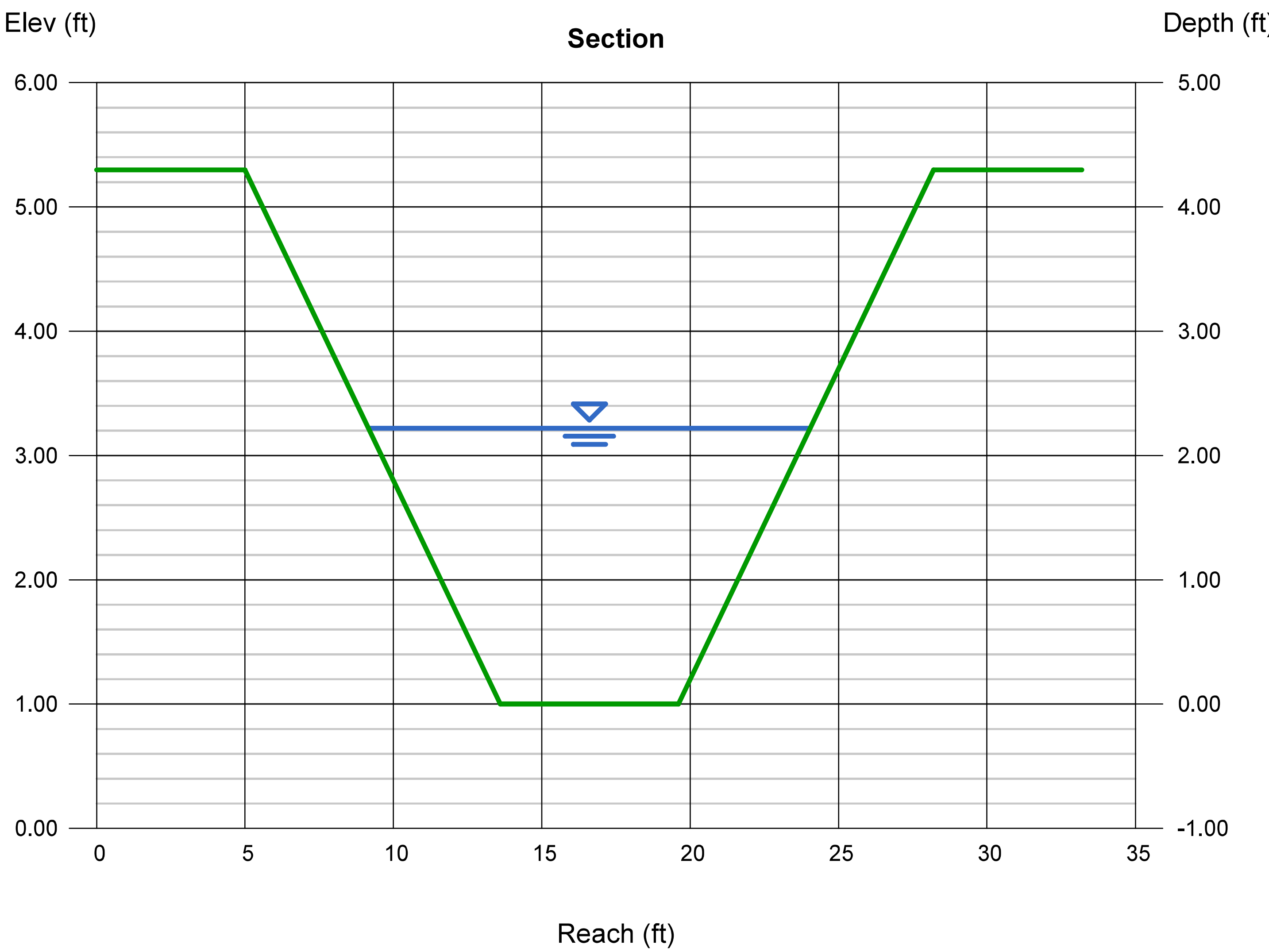


Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. | Wednesday, May 10 2023

NC-3

Trapezoidal		**Highlighted**	
Bottom Width (ft)	= 6.00	Depth (ft)	= 2.22
Side Slopes (z:1)	= 2.00, 2.00	Q (cfs)	= 188.00
Total Depth (ft)	= 4.30	Area (sqft)	= 23.18
Invert Elev (ft)	= 1.00	Velocity (ft/s)	= 8.11
Slope (%)	= 2.00	Wetted Perim (ft)	= 15.93
N-Value	= 0.033	Crit Depth, Yc (ft)	= 2.39
		Top Width (ft)	= 14.88
Calculations		EGL (ft)	= 3.24
Compute by:	Known Q		
Known Q (cfs)	= 188.00		



Channel Report

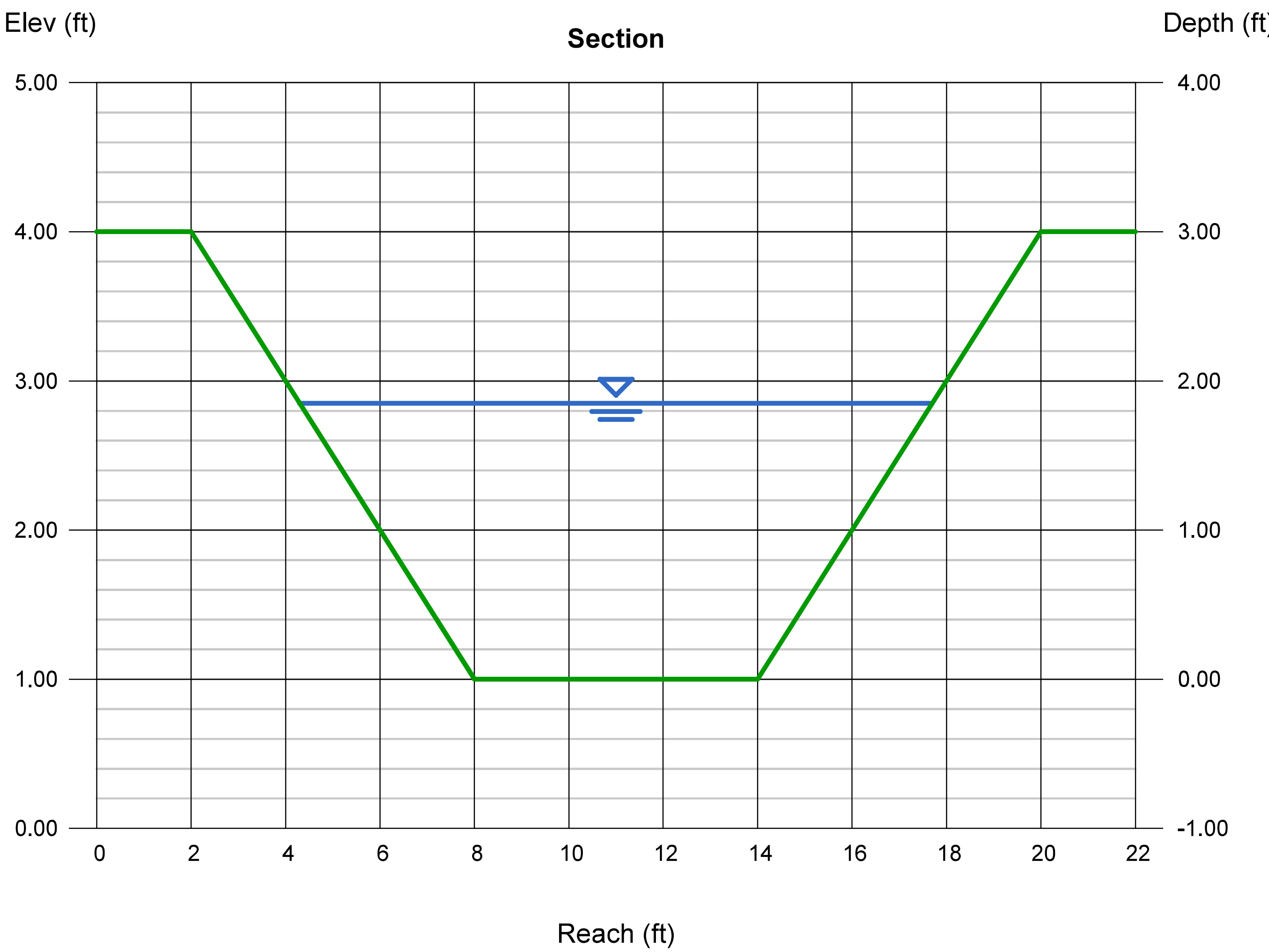
Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Wednesday, May 10 2023

NC-4

Trapezoidal	
Bottom Width (ft)	= 6.00
Side Slopes (z:1)	= 2.00, 2.00
Total Depth (ft)	= 3.00
Invert Elev (ft)	= 1.00
Slope (%)	= 4.00
N-Value	= 0.033

Calculations	
Compute by:	Known Q
Known Q (cfs)	= 188.00

Highlighted	
Depth (ft)	= 1.85
Q (cfs)	= 188.00
Area (sqft)	= 17.94
Velocity (ft/s)	= 10.48
Wetted Perim (ft)	= 14.27
Crit Depth, Yc (ft)	= 2.39
Top Width (ft)	= 13.40
EGL (ft)	= 3.56

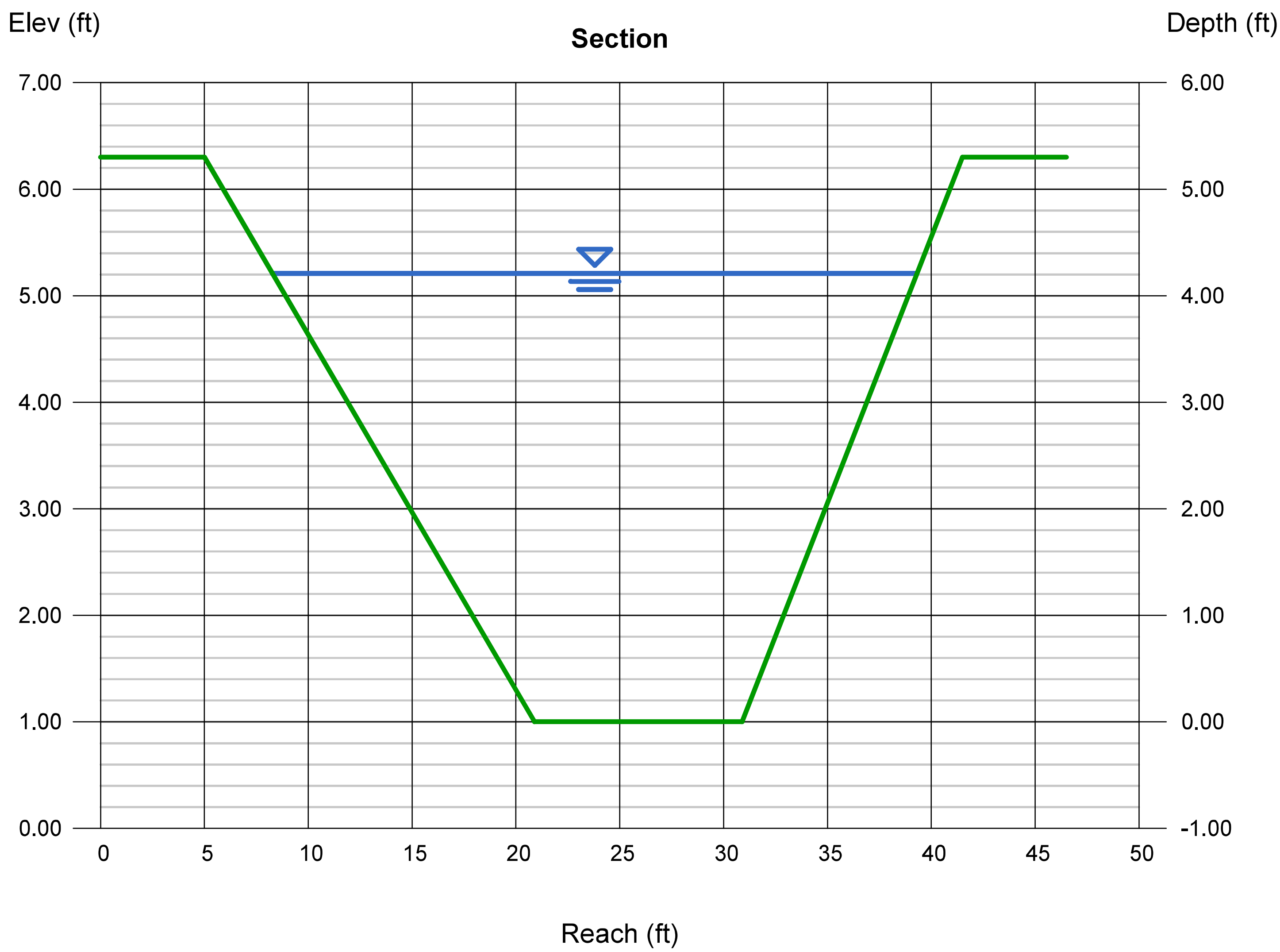


Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Wednesday, May 10 2023

PC-1

Trapezoidal		**Highlighted**	
Bottom Width (ft)	= 10.00	Depth (ft)	= 4.21
Side Slopes (z:1)	= 3.00, 2.00	Q (cfs)	= 438.70
Total Depth (ft)	= 5.30	Area (sqft)	= 86.41
Invert Elev (ft)	= 1.00	Velocity (ft/s)	= 5.08
Slope (%)	= 0.35	Wetted Perim (ft)	= 32.73
N-Value	= 0.033	Crit Depth, Yc (ft)	= 3.03
		Top Width (ft)	= 31.05
Calculations		EGL (ft)	= 4.61
Compute by:	Known Q		
Known Q (cfs)	= 438.70		

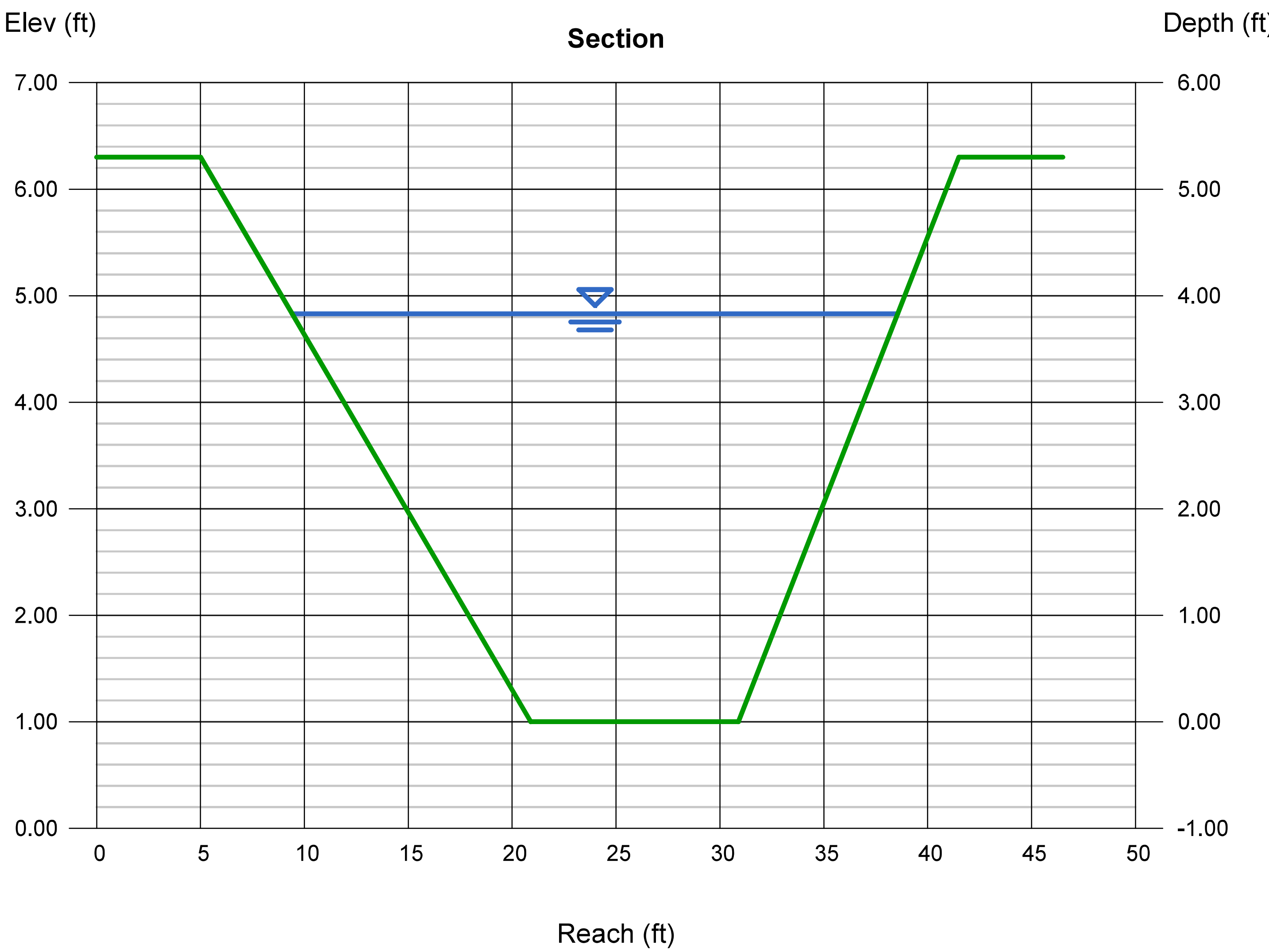


Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Wednesday, May 10 2023

PC-2

Trapezoidal		**Highlighted**	
Bottom Width (ft)	= 10.00	Depth (ft)	= 3.83
Side Slopes (z:1)	= 3.00, 2.00	Q (cfs)	= 373.60
Total Depth (ft)	= 5.30	Area (sqft)	= 74.97
Invert Elev (ft)	= 1.00	Velocity (ft/s)	= 4.98
Slope (%)	= 0.25	Wetted Perim (ft)	= 30.68
N-Value	= 0.027	Crit Depth, Yc (ft)	= 2.78
		Top Width (ft)	= 29.15
Calculations		EGL (ft)	= 4.22
Compute by:	Known Q		
Known Q (cfs)	= 373.60		

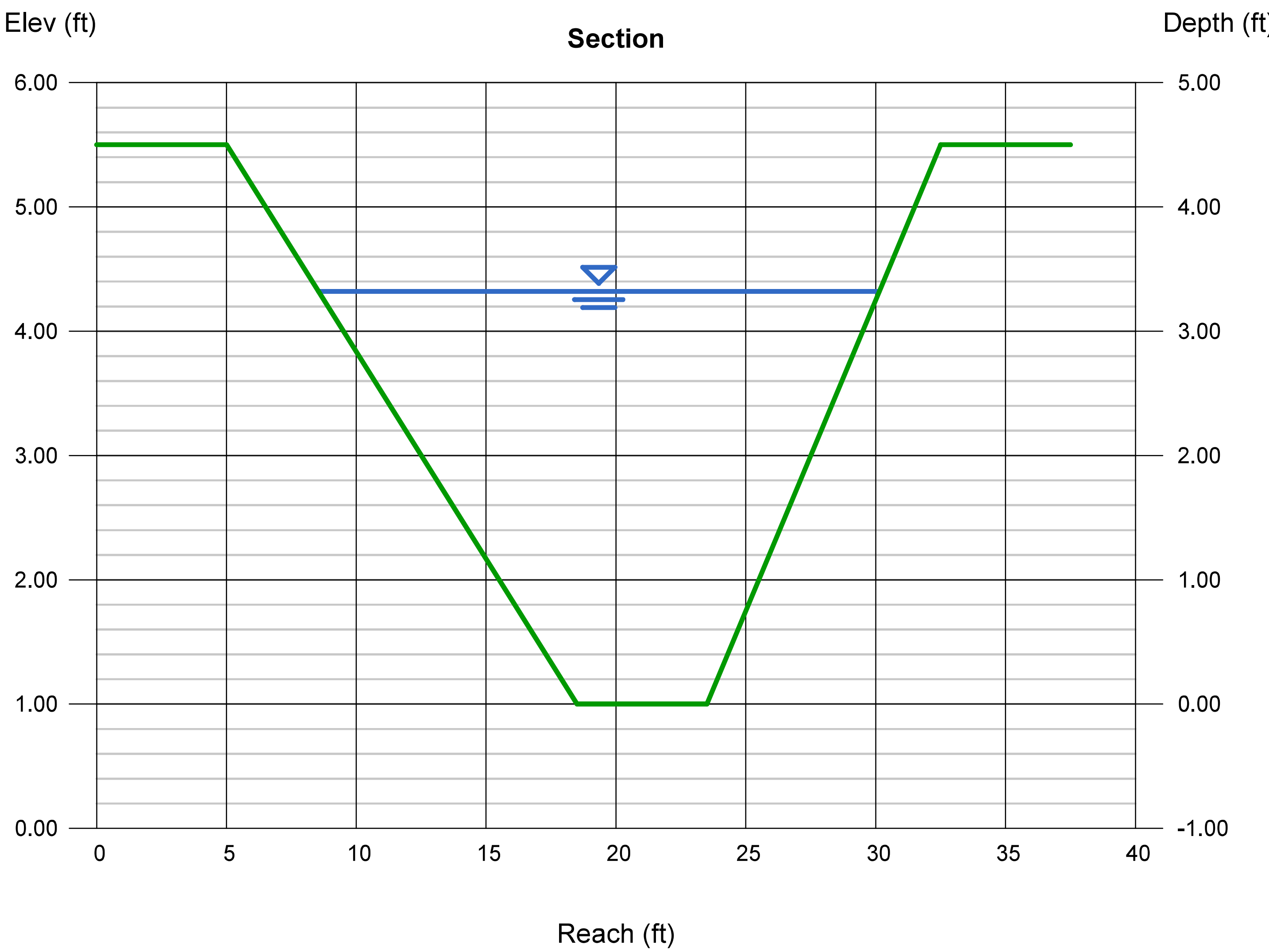


Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Wednesday, May 10 2023

PC-3A

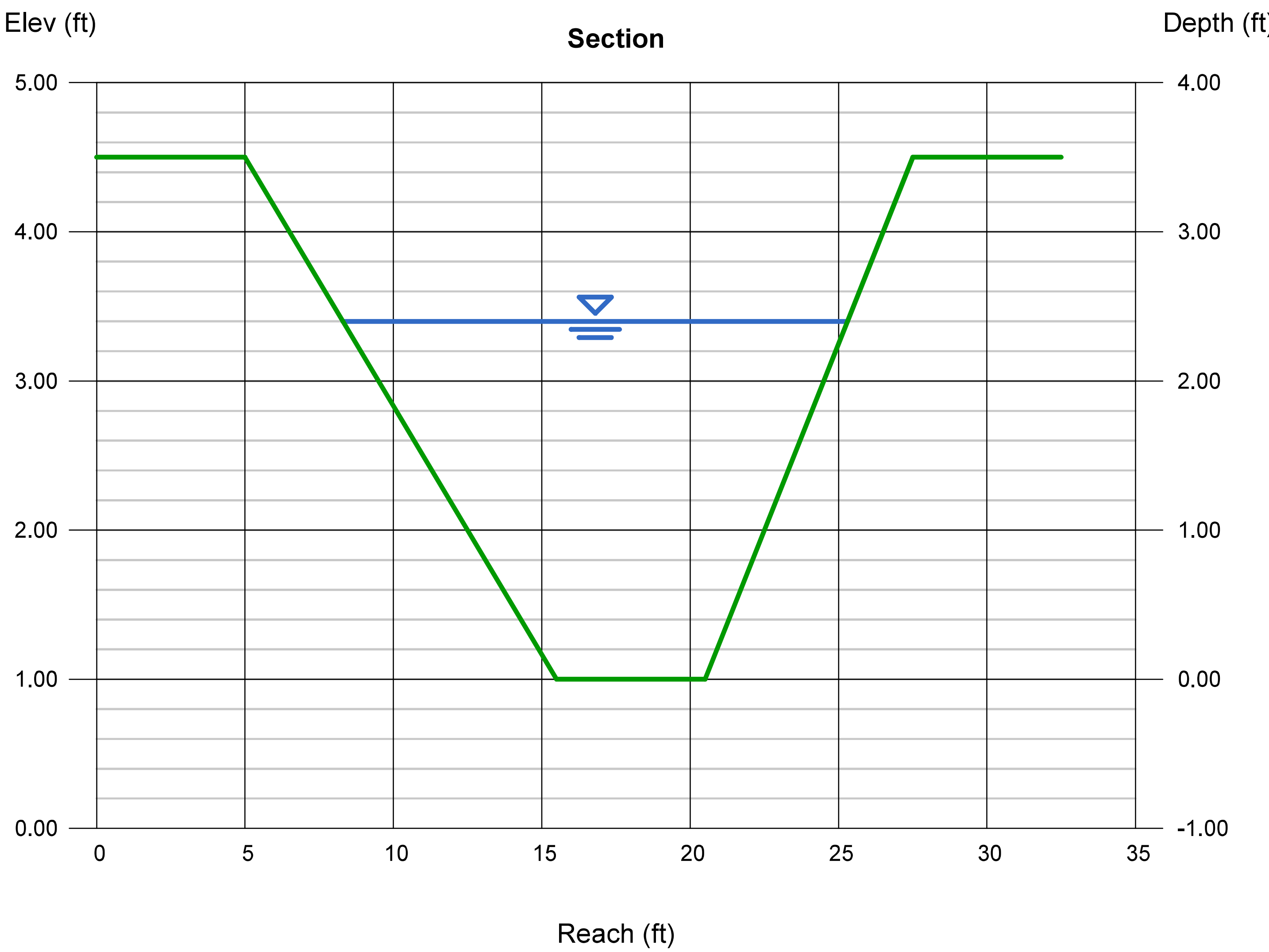
Trapezoidal		**Highlighted**	
Bottom Width (ft)	= 5.00	Depth (ft)	= 3.32
Side Slopes (z:1)	= 3.00, 2.00	Q (cfs)	= 187.90
Total Depth (ft)	= 4.50	Area (sqft)	= 44.16
Invert Elev (ft)	= 1.00	Velocity (ft/s)	= 4.26
Slope (%)	= 0.25	Wetted Perim (ft)	= 22.92
N-Value	= 0.027	Crit Depth, Yc (ft)	= 2.41
		Top Width (ft)	= 21.60
Calculations		EGL (ft)	= 3.60
Compute by:	Known Q		
Known Q (cfs)	= 187.90		



Channel Report

PC-3B

Trapezoidal		**Highlighted**	
Bottom Width (ft)	= 5.00	Depth (ft)	= 2.40
Side Slopes (z:1)	= 3.00, 2.00	Q (cfs)	= 187.90
Total Depth (ft)	= 3.50	Area (sqft)	= 26.40
Invert Elev (ft)	= 1.00	Velocity (ft/s)	= 7.12
Slope (%)	= 1.50	Wetted Perim (ft)	= 17.96
N-Value	= 0.033	Crit Depth, Yc (ft)	= 2.41
		Top Width (ft)	= 17.00
Calculations		EGL (ft)	= 3.19
Compute by:	Known Q		
Known Q (cfs)	= 187.90		



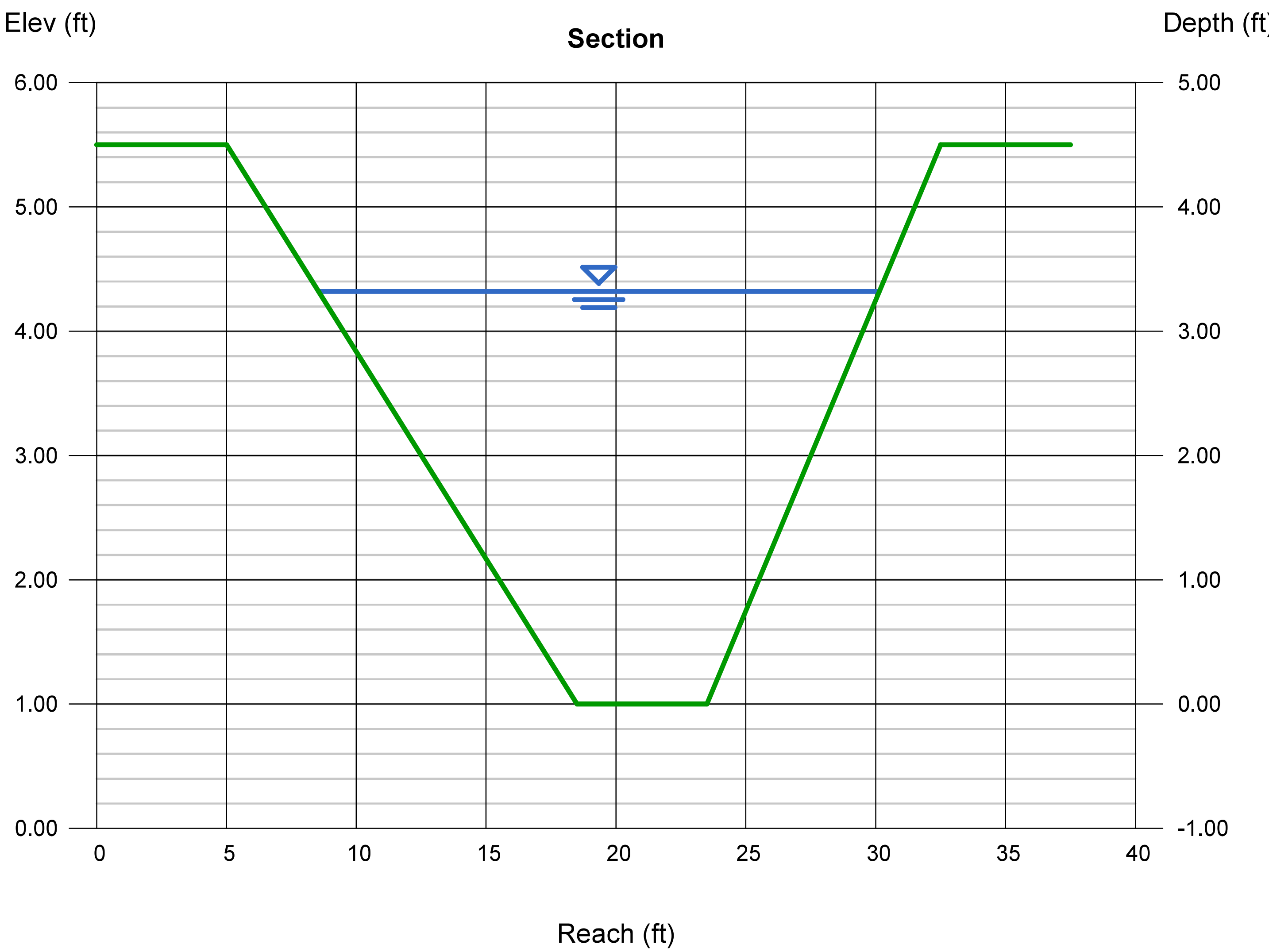
Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Wednesday, May 10 2023

PC-3C

Trapezoidal	
Bottom Width (ft)	= 5.00
Side Slopes (z:1)	= 3.00, 2.00
Total Depth (ft)	= 4.50
Invert Elev (ft)	= 1.00
Slope (%)	= 0.25
N-Value	= 0.027
Calculations	
Compute by:	Known Q
Known Q (cfs)	= 187.90

Highlighted	
Depth (ft)	= 3.32
Q (cfs)	= 187.90
Area (sqft)	= 44.16
Velocity (ft/s)	= 4.26
Wetted Perim (ft)	= 22.92
Crit Depth, Yc (ft)	= 2.41
Top Width (ft)	= 21.60
EGL (ft)	= 3.60

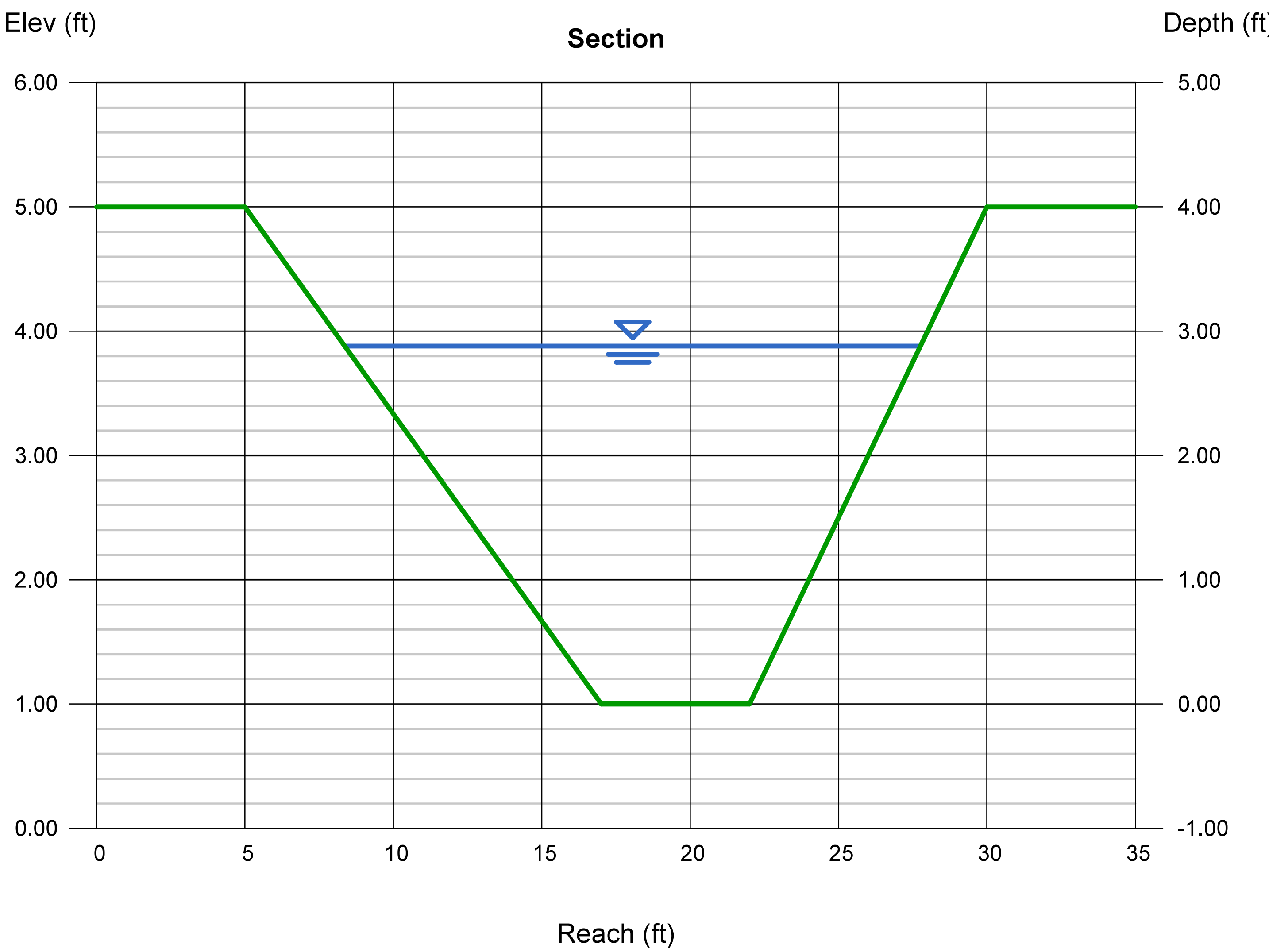


Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Wednesday, May 10 2023

PC-4A

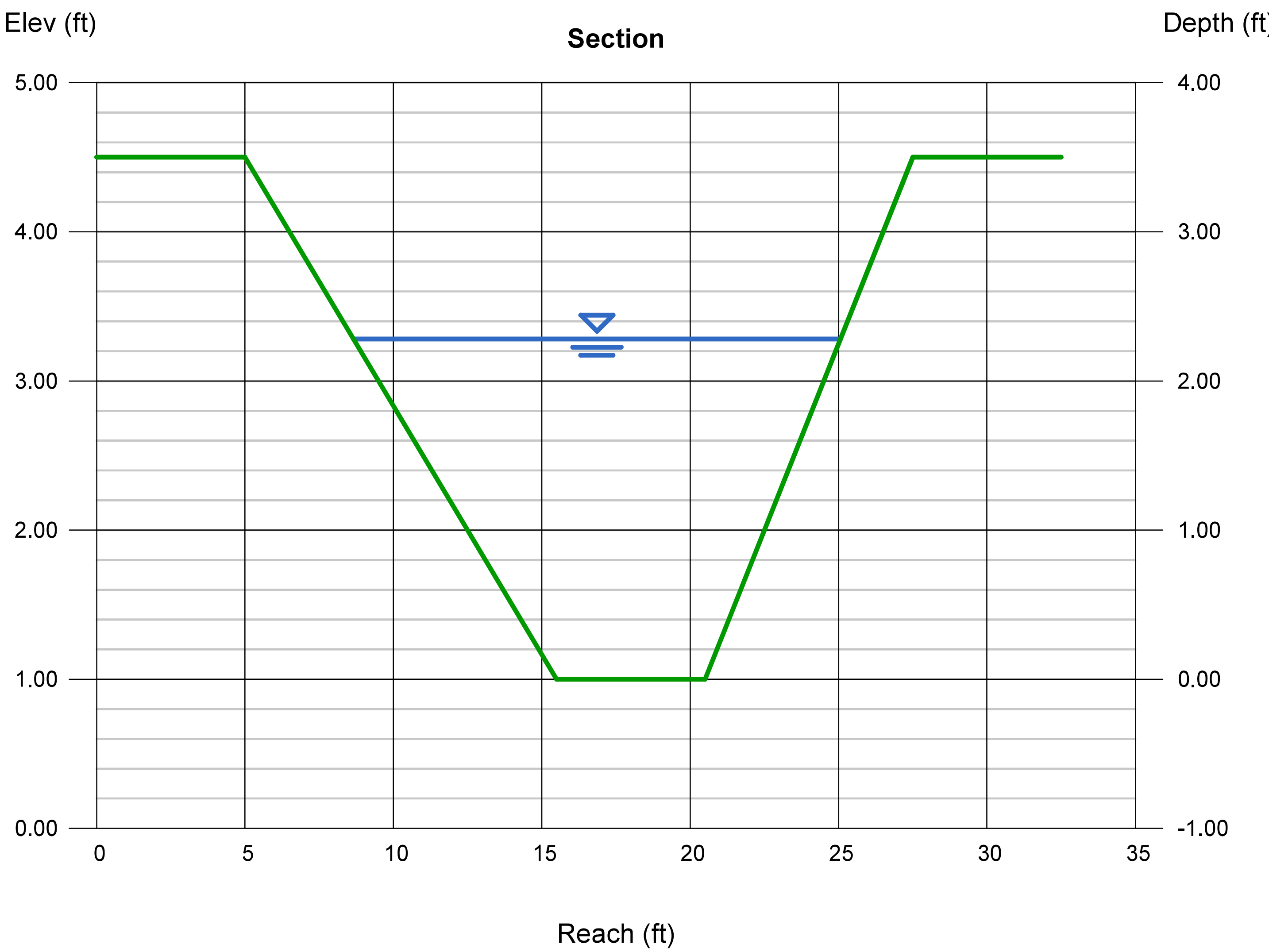
Trapezoidal		**Highlighted**	
Bottom Width (ft)	= 5.00	Depth (ft)	= 2.88
Side Slopes (z:1)	= 3.00, 2.00	Q (cfs)	= 137.60
Total Depth (ft)	= 4.00	Area (sqft)	= 35.14
Invert Elev (ft)	= 1.00	Velocity (ft/s)	= 3.92
Slope (%)	= 0.25	Wetted Perim (ft)	= 20.55
N-Value	= 0.027	Crit Depth, Yc (ft)	= 2.06
		Top Width (ft)	= 19.40
Calculations		EGL (ft)	= 3.12
Compute by:	Known Q		
Known Q (cfs)	= 137.60		



Channel Report

PC-4B

Trapezoidal		**Highlighted**	
Bottom Width (ft)	= 5.00	Depth (ft)	= 2.28
Side Slopes (z:1)	= 3.00, 2.00	Q (cfs)	= 137.60
Total Depth (ft)	= 3.50	Area (sqft)	= 24.40
Invert Elev (ft)	= 1.00	Velocity (ft/s)	= 5.64
Slope (%)	= 1.00	Wetted Perim (ft)	= 17.31
N-Value	= 0.033	Crit Depth, Yc (ft)	= 2.06
		Top Width (ft)	= 16.40
Calculations		EGL (ft)	= 2.77
Compute by:	Known Q		
Known Q (cfs)	= 137.60		

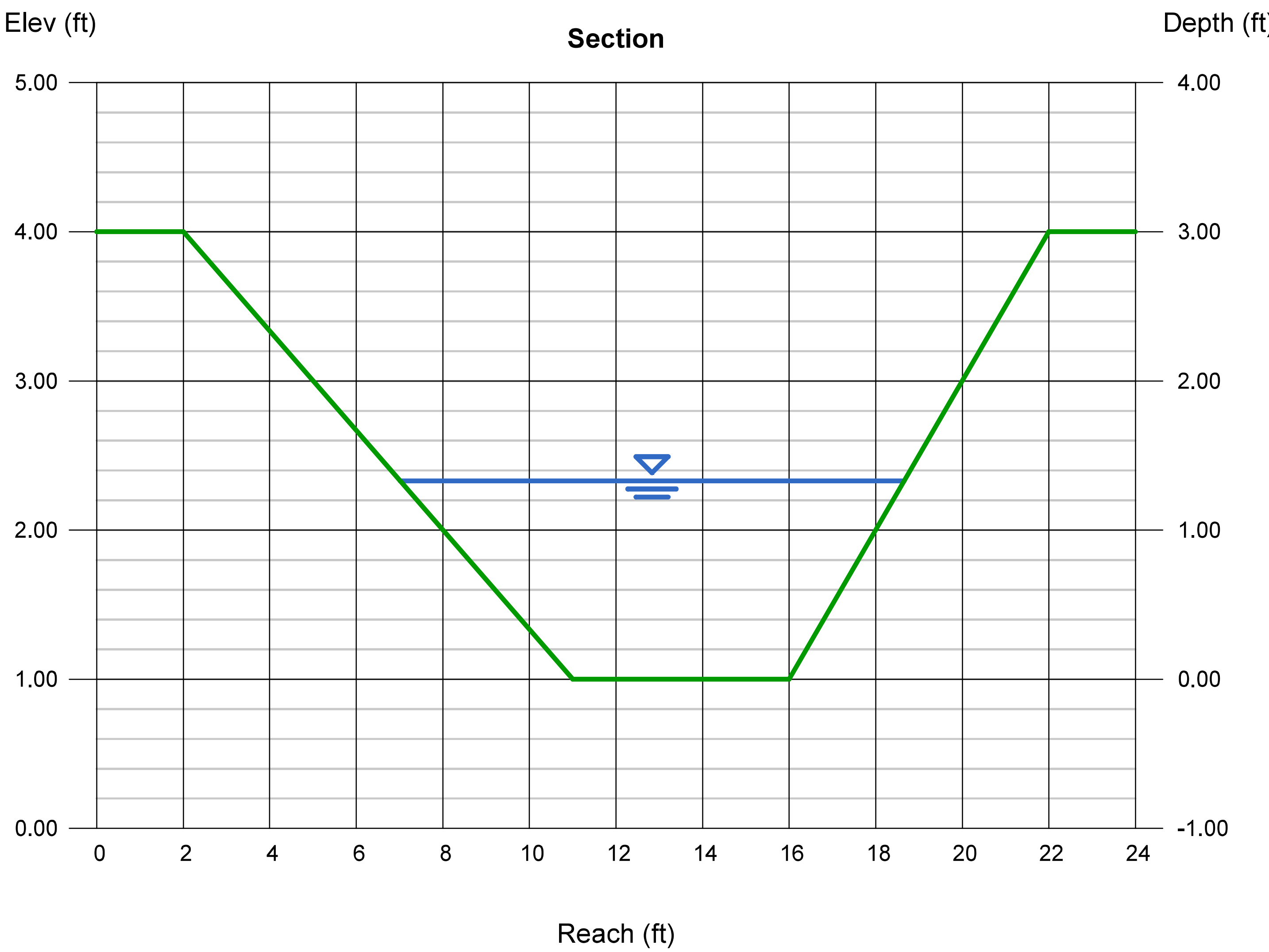


Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Wednesday, May 10 2023

PC-7

Trapezoidal		**Highlighted**	
Bottom Width (ft)	= 5.00	Depth (ft)	= 1.33
Side Slopes (z:1)	= 3.00, 2.00	Q (cfs)	= 39.90
Total Depth (ft)	= 3.00	Area (sqft)	= 11.07
Invert Elev (ft)	= 1.00	Velocity (ft/s)	= 3.60
Slope (%)	= 0.50	Wetted Perim (ft)	= 12.18
N-Value	= 0.027	Crit Depth, Yc (ft)	= 1.05
		Top Width (ft)	= 11.65
Calculations		EGL (ft)	= 1.53
Compute by:	Known Q		
Known Q (cfs)	= 39.90		

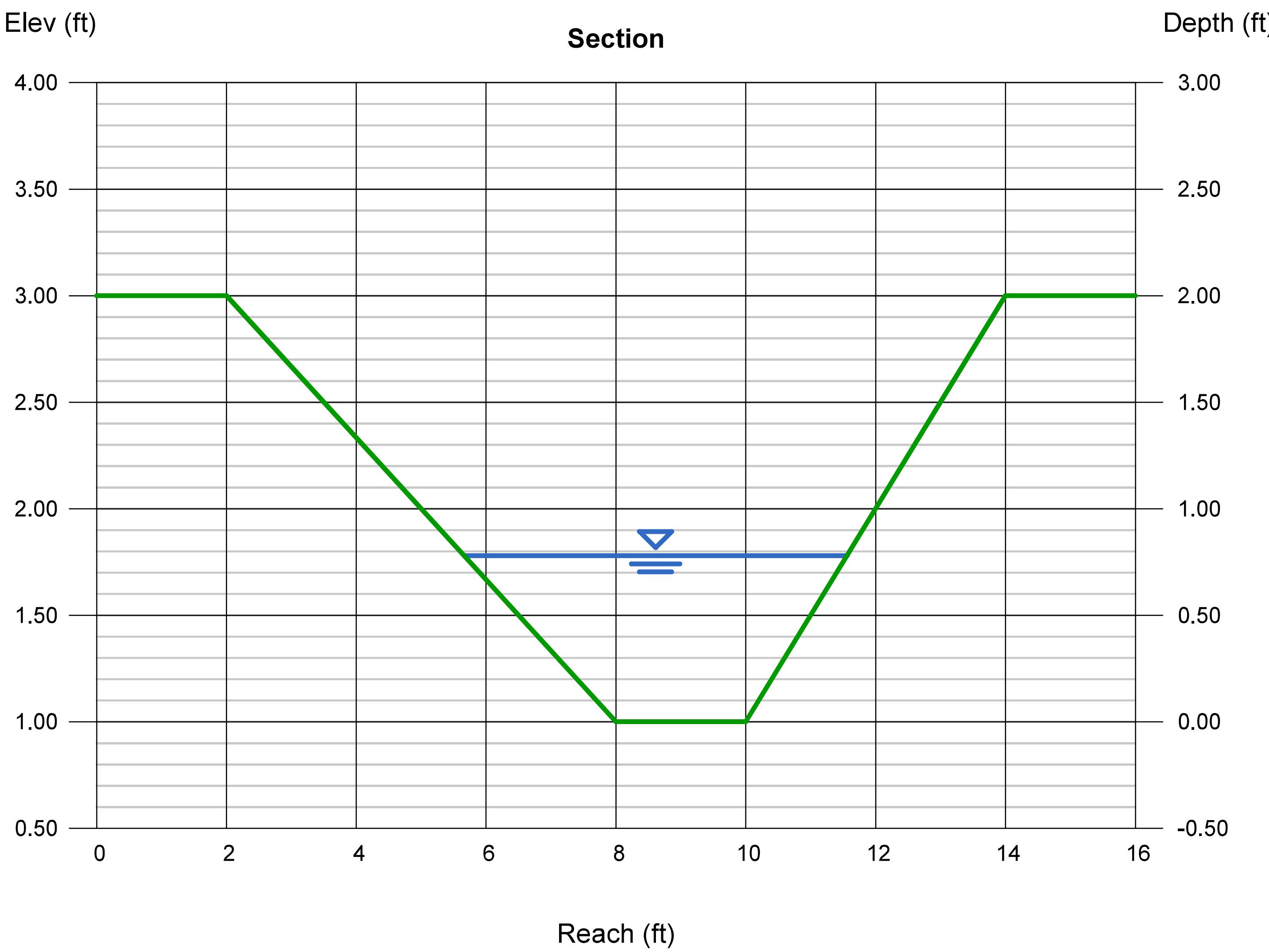


Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. — Wednesday, May 10 2023

PC-8

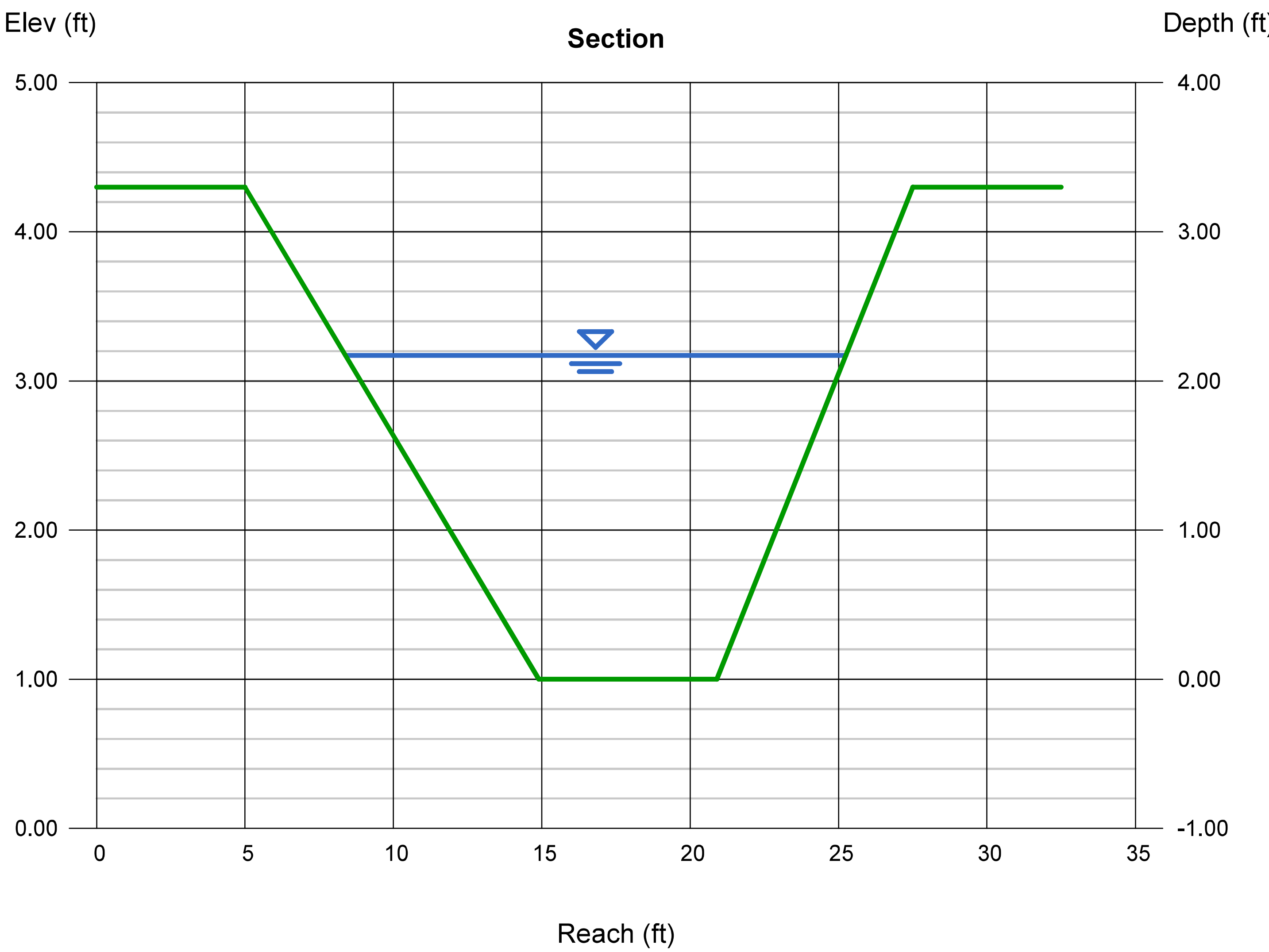
Trapezoidal		**Highlighted**	
Bottom Width (ft)	= 2.00	Depth (ft)	= 0.78
Side Slopes (z:1)	= 3.00, 2.00	Q (cfs)	= 10.50
Total Depth (ft)	= 2.00	Area (sqft)	= 3.08
Invert Elev (ft)	= 1.00	Velocity (ft/s)	= 3.41
Slope (%)	= 1.00	Wetted Perim (ft)	= 6.21
N-Value	= 0.027	Crit Depth, Yc (ft)	= 0.71
		Top Width (ft)	= 5.90
Calculations		EGL (ft)	= 0.96
Compute by:	Known Q		
Known Q (cfs)	= 10.50		



Channel Report

PC-9

Trapezoidal		**Highlighted**	
Bottom Width (ft)	= 6.00	Depth (ft)	= 2.17
Side Slopes (z:1)	= 3.00, 2.00	Q (cfs)	= 138.60
Total Depth (ft)	= 3.30	Area (sqft)	= 24.79
Invert Elev (ft)	= 1.00	Velocity (ft/s)	= 5.59
Slope (%)	= 1.00	Wetted Perim (ft)	= 17.71
N-Value	= 0.033	Crit Depth, Yc (ft)	= 1.95
		Top Width (ft)	= 16.85
Calculations		EGL (ft)	= 2.66
Compute by:	Known Q		
Known Q (cfs)	= 138.60		



SOIL LOSS ANALYSIS

Required: Determine expected soil loss for the landfill topslope and sideslope with final cover.

Method: Expected soil loss is calculated using the Universal Soil Loss Equation (USLE)/Revised Universal Soil Loss Equation (RUSLE). The annual soil loss calculated for final cover conditions is compared to the permissible soil loss of 3 tons/acre/year.

References:

1. SCS National Engineering Handbook, *Section 3 - Sedimentation, Chapter 3 - Erosion* .
2. USDA, *Predicting Soil Erosion by Water: A Guide to Conservation Planning with the Revised Universal Soil Loss Equation (RUSLE), 1997.*
3. United States Department of Agriculture, Soil Conservation Service, *Soil Survey of Oklahoma County, Oklahoma.*
4. Reference: USDA, *Predicting Rainfall Erosion Losses, A Guide to Conservation Planning* , Agriculture Handbook Number 537, 1978.

Solution:

1. Soil loss equation: A = RKLSCP

Where:

A =	Soil Loss (tons/ac/yr)
R =	Rainfall/Runoff Erosivity factor
K =	Soil Erodibility Factor
L =	Slope Length Factor
S =	Slope Steepness Factor
C =	Cover Management Factor
P =	Support Practice Factor

The rainfall factor, R, is a product of rainfall energy and maximum 30-min intensity.
Average annual R values for Eastern United States is presented in Figure 2-1 of USDA 1997.
Values of the R Factor (**see page F-4-41**), the R factor for the Site is:

R = 240

The soil erodibility, K, factor represents the resistance of a soil surface to erosion as a function of the soil's physical and chemical properties. As shown in soil surveys for Oklahoma County for the applicable on-site soils (**see page F-4-46**), the weighted average K factor for the area is:

K = 0.280

Solution (Cont.): The effect of topography on soil erosion are determined by the slope length factor, L, and slope steepness factor, S. The slopes of interest are represented by either of the following: (1) topslope above and sideslope below the first drainage swale placed on final cover or (2) sideslope area between consecutive drainage swales on final cover.

Topslope Conditions			Sideslope Conditions		
slope =	4	%	slope =	25	%
length, l =	160	ft	length, l =	160	ft

Topographic factor, combined slope length and slope steepness factors LS, is based on a low rill/interill erosion ratio (**see page F-4-52**).

Topslope, LS = 0.84 Sideslope, LS = 5.21

The cover and cropping management factor, C, represents the percentage of soil loss that would occur if the surface were partially protected by some combination of cover and management practices. Using of Table 2 - Factor C for Permanent Pasture, Range, and Idle Land (**see page F-4-53**) for 90% ground cover yields the following C value.

C = 0.006

The erosion control practice factor, P, measures the effect of control practices that reduce the erosion potential of the runoff by influencing drainage patterns, runoff concentration, and runoff velocity. Use of Table 3, for Countouring, Countouring, Stripcropping and Terracing (**see page F-4-54**), the P factor is determined to be:

P = 0.90

2. Soil loss calculations:

Slope Condition	R	K	LS	C	P	A (tons/ac /yr)
4% slope 160 ft length	240	0.28	0.548	0.006	0.90	0.20
25% slope 160ft length	240	0.28	5.176	0.006	0.90	1.88

Conclusions:

From review of the annual soil loss, a value of less than 3 tons/acre/year is achieved, consistent with guidance for addressing erosional stability during all phases of landfill operation.

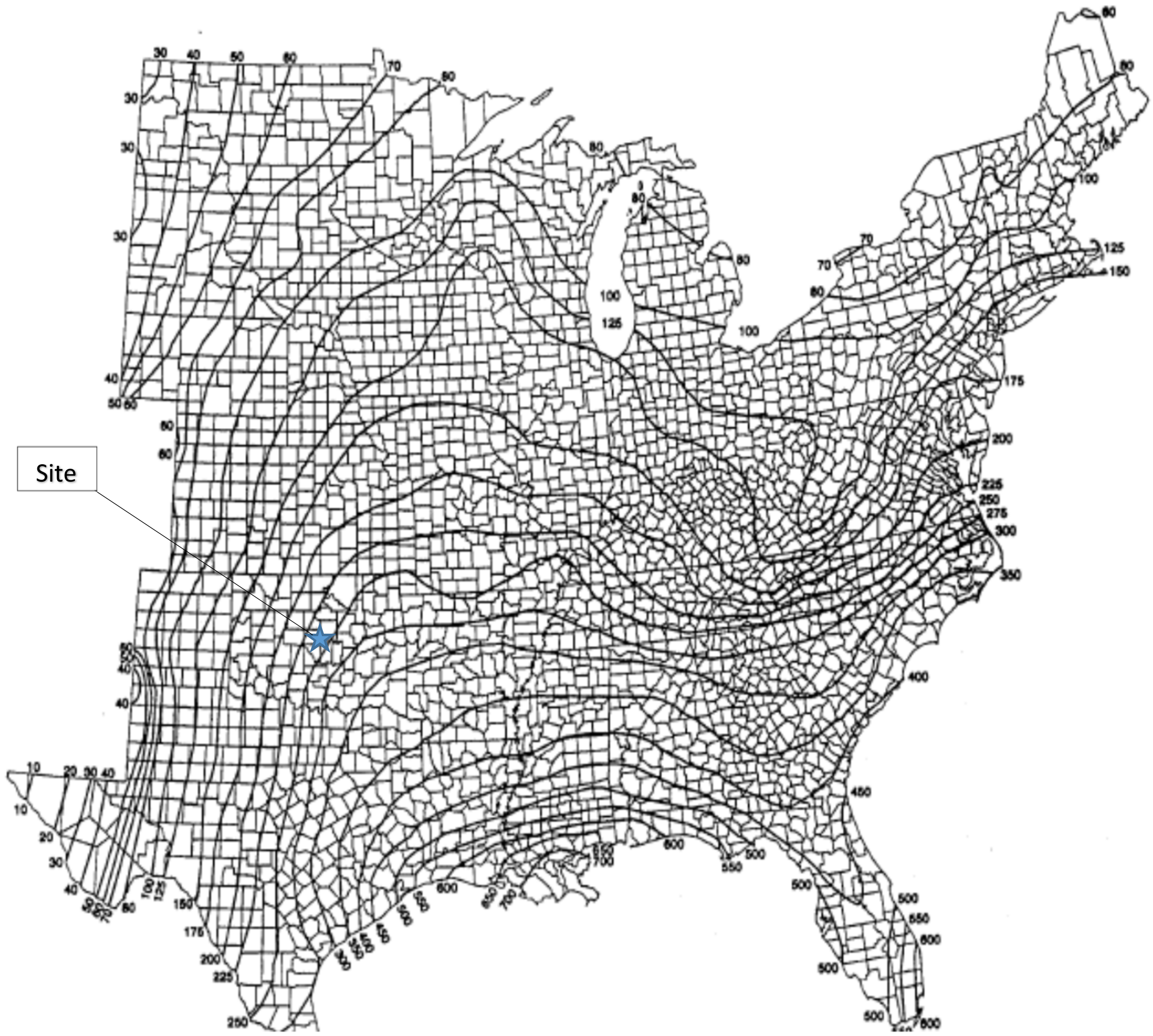


Figure 1. Isoerodent Map of Average Annual Rainfall Runoff Erosivity Factor, R.

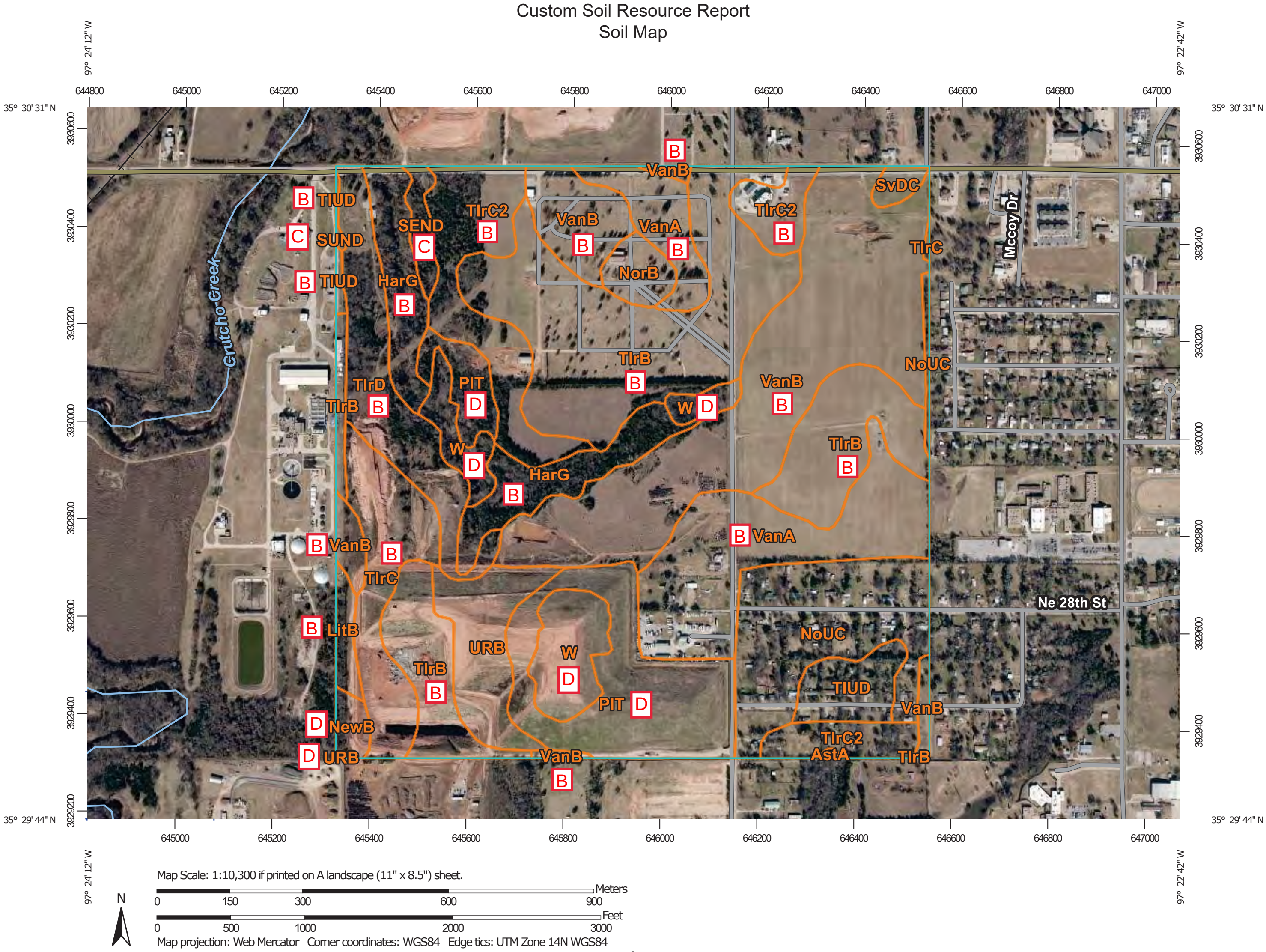
Reference: USDA, Predicting Soil Erosion by Water: A Guide to Conservation Planning with the Revised Universal Soil Loss Equation (RUSLE), Agricultural Research Service, Agriculture Handbook Number 703, 1997.

NORTHEAST LANDFILL K Factor

Soil Group	Area	K Factor
AstA	0.0%	0.37
HarG	5.6%	0.32
LitB	0.7%	0.32
NewB	0.6%	0.37
NorB	1.1%	0.32
NoUC	7.3%	0.32
PIT	8.1%	0
SEND	0.7%	0.32
SUND	0.0%	0.32
SvDC	0.5%	0.32
TIrB	19.9%	0.32
TIrC	4.6%	0.32
TIrC2	7.8%	0.32
TIrD	5.1%	0.32
TIUD	2.1%	0.32
URB	3.4%	0
VanA	10.0%	0.32
VanB	18.8%	0.32
W	3.8%	0

Weighted Avg. (K) 0.28

Custom Soil Resource Report
Soil Map



9

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:12,000.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Oklahoma County, Oklahoma
Survey Area Data: Version 21, Sep 16, 2019

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Nov 14, 2018—Nov 19, 2018

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
AstA	Ashport silt loam, 0 to 1 percent slopes, frequently flooded	0.1	0.0%
HarG	Harrah fine sandy loam, 3 to 45 percent slopes	20.5	5.6%
LitB	Littleaxe fine sandy loam, 1 to 3 percent slopes	2.6	0.7%
NewB	Newalla fine sandy loam, 1 to 5 percent slopes	2.2	0.6%
NorB	Norge silt loam, 1 to 3 percent slopes	4.1	1.1%
NoUC	Norge-Urban land complex, 1 to 5 percent slopes	27.1	7.3%
PIT	Pits	30.0	8.1%
SEND	Stephenville-Darnell-Newalla complex, 3 to 8 percent slopes	2.7	0.7%
SUND	Stephenville-Urban land-Newalla complex, 1 to 8 percent slopes	0.2	0.0%
SvDC	Stephenville-Darnell complex, 1 to 5 percent slopes	1.7	0.5%
TlrB	Teller fine sandy loam, 1 to 3 percent slopes	73.4	19.9%
TlrC	Teller fine sandy loam, 3 to 5 percent slopes	16.8	4.6%
TlrC2	Teller fine sandy loam, 3 to 5 percent slopes, eroded	28.7	7.8%
TlrD	Teller fine sandy loam, 5 to 8 percent slopes	18.7	5.1%
TlUD	Teller-Urban land complex, 1 to 8 percent slopes	7.6	2.1%
URB	Urban land	12.6	3.4%
VanA	Vanoss silt loam, 0 to 1 percent slopes	36.8	10.0%
VanB	Vanoss silt loam, 1 to 3 percent slopes	69.2	18.8%
W	Water	14.0	3.8%
Totals for Area of Interest		**369.0**	**100.0%**

United States
Department of
Agriculture

Natural
Resources
Conservation
Service

In cooperation with
the Oklahoma Agricultural
Experiment Station and the
Oklahoma Conservation
Commission

Soil Survey of Oklahoma County, Oklahoma

Part I

E-4-36

Physical Properties

The table “Physical Properties of the Soils” shows estimates of some characteristics and features that affect soil behavior. These estimates are given for the major layers of each soil in the survey area. The estimates are based on field observations and on test data for these and similar soils.

Depth to the upper and lower boundaries of each layer is indicated. The range in depth and information on other properties of each layer are given in the series descriptions in Part I of this survey.

Clay as a soil separate, or component, consists of mineral soil particles that are less than 0.002 millimeter in diameter. The estimated clay content of each major soil layer is given as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The amount and kind of clay greatly affect the fertility and physical condition of the soil. They determine the ability of the soil to adsorb cations and to retain moisture. They influence shrink-swell potential, permeability, plasticity, the ease of soil dispersion, and other soil properties. The amount and kind of clay in a soil also affect tillage and earth-moving operations.

Moist bulk density is the weight of soil (ovendry) per unit volume. Volume is measured when the soil is at field moisture capacity, that is, the moisture content at $^{1}/_{3}$-bar moisture tension. Weight is determined after drying the soil at 105 degrees C. In the table, the estimated moist bulk density of each major soil horizon is expressed in grams per cubic centimeter of soil material that is less than 2 millimeters in diameter. Bulk density data are used to compute shrink-swell potential, available water capacity, total pore space, and other soil properties. The moist bulk density of a soil indicates the pore space available for water and roots. A bulk density of more than 1.6 can restrict water storage and root penetration. Moist bulk density is influenced by texture, kind of clay, content of organic matter, and soil structure.

Permeability (K_{sat}) refers to the ability of a soil to transmit water or air. The estimates indicate the rate of downward movement of water when the soil is saturated. They are based on soil characteristics observed in the field, particularly structure, porosity, and texture. Permeability is considered in the design of soil drainage systems and septic tank absorption fields.

Available water capacity refers to the quantity of water that the soil is capable of storing for use by plants. The capacity for water storage is given in inches of water per inch of soil for each major soil layer. The capacity varies, depending on soil properties that affect the retention of water and the depth of the root zone. The most important properties are the content of organic matter, soil texture, bulk density, and soil structure. Available water capacity is an important factor in the choice of plants or crops to be grown and in the design and management of irrigation systems. Available water capacity is not an estimate of the quantity of water actually available to plants at any given time.

Linear extensibility refers to the change in length of an unconfined clod as moisture content is decreased from a moist to a dry state. It is an expression of the volume change between the water content of the clod at $^{1}/_{3}$- or $^{1}/_{10}$-bar tension (33kPa or 10kPa tension) and oven dryness. The volume change is reported in the table as percent change for the whole soil. Volume change is influenced by the amount and type of clay minerals in the soil.

Linear extensibility is used to determine the shrink-swell potential of soils. The shrink-swell potential is low if the soil has a linear extensibility of less than 3 percent; moderate if 3 to 6 percent; high if 6 to 9 percent; and very high if more than 9 percent. If the linear extensibility is more than 3, shrinking and swelling can cause damage to buildings, roads, and other structures and to plant roots. Special design commonly is needed.

Organic matter is the plant and animal residue in the soil at various stages of decomposition. In the table, the estimated content of organic matter is expressed as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The content of organic matter in a soil can be maintained or increased by returning crop residue to the soil. Organic matter affects the available water capacity, infiltration rate, and tilth. It is a source of nitrogen and other nutrients for crops.

Erosion factors.—Soil erodibility (K) and soil-loss tolerance (T) factors are used in an equation that predicts the amount of soil lost through water erosion in areas of cropland. The procedure for predicting soil loss is useful in guiding the selection of soil and water conservation practices.

Erosion factor K indicates the susceptibility of a soil to sheet and rill erosion by water. Factor K is one of six factors used in the Universal Soil Loss Equation (USLE) to predict the average rate of soil loss by sheet and rill erosion in tons per acre per year. The soil properties that influence erodibility are those that affect the infiltration rate, the movement of water through the soil, and the water storage capacity of the soil and those that allow the soil to resist dispersion, splashing, abrasion, and the transporting forces of rainfall and runoff. The most important soil properties are the content of silt plus very fine sand, the content of sand coarser than very fine sand, the content of organic matter, soil structure, and permeability. The estimates are modified by the presence of rock fragments. Values of K range from 0.02 to 0.64. The higher the value, the more susceptible the soil is to sheet and rill erosion.

Erosion factor Kw indicates the erodibility of the whole soil. The estimates are modified by the presence or rock fragments,

Erosion factor Kf indicates the erodibility of the fine-earth fraction, or the material less than 2 millimeters in size. This is one of the factors used in the Revised Universal Soil Loss Equation.

Erosion factor T is an estimate of the maximum annual rate of soil erosion by wind or water that can occur over a sustained period without affecting crop productivity. The rate is expressed in tons of soil loss per acre per year. Ratings of 1 to 5 are used, depending on soil properties and prior erosion. The criteria used in assigning a T factor to a soil include maintenance of an adequate rooting depth for crop production, potential reduction of crop yields, maintenance of water-control structures affected by sedimentation, prevention of gullying, and the value of nutrients lost through erosion.

Wind erodibility groups.—Wind erodibility is directly related to the percentage of dry, nonerodible surface soil aggregates larger than 0.84 millimeter in diameter. From this percentage, the wind erodibility index factor (I) is determined. This factor is an expression of the stability of the soil aggregates, or the extent to which they are broken down by tillage and the abrasion caused by windblown soil particles. Soils are assigned to wind erodibility groups (WEGs) having similar percentages of dry soil aggregates larger than 0.84 millimeter.

Wind erodibility groups are made up of soils that have similar properties affecting their resistance to soil blowing in cultivated areas. The groups indicate the susceptibility to soil blowing. Soils are grouped according to the following distinctions:

WEG 1. Very fine sand, fine sand, sand, and coarse sand.

WEG 2. Loamy very fine sand, loamy fine sand, loamy sand, loamy coarse sand, ash, and sapric organic soil material.

WEG 3. Very fine sandy loam, fine sandy loam, sandy loam, and coarse sandy loam.

WEG 4. Clay, silty clay, and noncalcareous clay loam and silty clay loam with more than 35 percent clay.

WEG 4L. Calcareous loam, silt loam, clay loam, and silty clay loam characterized by a strongly effervescent or violently effervescent reaction to cold dilute (1N) HCl.

WEG 5. Noncalcareous loam and silt loam with less than 20 percent clay and sandy clay loam, sandy clay, and hemic organic soil material.

WEG 6. Noncalcareous loam and silt loam with more than 20 percent clay and noncalcareous clay loam with less than 35 percent clay.

WEG 7. Silt, noncalcareous silty clay loam with less than 35 percent clay, and fibric organic soil material.

WEG 8. Soils that are not susceptible to soil blowing because of rock fragments on the surface or because of surface wetness.

Wind erodibility index is a numerical value indicating the susceptibility of soil to soil blowing, or the tons per acre per year that can be expected to be lost to soil blowing. There is a close correlation between soil blowing and the size and durability of surface clods, rock fragments, organic matter, and a calcareous reaction. Soil moisture and frozen soil layers also influence soil blowing.

Additional information about wind erodibility groups and K, Kf, T, and I factors can be obtained from local offices of the Natural Resources Conservation Service or the Cooperative Extension Service.

Physical Properties of the Soils

(Entries under "Erosion factors--T" apply to the entire profile. Entries under "Wind erodibility group" and "Wind erodibility index" apply only to the surface layer. Absence of an entry indicates that data were not estimated.)

Map symbol and soil name	Depth	Clay	Moist bulk density	Permea- bility (Ksat)	Available water capacity	Linear extensi- bility	Organic matter	Erosion factors			Wind erodi- bility group	Wind erodi- bility index
								Kw	Kf	T		
	In	*Pct*	*g/cc*	*In/hr*	*In/in*	*Pct*	*Pct*					
AhpA:												
Ashport---------------	0-5	27-35	1.30-1.60	0.60-2.00	0.15-0.22	3.0-5.9	1.0-3.0	.32	.32	5	7	38
	5-14	27-35	1.30-1.60	0.60-2.00	0.15-0.22	3.0-5.9	1.0-3.0	.32	.32			
	14-36	18-35	1.40-1.70	0.60-2.00	0.15-0.24	3.0-5.9	0.5-1.0	.37	.37			
	36-96	18-35	1.40-1.70	0.60-2.00	0.15-0.24	3.0-5.9	0.5-1.0	.37	.37			
AmbE:												
Amber-----------------	0-9	10-18	1.30-1.55	0.60-2.00	0.13-0.20	0.0-2.9	0.5-1.0	.37	.37	5	3	86
	9-11	10-18	1.30-1.55	0.60-2.00	0.13-0.20	0.0-2.9	0.5-1.0	.37	.37			
	11-22	10-18	1.30-1.60	0.60-2.00	0.13-0.20	0.0-2.9	0.5-1.0	.37	.37			
	22-38	5-18	1.30-1.60	0.60-2.00	0.13-0.24	0.0-2.9	0.5-1.0	.37	.37			
	38-84	5-35	1.30-1.70	0.00-2.00	0.13-0.22	0.0-2.9	0.0-0.8	.37	.37			
AshA:												
Asher-----------------	0-8	27-40	1.30-1.60	0.06-0.20	0.18-0.22	3.0-5.9	1.0-3.0	.37	.37	5	7	38
	8-14	27-40	1.30-1.60	0.06-0.20	0.18-0.22	3.0-5.9	1.0-3.0	.37	.37			
	14-31	27-40	1.45-1.70	0.06-0.20	0.18-0.22	3.0-5.9	0.5-2.0	.37	.37			
	31-88	8-18	1.40-1.65	0.60-2.00	0.07-0.24	0.0-2.9	0.0-1.0	.37	.37			
AspA:												
Ashport---------------	0-7	15-26	1.30-1.50	0.60-2.00	0.16-0.24	0.0-2.9	1.0-3.0	.37	.37	5	6	48
	7-15	15-26	1.30-1.50	0.60-2.00	0.16-0.24	0.0-2.9	1.0-3.0	.37	.37			
	15-29	18-35	1.40-1.70	0.60-2.00	0.15-0.24	3.0-5.9	0.5-1.0	.37	.37			
	29-72	18-35	1.40-1.70	0.60-2.00	0.15-0.24	3.0-5.9	0.5-1.0	.37	.37			
	72-83	18-35	1.40-1.70	0.60-2.00	0.15-0.24	3.0-5.9	0.5-1.0	.37	.37			
AstA:												
Ashport---------------	0-10	15-26	1.30-1.50	0.60-2.00	0.16-0.24	0.0-2.9	1.0-3.0	.37	.37	5	6	48
	10-24	18-35	1.40-1.70	0.60-2.00	0.15-0.24	3.0-5.9	0.5-1.0	.37	.37			
	24-36	18-35	1.40-1.70	0.60-2.00	0.15-0.24	3.0-5.9	0.5-1.0	.37	.37			
	36-48	18-35	1.40-1.70	0.60-2.00	0.15-0.24	3.0-5.9	0.5-1.0	.37	.37			
	48-64	18-35	1.40-1.70	0.60-2.00	0.15-0.24	3.0-5.9	0.5-1.0	.37	.37			
BetA:												
Bethany---------------	0-6	15-26	1.30-1.50	0.60-2.00	0.16-0.24	0.0-2.9	1.0-3.0	.43	.43	5	5	56
	6-14	15-26	1.30-1.50	0.60-2.00	0.16-0.24	0.0-2.9	1.0-3.0	.43	.43			
	14-18	27-35	1.45-1.70	0.20-0.60	0.16-0.22	3.0-5.9	1.0-3.0	.37	.37			
	18-36	35-50	1.40-1.70	0.06-0.20	0.12-0.22	6.0-8.9	0.5-2.0	.37	.37			
	36-56	35-50	1.40-1.70	0.06-0.20	0.12-0.22	6.0-8.9	0.0-2.0	.37	.37			
	56-80	35-50	1.40-1.70	0.06-0.20	0.12-0.22	6.0-8.9	0.0-2.0	.37	.37			
BetB:												
Bethany---------------	0-6	15-26	1.30-1.50	0.60-2.00	0.16-0.24	0.0-2.9	1.0-3.0	.43	.43	5	5	56
	6-13	15-26	1.30-1.50	0.60-2.00	0.16-0.24	0.0-2.9	1.0-3.0	.43	.43			
	13-19	27-35	1.45-1.70	0.20-0.60	0.16-0.22	3.0-5.9	1.0-3.0	.37	.37			
	19-32	35-50	1.40-1.70	0.06-0.20	0.12-0.22	6.0-8.9	0.5-2.0	.37	.37			
	32-59	35-50	1.40-1.70	0.06-0.20	0.12-0.22	6.0-8.9	0.0-2.0	.37	.37			
	59-84	35-50	1.40-1.70	0.06-0.20	0.12-0.22	6.0-8.9	0.0-2.0	.37	.37			
BeUB:												
Bethany---------------	0-12	15-26	1.30-1.50	0.60-2.00	0.16-0.24	0.0-2.9	1.0-3.0	.43	.43	5	5	56
	12-16	27-35	1.45-1.70	0.20-0.60	0.16-0.22	3.0-5.9	1.0-3.0	.37	.37			
	16-28	35-50	1.40-1.70	0.06-0.20	0.12-0.22	6.0-8.9	0.5-2.0	.37	.37			
	28-55	35-50	1.40-1.70	0.06-0.20	0.12-0.22	6.0-8.9	0.0-2.0	.37	.37			
	55-84	35-50	1.40-1.70	0.06-0.20	0.12-0.22	6.0-8.9	0.0-2.0	.37	.37			
Urban land------------	0-80	---	---	0.06-2.00	0.00-0.00	---	---	---	---	---	---	---

Physical Properties of the Soils--Continued

Map symbol and soil name	Depth	Clay	Moist bulk density	Permea- bility (Ksat)	Available water capacity	Linear extensi- bility	Organic matter	Erosion factors Kw	Kf	T	Wind erodi- bility group	Wind erodi- bility index
	In	*Pct*	*g/cc*	*In/hr*	*In/in*	*Pct*	*Pct*					
CaaA:												
Canadian	0-8	5-18	1.40-1.65	2.00-6.00	0.10-0.15	0.0-2.9	1.0-3.0	.20	.20	5	3	86
	8-19	10-18	1.35-1.70	2.00-6.00	0.10-0.20	0.0-2.9	0.0-2.0	.20	.20			
	19-30	10-18	1.35-1.70	2.00-6.00	0.10-0.20	0.0-2.9	0.0-2.0	.20	.20			
	30-80	5-18	1.40-1.70	2.00-20.00	0.07-0.20	0.0-2.9	0.0-1.0	.20	.20			
CaUB:												
Canadian	0-8	5-18	1.40-1.65	2.00-6.00	0.10-0.15	0.0-2.9	1.0-3.0	.20	.20	5	3	86
	8-18	10-18	1.35-1.70	2.00-6.00	0.10-0.20	0.0-2.9	0.0-2.0	.20	.20			
	18-28	10-18	1.35-1.70	2.00-6.00	0.10-0.20	0.0-2.9	0.0-2.0	.20	.20			
	28-43	5-18	1.40-1.70	2.00-20.00	0.07-0.20	0.0-2.9	0.0-1.0	.20	.20			
	43-52	5-18	1.40-1.70	2.00-20.00	0.07-0.20	0.0-2.9	0.0-1.0	.20	.20			
	52-84	5-18	1.40-1.70	2.00-20.00	0.07-0.20	0.0-2.9	0.0-1.0	.20	.20			
Urban land	0-60	---	---	0.06-2.00	0.00-0.00	---	---	---	---	---	---	---
CoIC2:												
Coyle	0-10	15-26	1.30-1.55	0.60-2.00	0.15-0.20	0.0-2.9	1.0-3.0	.37	.37	3	6	48
	10-13	18-26	1.40-1.70	0.60-2.00	0.11-0.20	0.0-2.9	0.5-2.0	.37	.37			
	13-24	20-35	1.40-1.70	0.60-2.00	0.11-0.20	0.0-2.9	0.5-1.0	.32	.32			
	24-31	18-35	1.40-1.70	0.60-2.00	0.07-0.20	0.0-2.9	0.0-0.5	.28	.32			
	31-36	---	1.85-2.00	0.00-0.20	---	---	---	---	---			
Ironmound	0-7	10-18	1.30-1.60	2.00-6.00	0.11-0.15	0.0-2.9	1.0-3.0	.20	.20	2	3	86
	7-12	10-27	1.40-1.70	0.60-2.00	0.11-0.20	0.0-2.9	0.0-0.5	.32	.32			
	12-15	---	1.85-2.00	0.00-0.20	---	---	---	---	---			
CoUB:												
Coyle	0-8	15-26	1.30-1.55	0.60-2.00	0.15-0.20	0.0-2.9	1.0-3.0	.37	.37	3	6	48
	8-14	18-26	1.40-1.70	0.60-2.00	0.11-0.20	0.0-2.9	0.5-2.0	.37	.37			
	14-22	20-35	1.40-1.70	0.60-2.00	0.11-0.20	0.0-2.9	0.5-1.0	.32	.32			
	22-30	---	1.85-2.00	0.00-0.20	---	---	---	---	---			
Urban land	0-60	---	---	0.06-2.00	0.00-0.00	---	---	---	---	---	---	---
CoyB:												
Coyle	0-7	15-26	1.30-1.55	0.60-2.00	0.15-0.20	0.0-2.9	1.0-3.0	.37	.37	3	6	48
	7-10	18-26	1.40-1.70	0.60-2.00	0.11-0.20	0.0-2.9	0.5-2.0	.37	.37			
	10-20	20-35	1.40-1.70	0.60-2.00	0.11-0.20	0.0-2.9	0.5-1.0	.32	.32			
	20-27	18-35	1.40-1.70	0.60-2.00	0.07-0.20	0.0-2.9	0.0-0.5	.28	.32			
	27-40	---	1.85-2.00	0.00-0.20	---	---	---	---	---			
DalA:												
Dale	0-8	15-26	1.30-1.50	0.60-2.00	0.15-0.24	0.0-2.9	1.0-3.0	.37	.37	5	5	56
	8-14	15-26	1.30-1.50	0.60-2.00	0.15-0.24	0.0-2.9	1.0-3.0	.37	.37			
	14-21	18-35	1.40-1.70	0.60-2.00	0.15-0.24	3.0-5.9	1.0-2.0	.37	.37			
	21-27	18-35	1.40-1.70	0.60-2.00	0.15-0.24	3.0-5.9	1.0-2.0	.37	.37			
	27-53	18-35	1.40-1.70	0.60-2.00	0.15-0.24	3.0-5.9	0.5-2.0	.37	.37			
	53-84	18-35	1.40-1.70	0.60-2.00	0.15-0.24	3.0-5.9	0.5-2.0	.37	.37			
DAM:												
Dams	0-80	---	---	0.06-2.00	0.00-0.00	---	---	---	---	---	---	---
DaUA:												
Dale	0-8	15-26	1.30-1.50	0.60-2.00	0.15-0.24	0.0-2.9	1.0-3.0	.37	.37	5	5	56
	8-22	15-26	1.30-1.50	0.60-2.00	0.15-0.24	0.0-2.9	1.0-3.0	.37	.37			
	22-30	18-35	1.40-1.70	0.60-2.00	0.15-0.24	3.0-5.9	1.0-2.0	.37	.37			
	30-38	18-35	1.40-1.70	0.60-2.00	0.15-0.24	3.0-5.9	1.0-2.0	.37	.37			
	38-52	18-35	1.40-1.70	0.60-2.00	0.15-0.24	3.0-5.9	0.5-2.0	.37	.37			
	52-84	18-35	1.40-1.70	0.60-2.00	0.15-0.24	3.0-5.9	0.5-2.0	.37	.37			

Physical Properties of the Soils--Continued

Map symbol and soil name	Depth	Clay	Moist bulk density	Permea- bility (Ksat)	Available water capacity	Linear extensi- bility	Organic matter	Erosion factors			Wind erodi- bility group	Wind erodi- bility index
								Kw	Kf	T		
	In	*Pct*	*g/cc*	*In/hr*	*In/in*	*Pct*	*Pct*					
DaUA:												
Urban land------------	0-84	---	---	0.06-2.00	0.00-0.00	---	---	---	---	---	---	---
DeDE:												
Derby-----------------	0-15	2-8	1.35-1.50	6.00-20.00	0.07-0.11	0.0-2.9	0.5-1.0	.15	.15	5	2	134
	15-27	1-10	1.50-1.70	6.00-20.00	0.05-0.11	0.0-2.9	0.0-0.5	.15	.15			
	27-45	1-10	1.50-1.70	6.00-20.00	0.05-0.11	0.0-2.9	0.0-0.5	.15	.15			
	45-61	1-10	1.50-1.70	6.00-20.00	0.05-0.11	0.0-2.9	0.0-0.5	.15	.15			
	61-72	1-10	1.50-1.70	6.00-20.00	0.05-0.11	0.0-2.9	0.0-0.5	.15	.15			
Dougherty-------------	0-6	2-10	1.45-1.65	2.00-6.00	0.07-0.11	0.0-2.9	0.5-1.0	.20	.20	5	2	134
	6-24	2-10	1.50-1.75	2.00-6.00	0.05-0.11	0.0-2.9	0.0-0.5	.15	.15			
	24-41	18-30	1.40-1.70	0.60-2.00	0.11-0.17	0.0-2.9	0.0-0.5	.32	.32			
	41-52	12-25	1.40-1.70	0.60-6.00	0.07-0.17	0.0-2.9	0.0-0.5	.24	.24			
	52-66	2-15	1.40-1.70	2.00-6.00	0.07-0.15	0.0-2.9	0.0-0.5	.20	.20			
DerB:												
Derby-----------------	0-16	2-8	1.35-1.50	6.00-20.00	0.07-0.11	0.0-2.9	0.5-1.0	.15	.15	5	2	134
	16-28	1-10	1.50-1.70	6.00-20.00	0.05-0.11	0.0-2.9	0.0-0.5	.15	.15			
	28-56	1-10	1.50-1.70	6.00-20.00	0.05-0.11	0.0-2.9	0.0-0.5	.15	.15			
	56-100	1-10	1.50-1.70	6.00-20.00	0.05-0.11	0.0-2.9	0.0-0.5	.15	.15			
DerE:												
Derby-----------------	0-4	2-8	1.35-1.50	6.00-20.00	0.07-0.11	0.0-2.9	0.5-1.0	.15	.15	5	2	134
	4-17	1-10	1.50-1.70	6.00-20.00	0.05-0.11	0.0-2.9	0.0-0.5	.15	.15			
	17-34	1-10	1.50-1.70	6.00-20.00	0.05-0.11	0.0-2.9	0.0-0.5	.15	.15			
	34-96	1-10	1.50-1.70	6.00-20.00	0.05-0.11	0.0-2.9	0.0-0.5	.15	.15			
DleA:												
Dale------------------	0-9	27-35	1.30-1.60	0.20-0.60	0.15-0.22	3.0-5.9	1.0-3.0	.32	.32	5	4	86
	9-22	27-35	1.30-1.60	0.20-0.60	0.15-0.22	3.0-5.9	1.0-3.0	.32	.32			
	22-31	18-35	1.40-1.70	0.60-2.00	0.15-0.24	3.0-5.9	1.0-2.0	.37	.37			
	31-39	18-35	1.40-1.70	0.60-2.00	0.15-0.24	3.0-5.9	1.0-2.0	.37	.37			
	39-66	18-35	1.40-1.70	0.60-2.00	0.15-0.24	3.0-5.9	0.5-2.0	.37	.37			
	66-96	18-35	1.40-1.70	0.60-2.00	0.15-0.24	3.0-5.9	0.5-2.0	.37	.37			
DSRG:												
Darsil----------------	0-6	1-10	1.45-1.65	6.00-20.00	0.07-0.11	0.0-2.9	0.5-3.0	.17	.17	2	2	134
	6-10	1-10	1.50-1.75	6.00-20.00	0.04-0.11	0.0-2.9	0.0-0.5	.17	.17			
	10-15	---	1.85-2.00	0.20-2.00	---	---	---	---	---			
Stephenville----------	0-4	10-20	1.40-1.65	2.00-6.00	0.13-0.19	0.0-2.9	0.5-1.0	.24	.24	3	3	86
	4-5	5-15	1.40-1.70	2.00-20.00	0.07-0.19	0.0-2.9	0.0-0.5	.20	.20			
	5-14	18-35	1.35-1.75	0.60-2.00	0.13-0.19	0.0-2.9	0.5-1.0	.32	.32			
	14-22	18-35	1.35-1.75	0.60-2.00	0.13-0.19	0.0-2.9	0.5-1.0	.32	.32			
	22-30	---	1.85-2.00	0.20-0.60	---	---	---	---	---			
Rock outcrop----------	0-60	---	1.85-2.00	0.06-2.00	---	---	---	---	---	---	8	0
DUDE:												
Derby-----------------	0-6	2-8	1.35-1.50	6.00-20.00	0.07-0.11	0.0-2.9	0.5-1.0	.15	.15	5	2	134
	6-23	1-10	1.50-1.70	6.00-20.00	0.05-0.11	0.0-2.9	0.0-0.5	.15	.15			
	23-32	1-10	1.50-1.70	6.00-20.00	0.05-0.11	0.0-2.9	0.0-0.5	.15	.15			
	32-84	1-10	1.50-1.70	6.00-20.00	0.05-0.11	0.0-2.9	0.0-0.5	.15	.15			
Urban land------------	0-60	---	---	0.06-2.00	0.00-0.00	---	---	---	---	---	---	---

Physical Properties of the Soils--Continued

Map symbol and soil name	Depth	Clay	Moist bulk density	Permea-bility (Ksat)	Available water capacity	Linear extensi-bility	Organic matter	Erosion factors Kw	Kf	T	Wind erodi-bility group	Wind erodi-bility index
	In	*Pct*	*g/cc*	*In/hr*	*In/in*	*Pct*	*Pct*					
DUDE:												
Dougherty-------------	0-5	2-10	1.45-1.65	2.00-6.00	0.07-0.11	0.0-2.9	0.5-1.0	.20	.20	5	2	134
	5-26	2-10	1.50-1.75	2.00-6.00	0.05-0.11	0.0-2.9	0.0-0.5	.15	.15			
	26-45	18-30	1.40-1.70	0.60-2.00	0.11-0.17	0.0-2.9	0.0-0.5	.32	.32			
	45-63	12-25	1.40-1.70	0.60-6.00	0.07-0.17	0.0-2.9	0.0-0.5	.24	.24			
	63-84	2-15	1.40-1.70	2.00-6.00	0.07-0.15	0.0-2.9	0.0-0.5	.20	.20			
EasA:												
Easpur----------------	0-10	12-26	1.30-1.55	0.60-2.00	0.15-0.24	0.0-2.9	1.0-3.0	.37	.37	5	5	56
	10-24	18-35	1.40-1.70	0.60-2.00	0.11-0.20	0.0-2.9	0.5-1.0	.37	.37			
	24-28	18-35	1.40-1.70	0.60-2.00	0.11-0.20	0.0-2.9	0.5-1.0	.37	.37			
	28-60	18-35	1.40-1.70	0.60-2.00	0.11-0.20	0.0-2.9	0.5-1.0	.32	.32			
	60-80	18-35	1.40-1.70	0.60-2.00	0.15-0.24	0.0-2.9	0.5-1.0	.37	.37			
GaGA:												
Gaddy-----------------	0-7	5-15	1.35-1.50	6.00-20.00	0.07-0.11	0.0-2.9	0.0-0.5	.17	.17	5	2	134
	7-19	5-35	1.50-1.70	6.00-20.00	0.06-0.10	0.0-2.9	0.5-1.0	.17	.17			
	19-79	5-35	1.50-1.70	6.00-20.00	0.06-0.10	0.0-2.9	0.5-1.0	.17	.17			
Gracemore-------------	0-8	2-10	1.35-1.50	6.00-20.00	0.07-0.11	0.0-2.9	0.5-1.0	.17	.17	5	2	134
	8-11	2-10	1.50-1.70	2.00-20.00	0.02-0.11	0.0-2.9	0.0-0.5	.17	.17			
	11-30	2-10	1.50-1.70	2.00-20.00	0.02-0.11	0.0-2.9	0.0-0.5	.17	.17			
	30-65	2-10	1.50-1.70	2.00-20.00	0.02-0.11	0.0-2.9	0.0-0.5	.17	.17			
	65-80	2-10	1.50-1.70	2.00-20.00	0.02-0.11	0.0-2.9	0.0-0.5	.17	.17			
GcmA:												
Gracemont-------------	0-6	40-60	1.25-1.45	0.00-0.06	0.12-0.18	6.0-8.9	1.0-3.0	.37	.37	5	4	86
	6-9	40-60	1.25-1.45	0.00-0.06	0.12-0.18	6.0-8.9	1.0-3.0	.37	.37			
	9-15	10-18	1.40-1.70	0.60-6.00	0.11-0.20	0.0-2.9	0.0-0.5	.37	.37			
	15-26	10-18	1.40-1.70	0.60-6.00	0.11-0.20	0.0-2.9	0.0-0.5	.37	.37			
	26-79	2-15	1.40-1.70	0.60-20.00	0.02-0.20	0.0-2.9	0.0-0.5	.37	.37			
GmtA:												
Gracemont-------------	0-9	10-18	1.30-1.60	0.60-6.00	0.11-0.15	0.0-2.9	0.5-1.0	.20	.20	5	3	86
	9-12	10-18	1.30-1.60	0.60-6.00	0.11-0.15	0.0-2.9	0.5-1.0	.20	.20			
	12-21	10-18	1.45-1.65	0.60-6.00	0.11-0.20	0.0-2.9	0.0-0.5	.32	.32			
	21-36	10-18	1.45-1.65	0.60-6.00	0.11-0.20	0.0-2.9	0.0-0.5	.32	.32			
	36-79	2-15	1.40-1.70	0.60-20.00	0.02-0.20	0.0-2.9	0.0-0.5	.37	.37			
GraC:												
Grainola--------------	0-8	27-35	1.30-1.55	0.20-0.60	0.15-0.22	3.0-5.9	0.5-1.0	.37	.37	3	7	38
	8-18	35-60	1.30-1.70	0.06-0.20	0.10-0.20	6.0-8.9	0.0-0.5	.37	.37			
	18-30	35-60	1.30-1.70	0.06-0.20	0.12-0.20	6.0-8.9	0.0-0.5	.37	.37			
	30-39	35-60	1.30-1.70	0.06-0.20	0.12-0.20	6.0-8.9	0.0-0.5	.37	.37			
	39-45	---	1.85-2.00	0.00-0.20	---	---	---	---	---			
GrAD:												
Grainola--------------	0-4	27-35	1.30-1.55	0.20-0.60	0.15-0.22	3.0-5.9	0.5-1.0	.37	.37	3	7	38
	4-6	35-60	1.30-1.70	0.06-0.20	0.10-0.20	6.0-8.9	0.0-0.5	.37	.37			
	6-18	35-60	1.30-1.70	0.06-0.20	0.12-0.20	6.0-8.9	0.0-0.5	.37	.37			
	18-34	35-60	1.30-1.70	0.06-0.20	0.12-0.20	6.0-8.9	0.0-0.5	.37	.37			
	34-40	---	1.85-2.00	0.00-0.20	---	---	---	---	---			
Ashport---------------	0-9	27-35	1.30-1.60	0.60-2.00	0.15-0.22	3.0-5.9	1.0-3.0	.32	.32	5	7	38
	9-14	18-35	1.40-1.70	0.60-2.00	0.15-0.24	3.0-5.9	0.5-1.0	.37	.37			
	14-32	18-35	1.40-1.70	0.60-2.00	0.15-0.24	3.0-5.9	0.5-1.0	.37	.37			
	32-55	18-35	1.40-1.70	0.60-2.00	0.15-0.24	3.0-5.9	0.5-1.0	.37	.37			
	55-79	18-35	1.40-1.70	0.60-2.00	0.15-0.24	3.0-5.9	0.5-1.0	.37	.37			

Physical Properties of the Soils--Continued

Map symbol and soil name	Depth	Clay	Moist bulk density	Permea- bility (Ksat)	Available water capacity	Linear extensi- bility	Organic matter	Erosion factors Kw	Kf	T	Wind erodi- bility group	Wind erodi- bility index
	In	Pct	g/cc	In/hr	In/in	Pct	Pct					
GrHC:												
Grant-----------------	0-11	15-26	1.30-1.50	0.60-2.00	0.15-0.20	0.0-2.9	1.0-3.0	.37	.37	4	5	56
	11-17	15-26	1.30-1.55	0.60-2.00	0.13-0.20	0.0-2.9	1.0-3.0	.37	.37			
	17-28	18-35	1.40-1.70	0.60-2.00	0.15-0.20	0.0-2.9	0.5-1.0	.37	.37			
	28-38	18-35	1.40-1.70	0.60-2.00	0.15-0.20	0.0-2.9	0.5-1.0	.37	.37			
	38-45	18-35	1.40-1.70	0.60-2.00	0.15-0.20	0.0-2.9	0.5-1.0	.37	.37			
	45-52	---	1.85-2.00	0.00-0.06	---	---	---	---	---			
Huska-----------------	0-6	12-26	1.30-1.55	0.60-2.00	0.10-0.20	0.0-2.9	1.0-3.0	.49	.49	2	5	56
	6-12	35-45	1.50-1.70	0.00-0.06	0.06-0.10	6.0-8.9	0.0-1.0	.43	.43			
	12-29	35-60	1.50-1.70	0.00-0.06	0.06-0.10	6.0-8.9	0.0-1.0	.43	.43			
	29-42	35-60	1.50-1.70	0.00-0.06	0.06-0.10	6.0-8.9	0.0-1.0	.43	.43			
	42-44	---	1.85-2.00	0.00-0.20	---	---	---	---	---			
GrIE:												
Grainola--------------	0-7	27-35	1.30-1.55	0.20-0.60	0.15-0.22	3.0-5.9	0.5-1.0	.37	.37	3	7	38
	7-12	35-60	1.30-1.70	0.06-0.20	0.10-0.20	6.0-8.9	0.0-0.5	.37	.37			
	12-27	35-60	1.30-1.70	0.06-0.20	0.12-0.20	6.0-8.9	0.0-0.5	.37	.37			
	27-38	35-60	1.30-1.70	0.06-0.20	0.12-0.20	6.0-8.9	0.0-0.5	.37	.37			
	38-46	---	1.85-2.00	0.00-0.20	---	---	---	---	---			
Ironmound-------------	0-7	10-18	1.30-1.60	2.00-6.00	0.11-0.15	0.0-2.9	1.0-3.0	.20	.20	2	3	86
	7-18	10-27	1.40-1.70	0.60-2.00	0.11-0.20	0.0-2.9	0.0-0.5	.32	.32			
	18-22	---	1.85-2.00	0.00-0.20	---	---	---	---	---			
GrPB2:												
Grainola--------------	0-4	15-26	1.25-1.55	0.60-2.00	0.15-0.24	0.0-2.9	0.5-1.0	.43	.43	3	5	56
	4-19	35-60	1.30-1.70	0.06-0.20	0.10-0.20	6.0-8.9	0.0-0.5	.37	.37			
	19-32	35-60	1.30-1.70	0.06-0.20	0.12-0.20	6.0-8.9	0.0-0.5	.37	.37			
	32-39	35-60	1.30-1.70	0.06-0.20	0.12-0.20	6.0-8.9	0.0-0.5	.37	.37			
	39-45	---	1.85-2.00	0.00-0.20	---	---	---	---	---			
Piedmont--------------	0-7	20-26	1.30-1.50	0.60-2.00	0.16-0.24	0.0-2.9	1.0-3.0	.49	.49	3	6	48
	7-16	35-55	1.35-1.70	0.00-0.06	0.12-0.22	6.0-8.9	0.5-1.0	.43	.43			
	16-33	35-55	1.35-1.70	0.00-0.06	0.06-0.18	6.0-8.9	0.5-1.0	.37	.37			
	33-39	---	1.85-2.00	0.00-0.20	---	---	---	---	---			
GrPC2:												
Grainola--------------	0-4	27-35	1.30-1.55	0.20-0.60	0.15-0.22	3.0-5.9	0.5-1.0	.37	.37	3	7	38
	4-12	35-60	1.30-1.70	0.06-0.20	0.10-0.20	6.0-8.9	0.0-0.5	.37	.37			
	12-24	35-60	1.30-1.70	0.06-0.20	0.12-0.20	6.0-8.9	0.0-0.5	.37	.37			
	24-30	---	1.85-2.00	0.00-0.20	---	---	---	---	---			
Piedmont--------------	0-7	27-35	1.30-1.60	0.20-0.60	0.15-0.22	3.0-5.9	1.0-3.0	.43	.43	3	6	48
	7-15	35-55	1.35-1.70	0.00-0.06	0.12-0.22	6.0-8.9	0.5-1.0	.43	.43			
	15-23	35-55	1.35-1.70	0.00-0.06	0.06-0.18	6.0-8.9	0.5-1.0	.37	.37			
	23-30	---	1.85-2.00	0.00-0.20	---	---	---	---	---			
GUIE:												
Grainola--------------	0-4	27-35	1.30-1.55	0.20-0.60	0.15-0.22	3.0-5.9	0.5-1.0	.37	.37	3	7	38
	4-16	35-60	1.30-1.70	0.06-0.20	0.12-0.20	6.0-8.9	0.0-0.5	.37	.37			
	16-28	35-60	1.30-1.70	0.06-0.20	0.12-0.20	6.0-8.9	0.0-0.5	.37	.37			
	28-36	---	1.85-2.00	0.00-0.20	---	---	---	---	---			
Urban land------------	0-60	---	---	0.06-2.00	0.00-0.00	---	---	---	---	---	---	---
Ironmound-------------	0-5	15-25	1.30-1.55	0.60-2.00	0.15-0.20	0.0-2.9	1.0-3.0	.32	.32	2	5	56
	5-12	10-27	1.40-1.70	0.60-2.00	0.11-0.20	0.0-2.9	0.0-0.5	.32	.32			
	12-18	---	1.85-2.00	0.00-0.20	---	---	---	---	---			

Physical Properties of the Soils--Continued

Map symbol and soil name	Depth	Clay	Moist bulk density	Permea- bility (Ksat)	Available water capacity	Linear extensi- bility	Organic matter	Erosion factors Kw	Kf	T	Wind erodi- bility group	Wind erodi- bility index
	In	Pct	g/cc	In/hr	In/in	Pct	Pct					
HarC:												
Harrah	0-6	10-18	1.30-1.60	2.00-6.00	0.11-0.15	0.0-2.9	0.5-2.0	.24	.24	5	3	86
	6-13	5-18	1.30-1.60	2.00-6.00	0.07-0.15	0.0-2.9	0.5-2.0	.20	.20			
	13-19	5-18	1.30-1.60	2.00-6.00	0.07-0.15	0.0-2.9	0.5-2.0	.20	.20			
	19-33	18-35	1.40-1.70	0.60-2.00	0.11-0.17	0.0-2.9	0.0-1.0	.32	.32			
	33-44	18-35	1.40-1.70	0.60-2.00	0.10-0.17	0.0-2.9	0.0-1.0	.32	.32			
	44-84	18-35	1.40-1.70	0.60-2.00	0.10-0.17	0.0-2.9	0.0-1.0	.32	.32			
HarC2:												
Harrah	0-6	10-18	1.30-1.60	2.00-6.00	0.11-0.15	0.0-2.9	0.5-2.0	.24	.24	5	3	86
	6-15	18-35	1.40-1.70	0.60-2.00	0.11-0.17	0.0-2.9	0.0-1.0	.32	.32			
	15-27	18-35	1.40-1.70	0.60-2.00	0.11-0.17	0.0-2.9	0.0-1.0	.32	.32			
	27-37	18-35	1.40-1.70	0.60-2.00	0.11-0.17	0.0-2.9	0.0-1.0	.32	.32			
	37-47	18-35	1.40-1.70	0.60-2.00	0.11-0.17	0.0-2.9	0.0-1.0	.32	.32			
	47-76	18-35	1.40-1.70	0.60-2.00	0.10-0.17	0.0-2.9	0.0-1.0	.32	.32			
HarC4:												
Harrah	0-5	10-18	1.30-1.60	2.00-6.00	0.11-0.15	0.0-2.9	0.5-2.0	.24	.24	4	3	86
	5-8	5-18	1.30-1.60	2.00-6.00	0.07-0.15	0.0-2.9	0.5-2.0	.20	.20			
	8-11	18-35	1.40-1.70	0.60-2.00	0.11-0.17	0.0-2.9	0.0-1.0	.32	.32			
	11-38	18-35	1.40-1.70	0.60-2.00	0.11-0.17	0.0-2.9	0.0-1.0	.32	.32			
	38-65	18-35	1.40-1.70	0.60-2.00	0.10-0.17	0.0-2.9	0.0-1.0	.32	.32			
	65-80	18-35	1.40-1.70	0.60-2.00	0.10-0.17	0.0-2.9	0.0-1.0	.32	.32			
HarG:												
Harrah	0-8	10-18	1.30-1.60	2.00-6.00	0.11-0.15	0.0-2.9	0.5-2.0	.24	.24	5	3	86
	8-13	5-18	1.30-1.60	2.00-6.00	0.07-0.15	0.0-2.9	0.5-2.0	.20	.20			
	13-25	18-35	1.40-1.70	0.60-2.00	0.11-0.17	0.0-2.9	0.0-1.0	.32	.32			
	25-35	18-35	1.40-1.70	0.60-2.00	0.11-0.17	0.0-2.9	0.0-1.0	.32	.32			
	35-43	18-35	1.40-1.70	0.60-2.00	0.11-0.17	0.0-2.9	0.0-1.0	.32	.32			
	43-84	18-35	1.40-1.70	0.60-2.00	0.10-0.17	0.0-2.9	0.0-1.0	.32	.32			
HaUC:												
Harrah	0-6	10-18	1.30-1.60	2.00-6.00	0.11-0.15	0.0-2.9	0.5-2.0	.24	.24	5	3	86
	6-8	5-18	1.30-1.60	2.00-6.00	0.07-0.15	0.0-2.9	0.5-2.0	.20	.20			
	8-18	18-35	1.40-1.70	0.60-2.00	0.11-0.17	0.0-2.9	0.0-1.0	.32	.32			
	18-37	18-35	1.40-1.70	0.60-2.00	0.11-0.17	0.0-2.9	0.0-1.0	.32	.32			
	37-52	18-35	1.40-1.70	0.60-2.00	0.11-0.17	0.0-2.9	0.0-1.0	.32	.32			
	52-84	18-35	1.40-1.70	0.60-2.00	0.10-0.17	0.0-2.9	0.0-1.0	.32	.32			
Urban land	0-60	---	---	0.06-2.00	0.00-0.00	---	---	---	---	---	---	---
HiLA:												
Hibsaw	0-8	18-27	1.30-1.60	0.60-2.00	0.04-0.20	0.0-3.0	0.5-2.0	.37	.37	5	6	48
	8-18	18-34	1.40-1.70	0.20-2.00	0.05-0.24	3.0-5.9	0.0-1.0	.37	.37			
	18-30	27-34	1.45-1.70	0.06-0.60	0.05-0.22	3.0-5.9	0.0-1.0	.37	.37			
	30-74	10-40	1.40-1.70	0.06-6.00	0.07-0.22	3.0-5.9	0.0-1.0	.37	.37			
	74-96	18-34	1.40-1.70	0.20-2.00	0.10-0.24	3.0-5.9	0.0-0.5	.37	.37			
Lomill	0-7	27-39	1.30-1.60	0.20-0.60	0.18-0.22	3.0-5.9	1.0-3.0	.43	.43	5	7	38
	7-25	35-60	1.35-1.65	0.00-0.06	0.10-0.20	6.0-8.9	0.5-1.0	.37	.37			
	25-31	35-60	1.35-1.65	0.00-0.06	0.10-0.20	6.0-8.9	0.5-1.0	.37	.37			
	31-84	10-34	1.40-1.70	2.00-6.00	0.07-0.17	0.0-2.9	0.5-1.0	.28	.28			
IrCE:												
Ironmound	0-8	10-18	1.30-1.60	2.00-6.00	0.11-0.15	0.0-2.9	1.0-3.0	.20	.20	2	3	86
	8-14	10-27	1.40-1.70	0.60-2.00	0.11-0.20	0.0-2.9	0.0-0.5	.32	.32			
	14-20	---	1.85-2.00	0.00-0.20	---	---	---	---	---			

Physical Properties of the Soils--Continued

Map symbol and soil name	Depth	Clay	Moist bulk density	Permea-bility (Ksat)	Available water capacity	Linear extensi-bility	Organic matter	Erosion factors Kw	Kf	T	Wind erodi-bility group	Wind erodi-bility index
	In	*Pct*	*g/cc*	*In/hr*	*In/in*	*Pct*	*Pct*					
IrCE:												
Coyle	0-9	15-26	1.30-1.55	0.60-2.00	0.15-0.20	0.0-2.9	1.0-3.0	.37	.37	3	6	48
	9-12	18-26	1.40-1.70	0.60-2.00	0.11-0.20	0.0-2.9	0.5-2.0	.37	.37			
	12-23	20-35	1.40-1.70	0.60-2.00	0.11-0.20	0.0-2.9	0.5-1.0	.32	.32			
	23-27	18-35	1.40-1.70	0.60-2.00	0.07-0.20	0.0-2.9	0.0-0.5	.28	.32			
	27-30	---	1.85-2.00	0.00-0.20	---	---	---	---	---			
IrKD:												
Ironmound	0-3	15-25	1.30-1.55	0.60-2.00	0.15-0.20	0.0-2.9	1.0-3.0	.32	.32	2	5	56
	3-13	10-27	1.40-1.70	0.60-2.00	0.11-0.20	0.0-2.9	0.0-0.5	.32	.32			
	13-21	---	1.85-2.00	0.00-0.20	---	---	---	---	---			
Kingfisher	0-10	15-27	1.30-1.55	0.60-2.00	0.16-0.24	0.0-2.9	1.0-3.0	.37	.37	3	5	56
	10-21	27-35	1.45-1.70	0.20-0.60	0.15-0.22	3.0-5.9	0.0-0.5	.32	.32			
	21-38	27-40	1.45-1.70	0.20-0.60	0.14-0.22	3.0-5.9	0.0-0.5	.32	.32			
	38-49	---	1.85-2.00	0.00-0.20	---	---	---	---	---			
KekA:												
Keokuk	0-8	10-18	1.30-1.55	0.60-2.00	0.13-0.20	0.0-2.9	1.0-3.0	.37	.37	5	5	56
	8-12	10-18	1.30-1.55	0.60-2.00	0.13-0.20	0.0-2.9	1.0-3.0	.37	.37			
	12-20	10-18	1.30-1.60	0.60-2.00	0.13-0.24	0.0-2.9	0.5-1.0	.37	.37			
	20-84	5-18	1.30-1.60	0.60-2.00	0.10-0.20	0.0-2.9	0.5-1.0	.37	.37			
KeoA:												
Keokuk	0-11	10-18	1.30-1.55	0.60-2.00	0.13-0.20	0.0-2.9	1.0-3.0	.37	.37	5	5	56
	11-25	10-18	1.30-1.60	0.60-2.00	0.13-0.24	0.0-2.9	0.5-1.0	.37	.37			
	25-96	5-18	1.30-1.60	0.60-2.00	0.10-0.20	0.0-2.9	0.5-1.0	.37	.37			
KeUA:												
Keokuk	0-16	10-18	1.30-1.55	0.60-2.00	0.13-0.20	0.0-2.9	1.0-3.0	.37	.37	5	5	56
	16-42	10-18	1.30-1.60	0.60-2.00	0.13-0.24	0.0-2.9	0.5-1.0	.37	.37			
	42-80	5-18	1.30-1.60	0.60-2.00	0.10-0.20	0.0-2.9	0.5-1.0	.37	.37			
Urban land	0-60	---	---	0.06-2.00	0.00-0.00	---	---	---	---	---	---	---
KgIC:												
Kingfisher	0-11	15-27	1.30-1.55	0.60-2.00	0.16-0.24	0.0-2.9	1.0-3.0	.37	.37	3	5	56
	11-13	25-35	1.40-1.70	0.20-0.60	0.15-0.24	3.0-5.9	0.0-1.0	.37	.37			
	13-25	27-35	1.45-1.70	0.20-0.60	0.15-0.22	3.0-5.9	0.0-0.5	.32	.32			
	25-28	---	1.85-2.00	0.00-0.20	---	---	---	---	---			
Ironmound	0-6	15-25	1.30-1.55	0.60-2.00	0.15-0.20	0.0-2.9	1.0-3.0	.32	.32	2	5	56
	6-14	10-27	1.40-1.70	0.60-2.00	0.11-0.20	0.0-2.9	0.0-0.5	.32	.32			
	14-18	---	1.85-2.00	0.00-0.20	---	---	---	---	---			
KowB:												
Konawa	0-5	8-18	1.40-1.65	2.00-6.00	0.13-0.19	0.0-2.9	0.5-1.0	.24	.24	5	3	86
	5-17	2-15	1.40-1.75	0.60-2.00	0.05-0.19	0.0-2.9	0.3-1.0	.32	.32			
	17-34	18-30	1.45-1.70	0.60-6.00	0.13-0.19	0.0-2.9	0.1-0.7	.24	.24			
	34-58	18-30	1.45-1.70	0.60-6.00	0.13-0.19	0.0-2.9	0.1-0.7	.24	.24			
	58-84	7-30	1.40-1.70	2.00-6.00	0.07-0.19	0.0-2.9	0.1-0.7	.20	.20			
KowD:												
Konawa	0-8	8-18	1.40-1.65	2.00-6.00	0.13-0.19	0.0-2.9	0.5-1.0	.24	.24	5	3	86
	8-11	2-15	1.40-1.75	0.60-2.00	0.05-0.19	0.0-2.9	0.3-1.0	.32	.32			
	11-28	18-30	1.45-1.70	0.60-6.00	0.13-0.19	0.0-2.9	0.1-0.7	.24	.24			
	28-38	18-30	1.45-1.70	0.60-6.00	0.13-0.19	0.0-2.9	0.1-0.7	.24	.24			
	38-52	18-30	1.45-1.70	0.60-6.00	0.13-0.19	0.0-2.9	0.1-0.7	.24	.24			
	52-80	7-30	1.40-1.70	2.00-6.00	0.07-0.19	0.0-2.9	0.1-0.7	.20	.20			

Physical Properties of the Soils--Continued

Map symbol and soil name	Depth	Clay	Moist bulk density	Permea- bility (Ksat)	Available water capacity	Linear extensi- bility	Organic matter	Erosion factors Kw	Kf	T	Wind erodi- bility group	Wind erodi- bility index
	In	*Pct*	*g/cc*	*In/hr*	*In/in*	*Pct*	*Pct*					
KowD2:												
Konawa----------------	0-7	8-18	1.40-1.65	2.00-6.00	0.13-0.19	0.0-2.9	0.5-1.0	.24	.24	5	3	86
	7-18	18-30	1.45-1.70	0.60-6.00	0.13-0.19	0.0-2.9	0.1-0.7	.24	.24			
	18-37	18-30	1.45-1.70	0.60-6.00	0.13-0.19	0.0-2.9	0.1-0.7	.24	.24			
	37-80	7-30	1.40-1.70	2.00-6.00	0.07-0.19	0.0-2.9	0.1-0.7	.20	.20			
KowD4:												
Konawa----------------	0-10	8-18	1.40-1.65	2.00-6.00	0.13-0.19	0.0-2.9	0.5-1.0	.24	.24	4	3	86
	10-13	2-15	1.40-1.75	0.60-2.00	0.05-0.19	0.0-2.9	0.3-1.0	.32	.32			
	13-35	18-30	1.45-1.70	0.60-6.00	0.13-0.19	0.0-2.9	0.1-0.7	.24	.24			
	35-53	18-30	1.45-1.70	0.60-6.00	0.13-0.19	0.0-2.9	0.1-0.7	.24	.24			
	53-65	18-30	1.45-1.70	0.60-6.00	0.13-0.19	0.0-2.9	0.1-0.7	.24	.24			
	65-80	18-30	1.45-1.70	0.60-6.00	0.13-0.19	0.0-2.9	0.1-0.7	.24	.24			
KrdA:												
Kirkland--------------	0-10	13-26	1.30-1.50	0.60-2.00	0.16-0.24	0.0-2.9	1.0-3.0	.49	.49	5	5	56
	10-22	40-60	1.35-1.60	0.00-0.06	0.10-0.14	6.0-8.9	1.0-2.0	.37	.37			
	22-37	40-60	1.35-1.60	0.00-0.06	0.10-0.14	6.0-8.9	1.0-2.0	.37	.37			
	37-63	40-60	1.35-1.60	0.00-0.06	0.10-0.14	6.0-8.9	1.0-2.0	.37	.37			
	63-82	35-60	1.30-1.65	0.00-0.06	0.10-0.18	9.0-25.0	0.5-1.0	.32	.32			
KrUA:												
Kirkland--------------	0-11	13-26	1.30-1.50	0.60-2.00	0.16-0.24	0.0-2.9	1.0-3.0	.49	.49	5	5	56
	11-28	40-60	1.35-1.60	0.00-0.06	0.10-0.14	6.0-8.9	1.0-2.0	.37	.37			
	28-48	35-60	1.30-1.65	0.00-0.06	0.10-0.18	9.0-25.0	0.5-1.0	.32	.32			
	48-76	35-60	1.30-1.65	0.00-0.06	0.10-0.18	9.0-25.0	0.5-1.0	.32	.32			
	76-84	---	1.85-2.00	0.00-0.20	---	---	---	---	---			
Urban land------------	0-60	---	---	0.06-2.00	0.00-0.00	---	---	---	---	---	---	---
KUIC:												
Kingfisher------------	0-11	15-27	1.30-1.55	0.60-2.00	0.16-0.24	0.0-2.9	1.0-3.0	.37	.37	3	5	56
	11-13	25-35	1.40-1.70	0.20-0.60	0.15-0.24	3.0-5.9	0.0-1.0	.37	.37			
	13-25	27-35	1.45-1.70	0.20-0.60	0.15-0.22	3.0-5.9	0.0-0.5	.32	.32			
	25-28	---	1.85-2.00	0.00-0.20	---	---	---	---	---			
Urban land------------	0-60	---	---	0.06-2.00	0.00-0.00	---	---	---	---	---	---	---
Ironmound-------------	0-6	15-25	1.30-1.55	0.60-2.00	0.15-0.20	0.0-2.9	1.0-3.0	.32	.32	2	5	56
	6-14	10-27	1.40-1.70	0.60-2.00	0.11-0.20	0.0-2.9	0.0-0.5	.32	.32			
	14-18	---	1.85-2.00	0.00-0.20	---	---	---	---	---			
KwUD:												
Konawa----------------	0-7	8-18	1.40-1.65	2.00-6.00	0.13-0.19	0.0-2.9	0.5-1.0	.24	.24	5	3	86
	7-10	2-15	1.40-1.75	0.60-2.00	0.05-0.19	0.0-2.9	0.3-1.0	.32	.32			
	10-25	18-30	1.45-1.70	0.60-6.00	0.13-0.19	0.0-2.9	0.1-0.7	.24	.24			
	25-49	18-30	1.45-1.70	0.60-6.00	0.13-0.19	0.0-2.9	0.1-0.7	.24	.24			
	49-80	7-30	1.40-1.70	2.00-6.00	0.07-0.19	0.0-2.9	0.1-0.7	.20	.20			
Urban land------------	0-60	---	---	0.06-2.00	0.00-0.00	---	---	---	---	---	---	---
LarA:												
Lawrie----------------	0-9	15-26	1.25-1.55	0.60-2.00	0.15-0.24	0.0-2.9	1.0-3.0	.37	.37	5	5	56
	9-24	15-26	1.25-1.55	0.60-2.00	0.15-0.24	0.0-2.9	1.0-3.0	.37	.37			
	24-40	18-35	1.30-1.75	0.60-2.00	0.16-0.24	3.0-5.9	1.0-3.0	.37	.37			
	40-67	18-35	1.30-1.75	0.60-2.00	0.16-0.24	3.0-5.9	1.0-3.0	.37	.37			
	67-87	18-35	1.30-1.75	0.60-2.00	0.15-0.24	3.0-5.9	0.5-2.0	.37	.37			

Physical Properties of the Soils--Continued

Map symbol and soil name	Depth	Clay	Moist bulk density	Permea- bility (Ksat)	Available water capacity	Linear extensi- bility	Organic matter	Erosion factors Kw	Kf	T	Wind erodi- bility group	Wind erodi- bility index
	In	*Pct*	*g/cc*	*In/hr*	*In/in*	*Pct*	*Pct*					
LatG:												
Latrass---------------	0-5	15-26	1.30-1.65	0.60-2.00	0.15-0.20	0.0-2.9	0.0-3.0	.49	.49	1	5	56
	5-22	35-60	1.30-1.85	0.00-0.06	0.08-0.19	6.0-8.9	0.0-1.0	.37	.37			
	22-42	35-60	1.30-1.85	0.00-0.06	0.08-0.19	6.0-8.9	0.0-1.0	.37	.37			
	42-80	---	1.00-2.35	0.06-20.00	---	---	---	---	---			
LawA:												
Lawrie----------------	0-9	15-26	1.25-1.55	0.60-2.00	0.15-0.24	0.0-2.9	1.0-3.0	.37	.37	5	5	56
	9-13	15-26	1.25-1.55	0.60-2.00	0.15-0.24	0.0-2.9	1.0-3.0	.37	.37			
	13-18	18-35	1.30-1.75	0.60-2.00	0.16-0.24	3.0-5.9	1.0-3.0	.37	.37			
	18-47	18-35	1.30-1.75	0.60-2.00	0.15-0.24	3.0-5.9	0.5-2.0	.37	.37			
	47-59	18-35	1.30-1.75	0.60-2.00	0.15-0.24	3.0-5.9	0.5-2.0	.37	.37			
	59-82	18-40	1.45-1.70	0.60-2.00	0.15-0.22	3.0-5.9	0.0-1.0	.37	.37			
LitB:												
Littleaxe-------------	0-5	8-18	1.30-1.60	2.00-6.00	0.11-0.15	0.0-2.9	0.5-2.0	.24	.24	4	3	86
	5-9	3-18	1.30-1.60	2.00-6.00	0.07-0.15	0.0-2.9	0.0-0.5	.20	.20			
	9-17	18-35	1.50-1.70	0.60-2.00	0.11-0.17	0.0-2.9	0.0-1.0	.32	.32			
	17-36	18-35	1.50-1.70	0.60-2.00	0.11-0.17	0.0-2.9	0.0-1.0	.32	.32			
	36-43	14-30	1.50-1.70	0.60-6.00	0.11-0.17	0.0-2.9	0.0-1.0	.32	.32			
	43-45	---	1.85-2.00	0.20-2.00	---	---	---	---	---			
LitC:												
Littleaxe-------------	0-6	8-18	1.30-1.60	2.00-6.00	0.11-0.15	0.0-2.9	0.5-2.0	.24	.24	4	3	86
	6-8	3-18	1.30-1.60	2.00-6.00	0.07-0.15	0.0-2.9	0.0-0.5	.20	.20			
	8-33	18-35	1.50-1.70	0.60-2.00	0.11-0.17	0.0-2.9	0.0-1.0	.32	.32			
	33-52	18-35	1.50-1.70	0.60-2.00	0.11-0.17	0.0-2.9	0.0-1.0	.32	.32			
	52-59	14-30	1.50-1.70	0.60-6.00	0.11-0.17	0.0-2.9	0.0-1.0	.32	.32			
	59-72	---	1.85-2.00	0.20-2.00	---	---	---	---	---			
LitC2:												
Littleaxe-------------	0-9	8-18	1.30-1.60	2.00-6.00	0.11-0.15	0.0-2.9	0.5-2.0	.24	.24	4	3	86
	9-21	18-35	1.50-1.70	0.60-2.00	0.11-0.17	0.0-2.9	0.0-1.0	.32	.32			
	21-32	18-35	1.50-1.70	0.60-2.00	0.11-0.17	0.0-2.9	0.0-1.0	.32	.32			
	32-45	14-30	1.50-1.70	0.60-6.00	0.11-0.17	0.0-2.9	0.0-1.0	.32	.32			
	45-50	---	1.85-2.00	0.20-2.00	---	---	---	---	---			
LomA:												
Lomill----------------	0-4	27-39	1.30-1.60	0.20-0.60	0.18-0.22	3.0-5.9	1.0-3.0	.43	.43	5	7	38
	4-12	35-60	1.35-1.65	0.00-0.06	0.10-0.20	6.0-8.9	0.5-1.0	.37	.37			
	12-27	35-60	1.35-1.65	0.00-0.06	0.10-0.20	6.0-8.9	0.5-1.0	.37	.37			
	27-48	10-34	1.40-1.70	2.00-6.00	0.07-0.17	0.0-2.9	0.5-1.0	.28	.28			
	48-72	10-34	1.40-1.70	2.00-6.00	0.07-0.17	0.0-2.9	0.5-1.0	.28	.28			
LtUC:												
Littleaxe-------------	0-6	8-18	1.30-1.60	2.00-6.00	0.11-0.15	0.0-2.9	0.5-2.0	.24	.24	4	3	86
	6-11	3-18	1.30-1.60	2.00-6.00	0.07-0.15	0.0-2.9	0.0-0.5	.20	.20			
	11-25	18-35	1.50-1.70	0.60-2.00	0.11-0.17	0.0-2.9	0.0-1.0	.32	.32			
	25-32	18-35	1.50-1.70	0.60-2.00	0.11-0.17	0.0-2.9	0.0-1.0	.32	.32			
	32-44	14-30	1.50-1.70	0.60-6.00	0.11-0.17	0.0-2.9	0.0-1.0	.32	.32			
	44-50	---	1.85-2.00	0.20-2.00	---	---	---	---	---			
Urban land------------	0-60	---	---	0.06-2.00	0.00-0.00	---	---	---	---	---	---	---
LweA:												
Lawrie----------------	0-11	27-40	1.30-1.50	0.60-2.00	0.18-0.22	3.0-5.9	1.0-3.0	.32	.32	5	7	38
	11-21	18-35	1.30-1.75	0.60-2.00	0.16-0.24	3.0-5.9	1.0-3.0	.37	.37			
	21-34	18-35	1.30-1.75	0.60-2.00	0.16-0.24	3.0-5.9	1.0-3.0	.37	.37			
	34-55	18-35	1.30-1.75	0.60-2.00	0.15-0.24	3.0-5.9	0.5-2.0	.37	.37			
	55-80	18-35	1.30-1.75	0.60-2.00	0.15-0.24	3.0-5.9	0.5-2.0	.37	.37			

Physical Properties of the Soils--Continued

Map symbol and soil name	Depth	Clay	Moist bulk density	Permea- bility (Ksat)	Available water capacity	Linear extensi- bility	Organic matter	Erosion factors Kw	Kf	T	Wind erodi- bility group	Wind erodi- bility index
	In	*Pct*	*g/cc*	*In/hr*	*In/in*	*Pct*	*Pct*					
LwfA:												
Lawrie----------------	0-14	10-18	1.30-1.60	2.00-6.00	0.11-0.15	0.0-2.9	1.0-3.0	.24	.24	5	3	86
	14-33	18-35	1.30-1.75	0.60-2.00	0.16-0.24	3.0-5.9	1.0-3.0	.37	.37			
	33-57	18-35	1.30-1.75	0.60-2.00	0.15-0.24	3.0-5.9	0.5-2.0	.37	.37			
	57-70	18-35	1.30-1.75	0.60-2.00	0.15-0.24	3.0-5.9	0.5-2.0	.37	.37			
	70-96	18-40	1.30-1.75	0.60-2.00	0.15-0.22	3.0-5.9	0.0-1.0	.37	.37			
LwUA:												
Lawrie----------------	0-9	15-26	1.25-1.55	0.60-2.00	0.15-0.24	0.0-2.9	1.0-3.0	.37	.37	5	5	56
	9-17	18-35	1.30-1.75	0.60-2.00	0.16-0.24	3.0-5.9	1.0-3.0	.37	.37			
	17-24	18-35	1.30-1.75	0.60-2.00	0.16-0.24	3.0-5.9	1.0-3.0	.37	.37			
	24-33	18-35	1.30-1.75	0.60-2.00	0.15-0.24	3.0-5.9	0.5-2.0	.37	.37			
	33-45	18-35	1.30-1.75	0.60-2.00	0.15-0.24	3.0-5.9	0.5-2.0	.37	.37			
	45-84	18-40	1.30-1.75	0.60-2.00	0.15-0.22	3.0-5.9	0.0-1.0	.37	.37			
Urban land------------	0-60	---	---	0.06-2.00	0.00-0.00	---	---	---	---	---	---	---
MlfA:												
Miller----------------	0-19	10-18	1.30-1.60	2.00-6.00	0.13-0.19	0.0-2.9	0.0-1.0	.37	.37	5	3	86
	19-29	40-50	1.25-1.45	0.00-0.06	0.12-0.18	6.0-8.9	1.0-3.0	.37	.37			
	29-37	40-60	1.35-1.65	0.00-0.06	0.12-0.19	6.0-8.9	0.5-2.0	.37	.37			
	37-96	35-60	1.35-1.65	0.06-0.20	0.12-0.19	6.0-8.9	0.5-1.0	.37	.37			
MllA:												
Miller----------------	0-7	40-50	1.25-1.45	0.00-0.06	0.12-0.18	6.0-8.9	1.0-3.0	.37	.37	5	4	86
	7-12	40-50	1.25-1.45	0.00-0.06	0.12-0.18	6.0-8.9	1.0-3.0	.37	.37			
	12-24	35-60	1.35-1.65	0.00-0.06	0.12-0.19	6.0-8.9	0.5-2.0	.37	.37			
	24-70	35-60	1.35-1.65	0.06-0.20	0.12-0.19	6.0-8.9	0.5-1.0	.37	.37			
	70-84	25-50	1.35-1.65	0.06-0.20	0.12-0.19	6.0-8.9	0.5-1.0	.37	.37			
M-W:												
Miscellaneous water.												
NewB:												
Newalla---------------	0-4	7-17	1.40-1.65	0.60-2.00	0.13-0.19	0.0-2.9	0.5-3.0	.37	.37	4	3	86
	4-8	7-17	1.40-1.65	0.60-2.00	0.13-0.19	0.0-2.9	0.5-3.0	.37	.37			
	8-16	20-35	1.30-1.70	0.60-2.00	0.14-0.20	0.0-2.9	0.5-1.0	.43	.43			
	16-32	40-60	1.30-1.60	0.00-0.06	0.12-0.18	6.0-8.9	0.0-0.5	.37	.37			
	32-42	40-60	1.30-1.65	0.00-0.06	0.04-0.18	6.0-8.9	0.0-0.5	.37	.37			
	42-48	---	1.85-2.00	0.00-0.06	---	---	---	---	---			
NewC2:												
Newalla---------------	0-6	7-17	1.40-1.65	0.60-2.00	0.13-0.19	0.0-2.9	0.5-3.0	.37	.37	4	3	86
	6-10	20-35	1.30-1.70	0.60-2.00	0.14-0.20	0.0-2.9	0.5-1.0	.43	.43			
	10-38	40-60	1.30-1.60	0.00-0.06	0.12-0.18	6.0-8.9	0.0-0.5	.37	.37			
	38-55	40-60	1.30-1.60	0.00-0.06	0.12-0.18	6.0-8.9	0.0-0.5	.37	.37			
	55-60	---	1.85-2.00	0.00-0.06	---	---	---	---	---			
NorB:												
Norge-----------------	0-12	15-26	1.30-1.50	0.60-2.00	0.15-0.24	0.0-2.9	1.0-3.0	.37	.37	5	6	48
	12-18	18-35	1.40-1.70	0.20-2.00	0.15-0.24	3.0-5.9	0.5-2.0	.32	.32			
	18-27	27-35	1.45-1.70	0.20-0.60	0.15-0.22	3.0-5.9	0.5-1.0	.32	.32			
	27-43	27-35	1.45-1.70	0.20-0.60	0.15-0.22	3.0-5.9	0.5-1.0	.32	.32			
	43-86	27-50	1.45-1.70	0.20-0.60	0.15-0.22	3.0-5.9	0.5-1.0	.32	.32			
NorC:												
Norge-----------------	0-9	15-26	1.30-1.50	0.60-2.00	0.15-0.24	0.0-2.9	1.0-3.0	.37	.37	5	6	48
	9-14	18-35	1.40-1.70	0.20-2.00	0.15-0.24	3.0-5.9	0.5-2.0	.32	.32			
	14-39	27-35	1.45-1.70	0.20-0.60	0.15-0.22	3.0-5.9	0.5-1.0	.32	.32			
	39-68	27-35	1.45-1.70	0.20-0.60	0.15-0.22	3.0-5.9	0.5-1.0	.32	.32			
	68-88	27-50	1.45-1.70	0.20-0.60	0.15-0.22	3.0-5.9	0.5-1.0	.32	.32			

Physical Properties of the Soils--Continued

Map symbol and soil name	Depth	Clay	Moist bulk density	Permea- bility (Ksat)	Available water capacity	Linear extensi- bility	Organic matter	Erosion factors Kw	Kf	T	Wind erodi- bility group	Wind erodi- bility index
	In	*Pct*	*g/cc*	*In/hr*	*In/in*	*Pct*	*Pct*					
NorC2:												
Norge-----------------	0-10	15-26	1.30-1.50	0.60-2.00	0.15-0.24	0.0-2.9	1.0-3.0	.37	.37	5	6	48
	10-30	27-35	1.45-1.70	0.20-0.60	0.15-0.22	3.0-5.9	0.5-1.0	.32	.32			
	30-49	27-35	1.45-1.70	0.20-0.60	0.15-0.22	3.0-5.9	0.5-1.0	.32	.32			
	49-63	27-35	1.45-1.70	0.20-0.60	0.15-0.22	3.0-5.9	0.5-1.0	.32	.32			
	63-84	27-50	1.45-1.70	0.20-0.60	0.15-0.22	3.0-5.9	0.5-1.0	.32	.32			
NoUC:												
Norge-----------------	0-9	15-26	1.30-1.50	0.60-2.00	0.15-0.24	0.0-2.9	1.0-3.0	.37	.37	5	6	48
	9-16	18-35	1.40-1.70	0.20-2.00	0.15-0.24	3.0-5.9	0.5-2.0	.32	.32			
	16-46	18-35	1.40-1.70	0.20-2.00	0.15-0.24	3.0-5.9	0.5-2.0	.32	.32			
	46-68	27-35	1.45-1.70	0.20-0.60	0.15-0.22	3.0-5.9	0.5-1.0	.32	.32			
	68-84	27-50	1.45-1.70	0.20-0.60	0.15-0.22	3.0-5.9	0.5-1.0	.32	.32			
Urban land------------	0-60	---	---	0.06-2.00	0.00-0.00	---	---	---	---	---	---	---
PdHC:												
Piedmont--------------	0-7	20-26	1.30-1.50	0.60-2.00	0.16-0.24	0.0-2.9	1.0-3.0	.49	.49	3	6	48
	7-10	27-40	1.45-1.70	0.20-0.60	0.15-0.22	3.0-5.9	1.0-3.0	.43	.43			
	10-15	35-55	1.35-1.70	0.00-0.06	0.12-0.22	6.0-8.9	0.5-1.0	.43	.43			
	15-25	35-55	1.35-1.70	0.00-0.06	0.06-0.18	6.0-8.9	0.5-1.0	.37	.37			
	25-37	35-55	1.35-1.70	0.00-0.06	0.06-0.18	6.0-8.9	0.5-1.0	.37	.37			
	37-45	---	1.85-2.00	0.00-0.20	---	---	---	---	---			
Huska-----------------	0-3	12-26	1.30-1.55	0.60-2.00	0.10-0.20	0.0-2.9	1.0-3.0	.49	.49	2	5	56
	3-18	35-45	1.50-1.70	0.00-0.06	0.06-0.10	6.0-8.9	0.0-1.0	.43	.43			
	18-40	35-60	1.50-1.70	0.00-0.06	0.06-0.10	6.0-8.9	0.0-1.0	.43	.43			
	40-45	---	1.85-2.00	0.00-0.20	---	---	---	---	---			
PieC2:												
Piedmont--------------	0-4	27-35	1.30-1.60	0.20-0.60	0.15-0.22	3.0-5.9	1.0-3.0	.43	.43	3	6	48
	4-20	35-55	1.35-1.70	0.00-0.06	0.12-0.22	6.0-8.9	0.5-1.0	.43	.43			
	20-32	35-55	1.35-1.70	0.00-0.06	0.06-0.18	6.0-8.9	0.5-1.0	.37	.37			
	32-40	---	1.85-2.00	0.00-0.20	---	---	---	---	---			
PimB:												
Piedmont--------------	0-4	20-26	1.30-1.50	0.60-2.00	0.16-0.24	0.0-2.9	1.0-3.0	.49	.49	3	6	48
	4-8	32-40	1.45-1.70	0.20-0.60	0.15-0.22	3.0-5.9	1.0-3.0	.43	.43			
	8-16	35-55	1.35-1.70	0.00-0.06	0.12-0.22	6.0-8.9	0.5-1.0	.43	.43			
	16-30	35-55	1.35-1.70	0.00-0.06	0.06-0.18	6.0-8.9	0.5-1.0	.37	.37			
	30-36	35-55	1.35-1.70	0.00-0.06	0.06-0.18	6.0-8.9	0.5-1.0	.37	.37			
	36-48	---	1.85-2.00	0.00-0.20	---	---	---	---	---			
PimC:												
Piedmont--------------	0-4	20-26	1.30-1.50	0.60-2.00	0.16-0.24	0.0-2.9	1.0-3.0	.49	.49	3	6	48
	4-6	32-40	1.45-1.70	0.20-0.60	0.15-0.22	3.0-5.9	1.0-3.0	.43	.43			
	6-23	35-55	1.35-1.70	0.00-0.06	0.12-0.22	6.0-8.9	0.5-1.0	.43	.43			
	23-31	35-55	1.35-1.70	0.00-0.06	0.06-0.18	6.0-8.9	0.5-1.0	.37	.37			
	31-40	---	1.85-2.00	0.00-0.20	---	---	---	---	---			
PIT:												
Pits------------------	0-60	---	1.35-1.70	0.06-6.00	---	---	---	---	---	---	8	0
PukA:												
Pulaski---------------	0-9	10-18	1.40-1.65	2.00-6.00	0.13-0.19	0.0-2.9	0.5-1.0	.20	.20	5	3	86
	9-14	10-18	1.30-1.70	2.00-6.00	0.13-0.19	0.0-2.9	0.0-1.0	.32	.32			
	14-55	10-18	1.30-1.70	2.00-6.00	0.13-0.19	0.0-2.9	0.0-1.0	.32	.32			
	55-79	5-18	1.30-1.70	2.00-6.00	0.07-0.20	0.0-2.9	0.0-1.0	.32	.32			

Physical Properties of the Soils--Continued

Map symbol and soil name	Depth	Clay	Moist bulk density	Permea- bility (Ksat)	Available water capacity	Linear extensi- bility	Organic matter	Erosion factors Kw	Kf	T	Wind erodi- bility group	Wind erodi- bility index
	In	Pct	g/cc	In/hr	In/in	Pct	Pct					
PulA:												
Pulaski---------------	0-5	10-18	1.40-1.65	2.00-6.00	0.13-0.19	0.0-2.9	0.5-1.0	.20	.20	5	3	86
	5-17	10-18	1.30-1.70	2.00-6.00	0.13-0.19	0.0-2.9	0.0-1.0	.32	.32			
	17-34	10-18	1.30-1.70	2.00-6.00	0.13-0.19	0.0-2.9	0.0-1.0	.32	.32			
	34-72	5-18	1.30-1.70	2.00-6.00	0.07-0.20	0.0-2.9	0.0-1.0	.32	.32			
RenB:												
Renfrow---------------	0-8	18-26	1.25-1.55	0.60-2.00	0.15-0.24	0.0-2.9	1.0-3.0	.49	.49	5	6	48
	8-15	22-40	1.30-1.75	0.20-0.60	0.15-0.24	3.0-5.9	0.5-2.0	.43	.43			
	15-41	35-55	1.30-1.75	0.00-0.06	0.12-0.22	6.0-8.9	0.5-1.0	.43	.43			
	41-68	35-55	1.30-1.75	0.00-0.06	0.12-0.22	6.0-8.9	0.5-1.0	.43	.43			
	68-99	35-55	1.30-1.75	0.00-0.06	0.12-0.22	6.0-8.9	0.5-1.0	.43	.43			
RinB:												
Renthin---------------	0-4	20-26	1.30-1.50	0.60-2.00	0.16-0.24	0.0-2.9	1.0-3.0	.49	.49	4	6	48
	4-10	32-40	1.45-1.70	0.20-0.60	0.15-0.22	3.0-5.9	1.0-3.0	.43	.43			
	10-29	35-55	1.35-1.70	0.00-0.06	0.12-0.22	6.0-8.9	0.5-1.0	.43	.43			
	29-55	35-55	1.30-1.70	0.00-0.06	0.07-0.22	6.0-8.9	0.5-1.0	.37	.37			
	55-77	---	1.85-2.00	0.00-0.06	---	---	---	---	---			
RnnB:												
Renthin---------------	0-10	27-35	1.30-1.60	0.20-0.60	0.15-0.22	3.0-5.9	1.0-3.0	.43	.43	4	6	48
	10-16	32-40	1.45-1.70	0.20-0.60	0.15-0.22	3.0-5.9	1.0-3.0	.43	.43			
	16-26	35-55	1.35-1.70	0.00-0.06	0.12-0.22	6.0-8.9	0.5-1.0	.43	.43			
	26-34	35-55	1.35-1.70	0.00-0.06	0.12-0.22	6.0-8.9	0.5-1.0	.43	.43			
	34-44	35-55	1.30-1.70	0.00-0.06	0.07-0.22	6.0-8.9	0.5-1.0	.37	.37			
	44-50	---	1.85-2.00	0.00-0.06	---	---	---	---	---			
RnnC2:												
Renthin---------------	0-8	27-35	1.30-1.60	0.20-0.60	0.15-0.22	3.0-5.9	1.0-3.0	.43	.43	4	6	48
	8-12	32-40	1.45-1.70	0.20-0.60	0.15-0.22	3.0-5.9	1.0-3.0	.43	.43			
	12-19	35-55	1.35-1.70	0.00-0.06	0.12-0.22	6.0-8.9	0.5-1.0	.43	.43			
	19-55	35-55	1.30-1.70	0.00-0.06	0.07-0.22	6.0-8.9	0.5-1.0	.37	.37			
	55-60	---	1.85-2.00	0.00-0.06	---	---	---	---	---			
RnUC:												
Renthin---------------	0-10	20-26	1.30-1.50	0.60-2.00	0.16-0.24	0.0-2.9	1.0-3.0	.49	.49	4	6	48
	10-14	32-40	1.45-1.70	0.20-0.60	0.15-0.22	3.0-5.9	1.0-3.0	.43	.43			
	14-51	35-55	1.35-1.70	0.00-0.06	0.12-0.22	6.0-8.9	0.5-1.0	.43	.43			
	51-58	35-55	1.30-1.70	0.00-0.06	0.07-0.22	6.0-8.9	0.5-1.0	.37	.37			
	58-72	---	1.85-2.00	0.00-0.06	---	---	---	---	---			
Urban land------------	0-60	---	---	0.06-2.00	0.00-0.00	---	---	---	---	---	---	---
SDGD4:												
Stephenville----------	0-4	10-20	1.40-1.65	2.00-6.00	0.13-0.19	0.0-2.9	0.5-1.0	.24	.24	2	3	86
	4-20	18-35	1.35-1.75	0.60-2.00	0.13-0.19	0.0-2.9	0.5-1.0	.32	.32			
	20-30	18-35	1.35-1.75	0.60-2.00	0.13-0.19	0.0-2.9	0.5-1.0	.32	.32			
	30-40	---	1.85-2.00	0.20-0.60	---	---	---	---	---			
Darsil----------------	0-6	1-10	1.45-1.65	6.00-20.00	0.07-0.11	0.0-2.9	0.5-3.0	.17	.17	1	2	134
	6-10	1-10	1.50-1.75	6.00-20.00	0.04-0.11	0.0-2.9	0.0-0.5	.17	.17			
	10-15	---	1.85-2.00	0.20-2.00	---	---	---	---	---			
Gullied land----------	0-60	---	1.30-1.70	0.20-20.00	---	---	---	---	---	---	8	0
SDND:												
Stephenville----------	0-3	10-20	1.40-1.65	2.00-6.00	0.13-0.19	0.0-2.9	0.5-1.0	.24	.24	3	3	86
	3-10	5-15	1.40-1.70	2.00-20.00	0.07-0.19	0.0-2.9	0.0-0.5	.20	.20			
	10-21	18-35	1.35-1.75	0.60-2.00	0.13-0.19	0.0-2.9	0.5-1.0	.32	.32			
	21-24	---	1.85-2.00	0.20-0.60	---	---	---	---	---			

Physical Properties of the Soils--Continued

Map symbol and soil name	Depth	Clay	Moist bulk density	Permea-bility (Ksat)	Available water capacity	Linear extensi-bility	Organic matter	Erosion factors Kw	Kf	T	Wind erodi-bility group	Wind erodi-bility index
	In	Pct	g/cc	In/hr	In/in	Pct	Pct					
SDND:												
Darsil	0-5	1-10	1.45-1.65	6.00-20.00	0.07-0.11	0.0-2.9	0.5-3.0	.17	.17	2	2	134
	5-16	1-10	1.50-1.75	6.00-20.00	0.04-0.11	0.0-2.9	0.0-0.5	.17	.17			
	16-18	---	1.85-2.00	0.20-2.00	---	---	---	---	---			
Newalla	0-3	7-17	1.40-1.65	0.60-2.00	0.13-0.19	0.0-2.9	0.5-3.0	.37	.37	4	3	86
	3-10	7-17	1.40-1.65	0.60-2.00	0.13-0.19	0.0-2.9	0.5-3.0	.37	.37			
	10-15	20-35	1.30-1.70	0.60-2.00	0.14-0.20	0.0-2.9	0.5-1.0	.43	.43			
	15-30	40-60	1.30-1.60	0.00-0.06	0.12-0.18	6.0-8.9	0.0-0.5	.37	.37			
	30-41	40-60	1.30-1.60	0.00-0.06	0.12-0.18	6.0-8.9	0.0-0.5	.37	.37			
	41-45	---	1.85-2.00	0.00-0.06	---	---	---	---	---			
SDND2:												
Stephenville	0-4	10-20	1.40-1.65	2.00-6.00	0.13-0.19	0.0-2.9	0.5-1.0	.24	.24	3	3	86
	4-17	18-35	1.35-1.75	0.60-2.00	0.13-0.19	0.0-2.9	0.5-1.0	.32	.32			
	17-24	18-35	1.35-1.75	0.60-2.00	0.13-0.19	0.0-2.9	0.5-1.0	.32	.32			
	24-29	18-35	1.35-1.75	0.60-2.00	0.13-0.19	0.0-2.9	0.5-1.0	.32	.32			
	29-31	---	1.85-2.00	0.20-0.60	---	---	---	---	---			
Darsil	0-6	1-10	1.45-1.65	6.00-20.00	0.07-0.11	0.0-2.9	0.5-3.0	.17	.17	2	2	134
	6-14	1-10	1.50-1.75	6.00-20.00	0.04-0.11	0.0-2.9	0.0-0.5	.17	.17			
	14-16	---	1.85-2.00	0.20-2.00	---	---	---	---	---			
Newalla	0-6	7-17	1.40-1.65	0.60-2.00	0.13-0.19	0.0-2.9	0.5-3.0	.37	.37	4	3	86
	6-14	20-35	1.30-1.70	0.60-2.00	0.14-0.20	0.0-2.9	0.5-1.0	.43	.43			
	14-44	40-60	1.30-1.60	0.00-0.06	0.12-0.18	6.0-8.9	0.0-0.5	.37	.37			
	44-50	40-60	1.30-1.65	0.00-0.06	0.04-0.18	6.0-8.9	0.0-0.5	.37	.37			
	50-55	---	1.85-2.00	0.00-0.06	---	---	---	---	---			
StDC:												
Stephenville	0-5	10-20	1.40-1.65	2.00-6.00	0.13-0.19	0.0-2.9	0.5-1.0	.24	.24	3	3	86
	5-8	5-15	1.40-1.70	2.00-20.00	0.07-0.19	0.0-2.9	0.0-0.5	.20	.20			
	8-20	18-35	1.35-1.75	0.60-2.00	0.13-0.19	0.0-2.9	0.5-1.0	.32	.32			
	20-27	18-35	1.35-1.75	0.60-2.00	0.13-0.19	0.0-2.9	0.5-1.0	.32	.32			
	27-32	---	1.85-2.00	0.20-0.60	---	---	---	---	---			
Darsil	0-4	1-10	1.45-1.65	6.00-20.00	0.07-0.11	0.0-2.9	0.5-3.0	.17	.17	2	2	134
	4-16	1-10	1.50-1.75	6.00-20.00	0.04-0.11	0.0-2.9	0.0-0.5	.17	.17			
	16-24	---	1.85-2.00	0.20-2.00	---	---	---	---	---			
StDC2:												
Stephenville	0-3	10-20	1.40-1.65	2.00-6.00	0.13-0.19	0.0-2.9	0.5-1.0	.24	.24	3	3	86
	3-6	18-35	1.35-1.75	0.60-2.00	0.13-0.19	0.0-2.9	0.5-1.0	.32	.32			
	6-17	18-35	1.35-1.75	0.60-2.00	0.13-0.19	0.0-2.9	0.5-1.0	.32	.32			
	17-26	18-35	1.35-1.75	0.60-2.00	0.13-0.19	0.0-2.9	0.5-1.0	.32	.32			
	26-42	---	1.85-2.00	0.20-0.60	---	---	---	---	---			
Darsil	0-4	1-10	1.45-1.65	6.00-20.00	0.07-0.11	0.0-2.9	0.5-3.0	.17	.17	2	2	134
	4-15	1-10	1.50-1.75	6.00-20.00	0.04-0.11	0.0-2.9	0.0-0.5	.17	.17			
	15-20	---	1.85-2.00	0.20-2.00	---	---	---	---	---			
StLC4:												
Stephenville	0-6	10-20	1.40-1.65	2.00-6.00	0.13-0.19	0.0-2.9	0.5-1.0	.24	.24	2	3	86
	6-20	18-35	1.35-1.75	0.60-2.00	0.13-0.19	0.0-2.9	0.5-1.0	.32	.32			
	20-30	18-35	1.35-1.75	0.60-2.00	0.13-0.19	0.0-2.9	0.5-1.0	.32	.32			
	30-40	---	1.85-2.00	0.20-0.60	---	---	---	---	---			

Physical Properties of the Soils--Continued

Map symbol and soil name	Depth	Clay	Moist bulk density	Permea-bility (Ksat)	Available water capacity	Linear extensi-bility	Organic matter	Erosion factors Kw	Kf	T	Wind erodi-bility group	Wind erodi-bility index
	In	Pct	g/cc	In/hr	In/in	Pct	Pct					
StLC4:												
Littleaxe	0-10	8-18	1.30-1.60	2.00-6.00	0.11-0.15	0.0-2.9	0.5-2.0	.24	.24	3	3	86
	10-24	18-35	1.50-1.70	0.60-2.00	0.11-0.17	0.0-2.9	0.0-1.0	.32	.32			
	24-42	18-35	1.50-1.70	0.60-2.00	0.11-0.17	0.0-2.9	0.0-1.0	.32	.32			
	42-52	14-30	1.50-1.70	0.60-6.00	0.11-0.17	0.0-2.9	0.0-1.0	.32	.32			
	52-56	---	1.85-2.00	0.20-2.00	---	---	---	---	---			
SUND:												
Stephenville	0-5	10-20	1.40-1.65	2.00-6.00	0.13-0.19	0.0-2.9	0.5-1.0	.24	.24	3	3	86
	5-9	5-15	1.40-1.70	2.00-20.00	0.07-0.19	0.0-2.9	0.0-0.5	.20	.20			
	9-22	18-35	1.35-1.75	0.60-2.00	0.13-0.19	0.0-2.9	0.5-1.0	.32	.32			
	22-28	18-35	1.35-1.75	0.60-2.00	0.13-0.19	0.0-2.9	0.5-1.0	.32	.32			
	28-35	---	1.85-2.00	0.20-0.60	---	---	---	---	---			
Urban land	0-60	---	---	0.06-2.00	0.00-0.00	---	---	---	---	---	---	---
Newalla	0-6	10-25	1.30-1.55	0.60-2.00	0.14-0.20	0.0-2.9	0.5-3.0	.49	.49	4	5	56
	6-11	20-35	1.30-1.70	0.60-2.00	0.14-0.20	0.0-2.9	0.5-1.0	.43	.43			
	11-34	40-60	1.30-1.60	0.00-0.06	0.12-0.18	6.0-8.9	0.0-0.5	.37	.37			
	34-58	40-60	1.30-1.60	0.00-0.06	0.12-0.18	6.0-8.9	0.0-0.5	.37	.37			
	58-72	---	1.85-2.00	0.00-0.06	---	---	---	---	---			
TevD:												
Teval	0-7	15-26	1.30-1.55	0.60-2.00	0.13-0.19	0.0-2.9	1.0-3.0	.37	.37	4	6	48
	7-11	18-30	1.40-1.70	0.60-2.00	0.13-0.20	0.0-2.9	1.0-3.0	.32	.32			
	11-20	18-34	1.40-1.70	0.60-2.00	0.13-0.20	0.0-2.9	0.5-1.0	.32	.32			
	20-38	18-34	1.40-1.70	0.60-2.00	0.13-0.20	0.0-2.9	0.5-1.0	.32	.32			
	38-50	5-30	1.40-1.70	2.00-20.00	0.03-0.17	0.0-2.9	0.0-1.0	.17	.32			
	50-96	2-20	1.40-1.70	2.00-20.00	0.03-0.17	0.0-2.9	0.0-1.0	.10	.28			
TevD2:												
Teval	0-5	15-26	1.30-1.55	0.60-2.00	0.13-0.19	0.0-2.9	1.0-3.0	.37	.37	4	6	48
	5-9	18-30	1.40-1.70	0.60-2.00	0.13-0.20	0.0-2.9	1.0-3.0	.32	.32			
	9-21	18-34	1.40-1.70	0.60-2.00	0.13-0.20	0.0-2.9	0.5-1.0	.32	.32			
	21-51	5-30	1.40-1.70	2.00-20.00	0.03-0.17	0.0-2.9	0.0-1.0	.17	.32			
	51-72	2-20	1.40-1.70	2.00-20.00	0.03-0.17	0.0-2.9	0.0-1.0	.10	.28			
TlrB:												
Teller	0-10	10-18	1.40-1.65	2.00-6.00	0.13-0.19	0.0-2.9	1.0-3.0	.24	.24	5	3	86
	10-18	18-30	1.30-1.70	0.60-2.00	0.14-0.20	0.0-2.9	0.5-1.0	.32	.32			
	18-29	18-30	1.30-1.70	0.60-2.00	0.14-0.20	0.0-2.9	0.5-1.0	.32	.32			
	29-38	18-30	1.30-1.70	0.60-2.00	0.14-0.20	0.0-2.9	0.5-1.0	.32	.32			
	38-47	18-30	1.30-1.70	0.60-2.00	0.14-0.20	0.0-2.9	0.5-1.0	.32	.32			
	47-84	10-20	1.30-1.70	2.00-6.00	0.13-0.20	0.0-2.9	0.5-1.0	.32	.32			
TlrC:												
Teller	0-12	10-18	1.40-1.65	2.00-6.00	0.13-0.19	0.0-2.9	1.0-3.0	.24	.24	5	3	86
	12-17	18-30	1.30-1.70	0.60-2.00	0.14-0.20	0.0-2.9	0.5-1.0	.32	.32			
	17-33	18-30	1.30-1.70	0.60-2.00	0.14-0.20	0.0-2.9	0.5-1.0	.32	.32			
	33-46	18-30	1.30-1.70	0.60-2.00	0.14-0.20	0.0-2.9	0.5-1.0	.32	.32			
	46-57	18-30	1.30-1.70	0.60-2.00	0.14-0.20	0.0-2.9	0.5-1.0	.32	.32			
	57-79	10-20	1.30-1.70	2.00-6.00	0.13-0.20	0.0-2.9	0.5-1.0	.32	.32			
TlrC2:												
Teller	0-10	10-18	1.40-1.65	2.00-6.00	0.14-0.19	0.0-2.9	1.0-3.0	.32	.32	5	3	86
	10-17	18-30	1.30-1.70	0.60-2.00	0.14-0.20	0.0-2.9	0.5-1.0	.32	.32			
	17-33	18-30	1.30-1.70	0.60-2.00	0.14-0.20	0.0-2.9	0.5-1.0	.32	.32			
	33-50	18-30	1.30-1.70	0.60-2.00	0.14-0.20	0.0-2.9	0.5-1.0	.32	.32			
	50-74	18-30	1.30-1.70	0.60-2.00	0.14-0.20	0.0-2.9	0.5-1.0	.32	.32			
	74-84	10-20	1.30-1.70	2.00-6.00	0.13-0.20	0.0-2.9	0.5-1.0	.32	.32			

Physical Properties of the Soils--Continued

Map symbol and soil name	Depth	Clay	Moist bulk density	Permea- bility (Ksat)	Available water capacity	Linear extensi- bility	Organic matter	Erosion factors Kw	Kf	T	Wind erodi- bility group	Wind erodi- bility index
	In	Pct	g/cc	In/hr	In/in	Pct	Pct					
TlrD:												
Teller----------------	0-12	10-18	1.40-1.65	2.00-6.00	0.14-0.19	0.0-2.9	1.0-3.0	.32	.32	5	3	86
	12-17	18-30	1.30-1.70	0.60-2.00	0.14-0.20	0.0-2.9	0.5-1.0	.32	.32			
	17-30	18-30	1.30-1.70	0.60-2.00	0.14-0.20	0.0-2.9	0.5-1.0	.32	.32			
	30-48	18-30	1.30-1.70	0.60-2.00	0.14-0.20	0.0-2.9	0.5-1.0	.32	.32			
	48-60	18-30	1.30-1.70	0.60-2.00	0.14-0.20	0.0-2.9	0.5-1.0	.32	.32			
	60-79	10-20	1.30-1.70	2.00-6.00	0.13-0.20	0.0-2.9	0.5-1.0	.32	.32			
TlUD:												
Teller----------------	0-11	10-18	1.40-1.65	2.00-6.00	0.13-0.19	0.0-2.9	1.0-3.0	.24	.24	5	3	86
	11-17	10-20	1.30-1.70	2.00-6.00	0.13-0.20	0.0-2.9	1.0-3.0	.32	.32			
	17-27	18-30	1.30-1.70	0.60-2.00	0.14-0.20	0.0-2.9	0.5-1.0	.32	.32			
	27-43	18-30	1.30-1.70	0.60-2.00	0.14-0.20	0.0-2.9	0.5-1.0	.32	.32			
	43-58	10-20	1.30-1.70	2.00-6.00	0.13-0.20	0.0-2.9	0.5-1.0	.32	.32			
	58-74	10-20	1.30-1.70	2.00-6.00	0.13-0.20	0.0-2.9	0.5-1.0	.32	.32			
Urban land------------	0-79	---	---	0.06-2.00	0.00-0.00	---	---	---	---	---	---	---
TriA:												
Tribbey---------------	0-8	10-18	1.40-1.65	2.00-6.00	0.13-0.19	0.0-2.9	0.5-1.0	.24	.24	5	3	86
	8-15	10-18	1.65-1.75	2.00-6.00	0.07-0.20	0.0-2.9	0.0-0.5	.24	.24			
	15-62	5-18	1.35-1.75	2.00-6.00	0.07-0.20	0.0-2.9	0.0-0.5	.24	.24			
	62-80	15-30	1.35-1.70	0.60-6.00	0.13-0.20	0.0-2.9	0.0-0.0	.24	.24			
URB:												
Urban land------------	0-80	---	---	0.06-2.00	0.00-0.00	---	---	---	---	---	---	---
VanA:												
Vanoss----------------	0-8	15-26	1.30-1.50	0.60-2.00	0.15-0.24	0.0-2.9	1.0-3.0	.37	.37	5	5	56
	8-14	18-30	1.40-1.70	0.60-2.00	0.15-0.24	3.0-5.9	0.5-2.0	.32	.32			
	14-30	27-35	1.45-1.70	0.60-2.00	0.15-0.22	3.0-5.9	0.5-1.0	.32	.32			
	30-39	27-35	1.45-1.70	0.60-2.00	0.15-0.22	3.0-5.9	0.5-1.0	.32	.32			
	39-59	18-35	1.40-1.70	0.60-2.00	0.15-0.24	3.0-5.9	0.5-1.0	.32	.32			
	59-76	18-35	1.40-1.70	0.60-2.00	0.11-0.17	0.0-2.9	0.0-1.0	.32	.32			
VanB:												
Vanoss----------------	0-8	15-26	1.30-1.50	0.60-2.00	0.15-0.24	0.0-2.9	1.0-3.0	.37	.37	5	5	56
	8-14	18-30	1.40-1.70	0.60-2.00	0.15-0.24	3.0-5.9	0.5-2.0	.32	.32			
	14-19	18-30	1.40-1.70	0.60-2.00	0.15-0.24	3.0-5.9	0.5-2.0	.32	.32			
	19-33	27-35	1.45-1.70	0.60-2.00	0.15-0.22	3.0-5.9	0.5-1.0	.32	.32			
	33-52	10-35	1.40-1.70	0.60-2.00	0.11-0.24	0.0-2.9	0.5-1.0	.32	.32			
	52-80	18-35	1.40-1.70	0.60-2.00	0.11-0.17	0.0-2.9	0.0-1.0	.32	.32			
W:												
Water.												
WauA:												
Waurika---------------	0-10	15-25	1.30-1.50	0.60-2.00	0.16-0.24	0.0-2.9	1.0-3.0	.49	.49	5	6	48
	10-13	15-25	1.30-1.60	0.60-2.00	0.15-0.20	0.0-2.9	0.5-1.0	.49	.49			
	13-38	40-60	1.35-1.60	0.00-0.06	0.10-0.17	6.0-8.9	1.0-2.0	.37	.37			
	38-69	30-50	1.40-1.70	0.06-0.20	0.10-0.19	6.0-8.9	0.0-1.0	.37	.37			
	69-84	30-50	1.35-1.70	0.00-0.20	0.10-0.19	3.0-8.9	0.0-1.0	.43	.43			
WtgA:												
Watonga---------------	0-9	40-60	1.25-1.45	0.00-0.06	0.12-0.18	6.0-8.9	1.0-3.0	.37	.37	5	4	86
	9-25	40-60	1.25-1.45	0.00-0.06	0.12-0.22	9.0-25.0	1.0-3.0	.37	.37			
	25-42	35-60	1.35-1.70	0.00-0.06	0.12-0.20	9.0-25.0	0.5-2.0	.37	.37			
	42-80	35-50	1.35-1.70	0.00-0.06	0.12-0.20	6.0-8.9	0.5-1.0	.37	.37			

Physical Properties of the Soils--Continued

Map symbol and soil name	Depth	Clay	Moist bulk density	Permea-bility (Ksat)	Available water capacity	Linear extensi-bility	Organic matter	Erosion factors Kw	Kf	T	Wind erodi-bility group	Wind erodi-bility index
	In	Pct	g/cc	In/hr	In/in	Pct	Pct					
WuUA:												
Watonga	0-13	40-60	1.25-1.45	0.00-0.06	0.12-0.18	6.0-8.9	1.0-3.0	.37	.37	5	4	86
	13-34	40-60	1.25-1.45	0.00-0.06	0.12-0.22	9.0-25.0	1.0-3.0	.37	.37			
	34-54	35-60	1.35-1.70	0.00-0.06	0.12-0.20	9.0-25.0	0.5-2.0	.37	.37			
	54-80	35-50	1.35-1.70	0.00-0.06	0.12-0.20	6.0-8.9	0.5-1.0	.37	.37			
Urban land	0-80	---	---	0.06-2.00	0.00-0.00	---	---	---	---	---	---	---
YaGA:												
Yahola	0-10	10-18	1.40-1.65	2.00-6.00	0.13-0.19	0.0-2.9	0.5-1.0	.20	.20	5	3	86
	10-24	5-18	1.30-1.70	2.00-6.00	0.13-0.20	0.0-2.9	0.0-0.5	.32	.32			
	24-42	5-18	1.30-1.70	2.00-6.00	0.13-0.20	0.0-2.9	0.0-0.5	.32	.32			
	42-79	5-18	1.30-1.70	2.00-6.00	0.07-0.19	0.0-2.9	0.0-0.5	.32	.32			
Gaddy	0-8	10-18	1.30-1.60	2.00-6.00	0.11-0.15	0.0-2.9	0.0-0.5	.20	.20	5	3	86
	8-21	5-35	1.50-1.70	6.00-20.00	0.06-0.10	0.0-2.9	0.5-1.0	.17	.17			
	21-80	5-35	1.50-1.70	6.00-20.00	0.06-0.10	0.0-2.9	0.5-1.0	.17	.17			
YahA:												
Yahola	0-6	10-18	1.40-1.65	2.00-6.00	0.13-0.19	0.0-2.9	0.5-1.0	.20	.20	5	3	86
	6-11	5-18	1.30-1.70	2.00-6.00	0.13-0.20	0.0-2.9	0.0-0.5	.32	.32			
	11-71	5-18	1.30-1.70	2.00-6.00	0.07-0.19	0.0-2.9	0.0-0.5	.32	.32			
	71-96	5-18	1.30-1.70	2.00-6.00	0.07-0.19	0.0-2.9	0.0-0.5	.32	.32			
YaUA:												
Yahola	0-4	10-18	1.30-1.55	2.00-6.00	0.13-0.20	0.0-2.9	0.5-1.0	.32	.32	5	5	56
	4-22	5-18	1.30-1.70	2.00-6.00	0.13-0.20	0.0-2.9	0.0-0.5	.32	.32			
	22-48	5-18	1.30-1.70	2.00-6.00	0.13-0.20	0.0-2.9	0.0-0.5	.32	.32			
	48-80	5-18	1.30-1.70	2.00-6.00	0.07-0.19	0.0-2.9	0.0-0.5	.32	.32			
Urban land	0-80	---	---	0.06-2.00	0.00-0.00	---	---	---	---	---	---	---
ZanB:												
Zaneis	0-9	15-26	1.30-1.60	0.60-2.00	0.15-0.20	0.0-2.9	1.0-3.0	.37	.37	4	5	56
	9-14	18-30	1.40-1.70	0.60-2.00	0.12-0.20	0.0-2.9	0.5-2.0	.37	.37			
	14-35	20-38	1.45-1.70	0.20-0.60	0.12-0.20	3.0-5.9	0.5-1.0	.32	.32			
	35-54	20-38	1.45-1.70	0.20-0.60	0.12-0.20	3.0-5.9	0.5-1.0	.32	.32			
	54-59	18-30	1.40-1.70	0.60-2.00	0.11-0.20	0.0-2.9	0.5-1.0	.32	.32			
	59-72	---	1.85-2.00	0.00-0.20	---	---	---	---	---			
ZanC:												
Zaneis	0-12	15-26	1.30-1.60	0.60-2.00	0.15-0.20	0.0-2.9	1.0-3.0	.37	.37	4	5	56
	12-19	18-30	1.40-1.70	0.60-2.00	0.12-0.20	0.0-2.9	0.5-2.0	.37	.37			
	19-31	20-38	1.45-1.70	0.20-0.60	0.12-0.20	3.0-5.9	0.5-1.0	.32	.32			
	31-48	20-38	1.45-1.70	0.20-0.60	0.12-0.20	3.0-5.9	0.5-1.0	.32	.32			
	48-59	18-30	1.40-1.70	0.60-2.00	0.11-0.20	0.0-2.9	0.5-1.0	.32	.32			
	59-65	---	1.85-2.00	0.00-0.20	---	---	---	---	---			
ZanC2:												
Zaneis	0-12	15-26	1.30-1.60	0.60-2.00	0.15-0.20	0.0-2.9	1.0-3.0	.37	.37	4	5	56
	12-30	18-30	1.40-1.70	0.60-2.00	0.12-0.20	0.0-2.9	0.5-2.0	.37	.37			
	30-40	20-38	1.45-1.70	0.20-0.60	0.12-0.20	3.0-5.9	0.5-1.0	.32	.32			
	40-47	18-30	1.40-1.70	0.60-2.00	0.11-0.20	0.0-2.9	0.5-1.0	.32	.32			
	47-55	18-30	1.40-1.70	0.60-2.00	0.11-0.20	0.0-2.9	0.5-1.0	.32	.32			
	55-65	---	1.85-2.00	0.00-0.20	---	---	---	---	---			

Table 4-1.
Values for topographic factor, LS, for low ratio of rill to interrill erosion.[1]

Slope (%)	Horizontal slope length (ft)																
	<3	6	9	12	15	25	50	75	100	150	200	250	300	400	600	800	1000
0.2	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
0.5	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09
1.0	0.12	0.12	0.12	0.12	0.12	0.13	0.13	0.14	0.14	0.15	0.15	0.15	0.15	0.16	0.16	0.17	0.17
2.0	0.20	0.20	0.20	0.20	0.20	0.21	0.23	0.25	0.26	0.27	0.28	0.29	0.30	0.31	0.33	0.34	0.35
3.0	0.26	0.26	0.26	0.26	0.26	0.29	0.33	0.36	0.38	0.40	0.43	0.44	0.46	0.48	0.52	0.55	0.57
4.0	0.33	0.33	0.33	0.33	0.33	0.36	0.43	0.46	0.50	0.54	0.58	0.61	0.63	0.67	0.74	0.78	0.82
5.0	0.38	0.38	0.38	0.38	0.38	0.44	0.52	0.57	0.62	0.68	0.73	0.78	0.81	0.87	0.97	1.04	1.10
6.0	0.44	0.44	0.44	0.44	0.44	0.50	0.61	0.68	0.74	0.83	0.90	0.95	1.00	1.08	1.21	1.31	1.40
8.0	0.54	0.54	0.54	0.54	0.54	0.64	0.79	0.90	0.99	1.12	1.23	1.32	1.40	1.53	1.74	1.91	2.05
10.0	0.60	0.63	0.65	0.66	0.68	0.81	1.03	1.19	1.31	1.51	1.67	1.80	1.92	2.13	2.45	2.71	2.93
12.0	0.61	0.70	0.75	0.80	0.83	1.01	1.31	1.52	1.69	1.97	2.20	2.39	2.56	2.85	3.32	3.70	4.02
14.0	0.63	0.76	0.85	0.92	0.98	1.20	1.58	1.85	2.08	2.44	2.73	2.99	3.21	3.60	4.23	4.74	5.18
16.0	0.65	0.82	0.94	1.04	1.12	1.38	1.85	2.18	2.46	2.91	3.28	3.60	3.88	4.37	5.17	5.82	6.39
20.0	0.68	0.93	1.11	1.26	1.39	1.74	2.37	2.84	3.22	3.85	4.38	4.83	5.24	5.95	7.13	8.10	8.94
25.0	0.73	1.05	1.30	1.51	1.70	2.17	3.00	3.63	4.16	5.03	5.76	6.39	6.96	7.97	9.65	11.04	12.26
30.0	0.77	1.16	1.48	1.75	2.00	2.57	3.60	4.40	5.06	6.18	7.11	7.94	8.68	9.99	12.19	14.04	15.66
40.0	0.85	1.36	1.79	2.17	2.53	3.30	4.73	5.84	6.78	8.37	9.71	10.91	11.99	13.92	17.19	19.96	22.41
50.0	0.91	1.52	2.06	2.54	3.00	3.95	5.74	7.14	8.33	10.37	12.11	13.65	15.06	17.59	21.88	25.55	28.82
60.0	0.97	1.67	2.29	2.86	3.41	4.52	6.63	8.29	9.72	12.16	14.26	16.13	17.84	20.92	26.17	30.68	34.71

[1]Such as for rangeland and other consolidated soil conditions with cover (applicable to thawing soil where both interrill and rill erosion are significant).

Reference: USDA, Predicting Soil Erosion by Water: A guide to Conservation Planning with the Revised Universal Soil Loss Equation (RUSLE), Agricultural Research Service, Agriculture Handbook Number 703, 1997.

TABLE 10.—*Factor* **C** *for permanent pasture, range, and idle land*[1]

Vegetative canopy: Type and height[2]	Percent cover[3]	Type[4]	0	20	40	60	80	95+
			Cover that contacts the soil surface — Percent ground cover					
No appreciable canopy		G	0.45	0.20	0.10	0.042	0.013	0.003
		W	.45	.24	.15	.091	.043	.011
Tall weeds or short brush with average drop fall height of 20 in	25	G	.36	.17	.09	.038	.013	.003
		W	.36	.20	.13	.083	.041	.011
	50	G	.26	.13	.07	.035	.012	.003
		W	.26	.16	.11	.076	.039	.011
	75	G	.17	.10	.06	.032	.011	.003
		W	.17	.12	.09	.068	.038	.011
Appreciable brush or bushes, with average drop fall height of 6½ ft	25	G	.40	.18	.09	.040	.013	.003
		W	.40	.22	.14	.087	.042	.011
	50	G	.34	.16	.08	.038	.012	.003
		W	.34	.19	.13	.082	.041	.011
	75	G	.28	.14	.08	.036	.012	.003
		W	.28	.17	.12	.078	.040	.011
Trees, but no appreciable low brush. Average drop fall height of 13 ft	25	G	.42	.19	.10	.041	.013	.003
		W	.42	.23	.14	.089	.042	.011
	50	G	.39	.18	.09	.040	.013	.003
		W	.39	.21	.14	.087	.042	.011
	75	G	.36	.17	.09	.039	.012	.003
		W	.36	.20	.13	.084	.041	.011

Final
Cover (use 0.006)

Intermediate
Cover

[1] The listed **C** values assume that the vegetation and mulch are randomly distributed over the entire area.

[2] Canopy height is measured as the average fall height of water drops falling from the canopy to the ground. Canopy effect is inversely proportional to drop fall height and is negligible if fall height exceeds 33 ft.

[3] Portion of total-area surface that would be hidden from view by canopy in a vertical projection (a bird's-eye view).

[4] G: cover at surface is grass, grasslike plants, decaying compacted duff, or litter at least 2 in deep.

W: cover at surface is mostly broadleaf herbaceous plants (as weeds with little lateral-root network near the surface) or undecayed residues or both.

Reference: USDA, Predicting Rainfall Erosion Losses, A Guide to Conservation Planning, Agriculture Handbook Number 537, 1978.

Table 3 P Factors for Contouring, Contour Stripcropping and Terracing

Land Slope	P values	
%	Contouring†	Terracing†
2.0 to 7	0.50	0.50
8.0 to 12	0.60	0.60
13.0 to 18	0.80	0.80
19.0 to 24	0.90	0.90

(This table appeared in SCS (5), p.9)

† Contouring and terracing columns are suitable for MSWLF cover. Contour stripcropping is not suitable for the type of vegetative cover normally practiced at municipal landfills.

Table 4 Guide for Assigning Soil Loss Tolerance Values (T) to Solid Having Different Rooting Depths

Rooting Depth	Soil Loss Tolerance Values Annual Soil Loss - (Tons/Acre)
Inches	Non-Renewable Soil a/
10 - 20	1
20 - 40	2
40 - 50	3
50 - 60	4
60 +	< 5

(This table appears in SCS (6) p.4)

a/ Soils with unfavorable substrata such as rock or soft rock that cannot be renewed by economical means. Most of the MSWLF covers with constructed, or recompacted clay cap and/or flexible membrane should use this performance criteria.

HYDRAULIC ANALYSIS REFERENCES

Chapter 7

HYDROLOGY

ODOT ROADWAY DRAINAGE MANUAL

November 2014

frequency is the dominant factor. For larger drainage basins, the response characteristics control, for drainage basins with few imperious surfaces (less urban development), antecedent moisture conditions usually govern, especially for rainfall events with a return period of 10 years or less.

3. Runoff. The fraction of rainfall that becomes runoff (C) is independent of rainfall intensity or volume. This assumption is reasonable for impervious areas, such as streets, rooftops and parking lots. For pervious areas, the fraction of runoff varies with rainfall intensity and the accumulated volume of rainfall. Thus, the art necessary for application of the Rational Method involves the selection of a coefficient that is appropriate for the storm, soil and land use conditions.

4. Peak Rate. The peak rate of runoff is sufficient information for the decision. Modern drainage practice often includes detention of urban storm runoff to reduce the peak rate of runoff downstream. With only the peak rate of runoff, the Rational method severely limits the evaluation of design alternatives available in urban and in some instances, rural drainage design. The use of the Rational triangular hydrograph is not recommended in the design of the detention/retention pond.

7.6.4 Equation

The Rational equation estimates the peak rate of runoff at any location in a watershed as a function of the drainage area, runoff coefficient and mean rainfall intensity for a duration equal to the time of concentration (the time required for water to flow from the most remote point of the basin to the location being analyzed). The Rational equation is expressed as follows:

$$Q = C_f CIA \qquad \text{Equation 7.6(1)}$$

Where:

Q = maximum rate of runoff, cfs

C = runoff coefficient representing a ratio of runoff to rainfall

C_f = 1.0 for 10-year or less recurrence interval
1.1 for 25-year
1.2 for 50-year
1.25 for 100-year

I = average rainfall intensity for a duration equal to the time of concentration for a selected return period, in/hr

A = drainage area tributary to the design location, acres

Note: If the product of C_f and C is greater than 1.0, use 1.0 in equation 7.6(1).

7.6.6.3 Minimum Time of Concentration

ODOT has adopted the following for minimum time of concentration for the Rational method only:

- use a minimum t_c = 5 minutes for the densely populated, steep slopes (> 4%) urban areas; and
- use a minimum t_c = 10 minutes for rural areas or well-developed, flat slopes (< 1.00%) urban areas.

7.6.7 Rainfall Intensity

The rainfall intensity (I) is the average rainfall rate (in/hr) for a duration equal to the time of concentration (subject to the minimum time of concentration) for a selected return period. Once the return period has been selected for design and a time of concentration calculated for the drainage area, the rainfall intensity can be determined from Intensity-Duration-Frequency (IDF) curves. Oklahoma IDF curves for 8 zones (see Figure 7.6-G) were developed by Te Ngo (4). The report contains the data used and equations for each curve for each of the following zones:

- Zone 1 – 8 counties (Atoka, Bryan, Choctaw, Latimer, Leflore, McCurtain, Pittsburg and Pushmataha), see Figure 7.6-H
- Zone 2 – 6 counties (Adair, Cherokee, Haskell, McIntosh, Muskogee and Sequoyah), see Figure 7.6-I
- Zone 3 – 7 counties (Craig, Delaware, Mayes, Nowata, Ottawa, Rogers and Wagoner), see Figure 7.6-J
- Zone 4 – 18 counties (Creek, Garfield, Grant, Hughes, Kay, Kingfisher, Lincoln, Logan, Noble, Okfuskee, Okmulgee, Osage, Payne, Pawnee, Pottawatomie, Seminole, Tulsa and Washington), see Figure 7.6-K
- Zone 5 – 19 counties (Caddo, Canadian, Carter, Cleveland, Coal, Comanche, Cotton, Garvin, Grady, Jefferson, Johnston, Love, Marshall, McClain, Murray, Oklahoma, Pontotoc, Stephens and Tillman), see Figure 7.6-L
- Zone 6 – 10 counties (Beckham, Blaine, Custer, Dewey, Harmon, Jackson, Kiowa, Roger Mills and Washita), see Figure 7.6-M
- Zone 7 – 7 counties (Alfalfa, Beaver, Ellis, Harper, Major, Woods and Woodward), see Figure 7.6-N
- Zone 8 – 2 counties (Cimarron and Texas), see Figure 7.6-O

Type of Drainage Area	Runoff Coefficient (C)
Business:	
Downtown areas	0.70 – 0.95
Neighborhood areas	0.50 – 0.70
Residential:	
Single-family areas	0.30 – 0.50
Multi-units, detached	0.40 – 0.60
Multi-units, attached	0.60 – 0.75
Suburban	0.25 – 0.40
Apartment dwelling areas	0.50 – 0.70
Industrial:	
Light areas	0.50 – 0.80
Heavy areas	0.60 – 0.90
Parks, cemeteries	0.10 – 0.25
Playground	0.20 – 0.40
Railroad yard areas	0.20 – 0.40
Unimproved areas	0.10 – 0.30
Lawns: Steep Grased Area	0.7
Sandy soil, flat (< 2%)	0.05 – 0.10
Sandy soil, average (2% to 7%)	0.10 – 0.15
Sandy soil, steep (> 7%)	0.15 – 0.20
Heavy soil, flat (< 2%)	0.13 – 0.17
Heavy soil, average (2% to 7%)	0.18 – 0.22
Heavy soil, steep (> 7%)	0.25 – 0.35
Agricultural land:	
Bare, packed soil, smooth	0.30 – 0.60
Bare, packed soil, rough	0.20 – 0.50
Cultivated rows:	
Heavy soil, no crop	0.30 – 0.60
Heavy soil, with crop	0.20 – 0.50
Sandy soil, no crop	0.20 – 0.40
Sandy soil, with crop	0.10 – 0.25
Pasture:	
Heavy soil	0.15 – 0.45
Sandy soil	0.05 – 0.25
Woodland	0.05 – 0.25
Streets:	
Asphalt	0.70 – 0.95
Concrete	0.80 – 0.95
Brick	0.70 – 0.85
Drives and walks	0.75 – 0.85
Roofs	0.75 – 0.95

Source: FHWA HDS 2 (2)

Note: Use lower values for large areas; use higher values for steep slope.

Figure 7.6-A — RUNOFF COEFFICIENTS FOR THE RATIONAL EQUATION

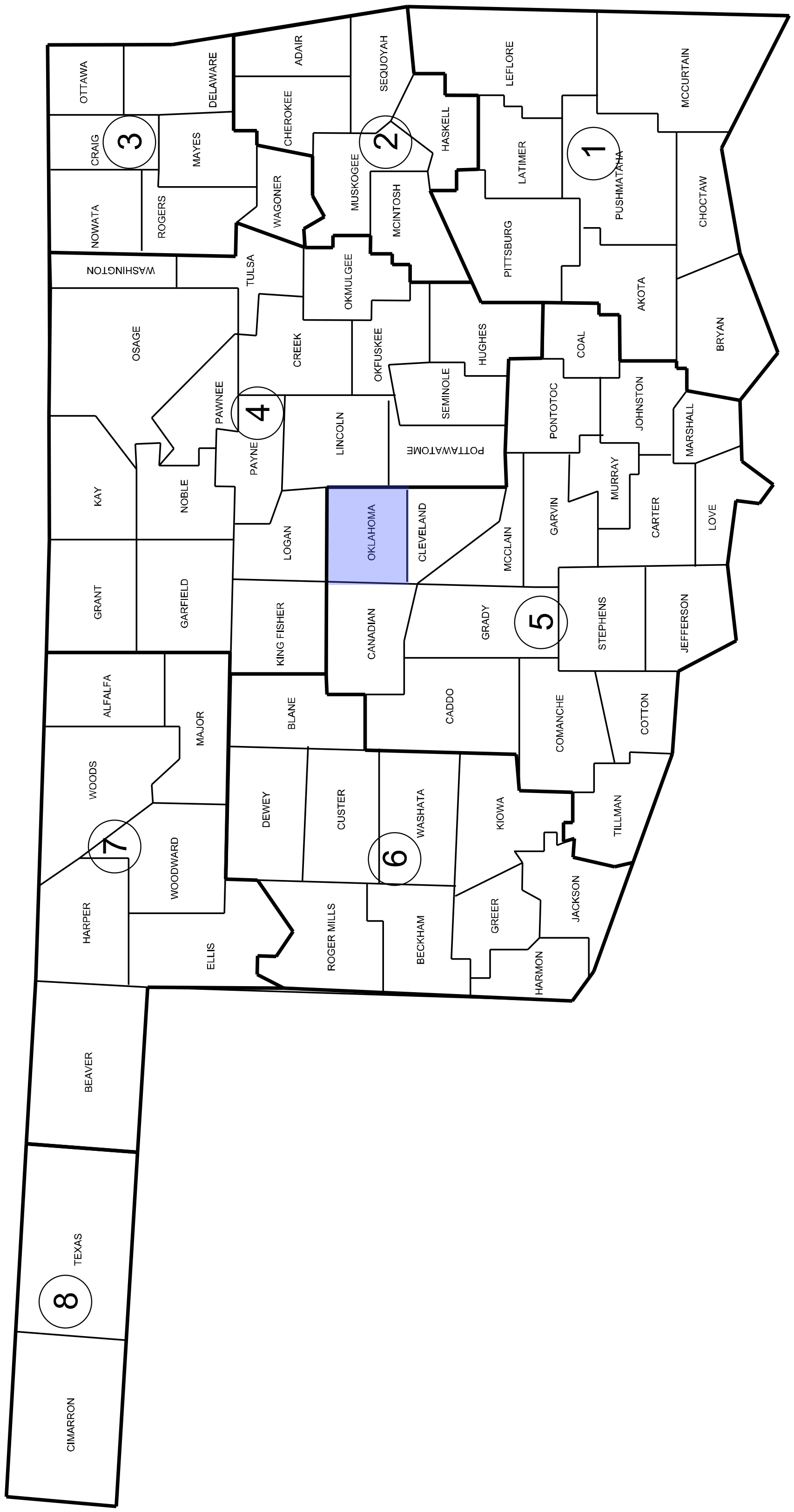
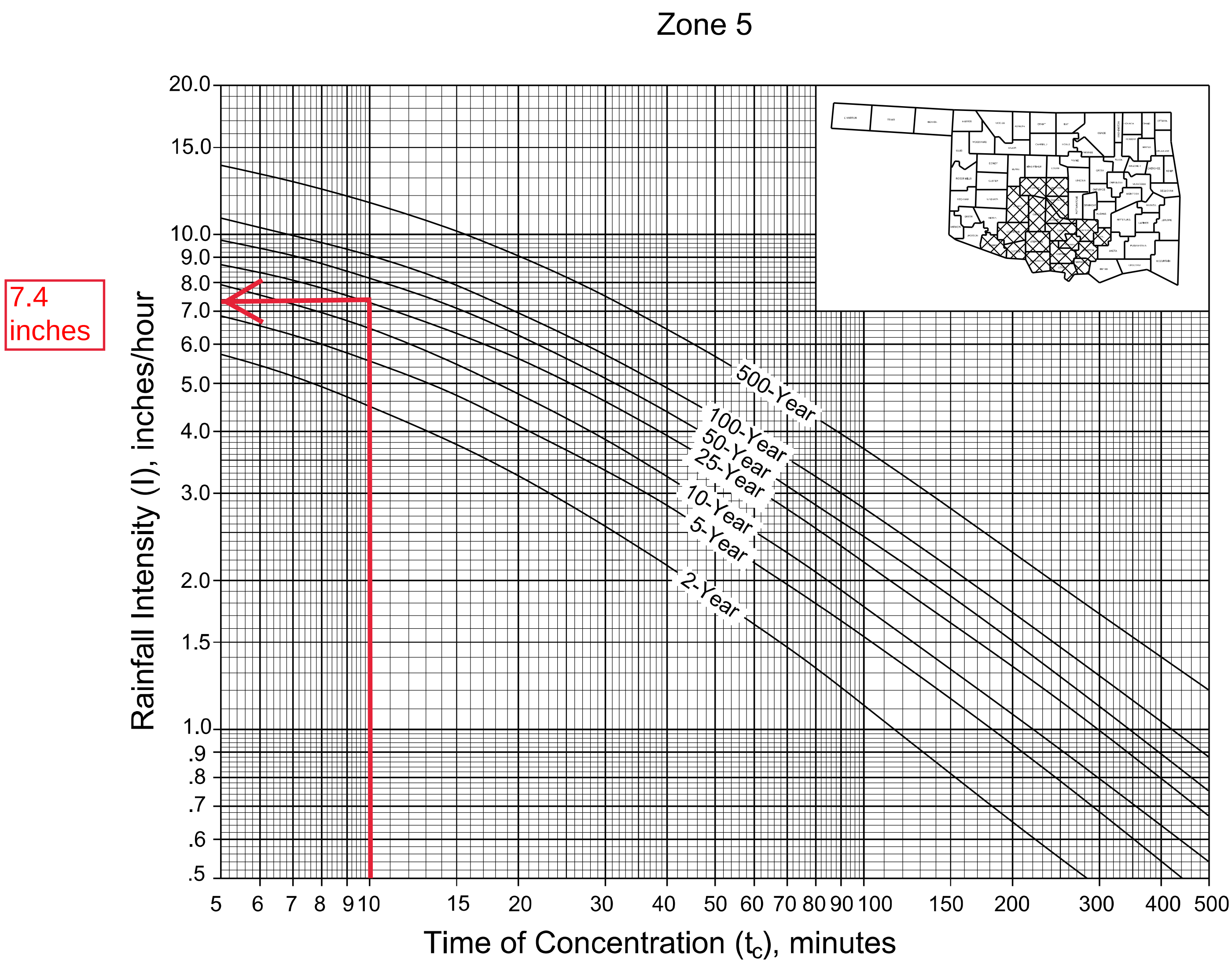


Figure 7.6-G — IDF CURVE ZONES IN OKLAHOMA



Source: (4)

Figure 7.6-L — ZONE 5 IDF CURVE (Caddo, Canadian, Carter, Cleveland, Coal, Comanche, Cotton, Garvin, Grady, Jefferson, Johnston, Love, Marshall, McClain, Murray, Oklahoma, Pontotoc, Stephens and Tillman Counties)

Appendix F

Construction Quality Assurance/Quality Control Plan

NORTHEAST LANDFILL, INC.
PERMIT NUMBER 3555050

Construction Quality Assurance/ Quality Control Plan

Prepared by:
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405-842-1066

December 2008

TABLE OF CONTENTS

I. INTRODUCTION

This Construction Quality Assurance/Quality Control (CQA/QC) document is to ensure that the construction of cells at the Northeast Landfill Facility comply with the Oklahoma Department of Environmental Quality (ODEQ) regulations. The document is structured so that both construction and regulatory personnel can refer to it to determine proper CQA. The document discusses the project organization and the responsibilities of the various personnel, describes the qualifications for each position and defines the inspection activities associated with the project. Finally, it details the documentation required to provide evidence of adherence to this plan. When the various components of this plan are combined, the resulting efforts should produce a well constructed and operational project.

II. ORGANIZATION

The Construction Manager is ultimately responsible for all activities associated with the successful construction of the landfill and closure cap. The construction quality control and assurance are carried out by individuals who function independently of each other, both of whom report to the Construction Manager. These individuals include the Construction Quality Control (CQC) Officer and the Construction Quality Assurance (CQA) Officer.

The Construction Manager may serve as the CQC Officer. The CQC Officer will be responsible for overseeing the CQC personnel and supplying the CQA Officer with all CQC documentation. The

CQC personnel, which include the soils laboratory, the surveyor, and the liner installer's off- site laboratory, will report to the CQC Officer. The CQC personnel will be responsible for conducting the various tests and observations within their assigned areas as specified in the CQA/CQC plan, for documenting those tests, and for reporting and reviewing the test results with the CQA personnel.

The CQA Officer or designate will ensure that all observation and testing activities required to ensure compliance with the plans and the specifications defined herein are being carried out by the CQC personnel. The CQA Officer will ensure that the designated frequency of testing is being accomplished and that all aspects of the CQA/CQC plan are being carried out. The primary responsibility of the CQA Officer will be to review the documentation obtained by the CQC personnel. The CQA Officer has the authority to stop work and require correction of any aspect of the work which is not in compliance with the CQA/CQC Plan. The CQA Officer may designate another individual to assume CQA responsibilities.

III. RESPONSIBILITIES

Construction Manager: The Construction Manager will ensure that the cell design, specifications, and CQA/CQC plan fulfill all ODEQ regulations. He will provide the relevant regulations to the CQA Officer prior to project initiation. He will function as an advisor to the CQA Officer and will advise him of any regulatory problems he may identify during construction.

CQC Officer: The CQC Officer will be responsible for the overall construction of the project.

The CQA Officer or Construction Manager will provide him with the relevant ODEQ regulations. The CQC Officer will coordinate various project inspection and testing activities. He will supervise the CQC personnel.

CQA Officer: The CQA Officer will be responsible for reviewing the project design and specifications to ensure compliance with the CQA/CQC plan. He will ensure that inspection and testing activities during construction fulfills the CQA/CQC plan. Finally, he will be responsible for reviewing all test results to ensure compliance with the plan.

Laboratories: The laboratories will be responsible for performing their respective testing of clay liner materials and protective cover layers at the frequency required in the CQA/CQC plan.

Surveyor: The surveyor will be responsible for measuring, recording and reporting to the Construction Manager; the constructed cell elevations and liner thickness. It is the Surveyors responsibility to ensure that the cell is constructed to the specified tolerance, and that the recompacted soil liner is the specified thickness.

IV. QUALIFICATIONS

Individuals responsible for the CQA plan will possess the following qualifications.

1. Construction Manager
   a. Undergraduate engineering degree
   b. Three years of experience in the waste management industry

c. Three years of construction/supervisory experience

2. CQA Officer
    a. Two years of construction management
    b. Two years of project inspection or management

3. Surveyor
    a. Registered land surveyor in State of Oklahoma

4. Soils Laboratory
    a. Necessary equipment and personnel to conduct required testing

V. INSPECTION ACTIVITIES

Appendix A details the inspection activities and describes the activities of the CQC and CQA Officer.

VI. PROJECT MEETINGS

Meetings may be held periodically during the project to enhance communications between personnel responsible for design, inspection, and construction of the project. These meetings may include a preconstruction meeting and weekly or monthly meetings.

VII. DOCUMENTATION

The Construction Manager will maintain the CQC records. The records will contain the CQC daily reports and all test data. These records will be maintained for prompt review by the CQA Officer and regulatory officials.

The CQC or CQA Officer will oversee the preparation of the "Liner Installation and Testing Report" upon project completion. The report will certify that the cell was constructed or closed in compliance with the design plans and specifications. The certification will be signed by a professional engineer registered in the State of Oklahoma. The CQA or CQC Officer will review and approve the final report. The "Liner Installation and Testing Report" will be submitted to for ODEQ approval.

Appendix A

Inspection Activities

APPENDIX A - LANDFILL CELL CONSTRUCTION AND CLOSURE INSPECTION ACTIVITIES

WORK ELEMENT	SPECIFICATIONS	CONSTRUCTION QUALITY CONTROL (CQC)	CONSTRUCTION QUALITY ASSURANCE (CQA)
PRECONSTRUCTION MEETING	The meeting will be attended by the Construction Manager, the CQC officer, the CQA officer, and the soils contractor. The Oklahoma Department Of Environmental Quality (ODEQ) will be invited to these meetings.	Conduct and/or attend the meeting.	Conduct and/or attend the meeting.
PERIODIC CONSTRUCTION MEETING	The meetings will be attended by the CQC officer, the CQA officer, and the Construction Manager. Project progress and CQA issues will be reviewed.	Conduct and/or attend the meeting.	Conduct and/or attend the meeting.
FOUNDATION PREPARATION	**CLEARING & GRUBBING:** Remove vegetation, debris, organic, or deleterious material from below areas to receive foundation material.	Observe the cleared and grubbed area when complete. Advise contractor of deficiencies. Record observations and corrective actions taken on "Daily Construction Report" (see Appendix B). Provide CQA officer with copies of "Daily Construction Report". Ensure that corrective actions required by CQA officer are accomplished.	Review reports generated by CQC personnel. Report deficiencies to CQC personnel. Countersign "Daily Construction Report" indicating documentation is adequate, correct, and has been accepted by CQA.
	SCARIFICATION & COMPACTION: Foundation area - Scarify to a depth of at least 6 inches and compact to ≥ 90%.	Conduct or supervise in-place density tests. Record approximate test location. Approve densities ≥90%. Require the soils contractor to bring the nonpassing area into compliance. Record all test results. Provide CQA officer with copies of the "Daily Construction Report".	Review density test results. Verify that densities in areas accepted are ≥90%. Report deficiencies to CQC personnel. Countersign the daily reports indicating documentation is adequate, correct, and has been accepted by CQA.

WORK ELEMENT	SPECIFICATIONS	CONSTRUCTION QUALITY CONTROL (CQC)	CONSTRUCTION QUALITY ASSURANCE (CQA)
		Conduct survey measurement at completion on a maximum 100 foot grid. Survey shall be conducted by a surveyor licensed in the state of Oklahoma. Surveyor shall indicate where the subgrade meets design line and grade. Deficiencies shall be noted by CQC personnel and rectified by the soils contractor. Once corrective action has been taken, the deficient area will be re-surveyed to verify line and grade. Final survey measurements will be documented and certified by the surveyor.	Review final survey data. Verify that the surveyor certified that the construction is to the specified line and grade. Report deficiencies (if any) to CQC personnel.
BORROW PREPARATION	Remove vegetation, debris, organic, or deleterious material from borrow areas.	Observe the borrow area once it has been cleared and grubbed. Advise contractor of deficiencies. Record observations and corrective actions taken on "Daily Construction Report". Provide CQA officer copies of "Daily Construction Report". Ensure that corrective actions required by CQA officer are accomplished.	Review the reports generated by CQC personnel. Report deficiencies to CQC personnel. Countersign "Daily Construction Report" indicating documentation is adequate, correct, and has been accepted by CQA.
CLAY LINER	BORROW: Satisfactory clay liner material is defined as soils or blended soils with a plasticity index ≥10%, a liquid limit ≥24%, a portion passing the #200 sieve ≥30%, a portion retained on the #4 sieve ≤20% and no particle	Collect clay sample initially and every 10,000 cubic yards and run the following tests: 1) Soils classification, ASTM D2487; 2) Particle size analysis, ASTM D422;	Review the reports generated by CQC personnel. Verify frequency of laboratory tests and compliance of test results. Report deficiencies (if any) to CQC personnel. Countersign "Daily Construction Report" indicating

WORK ELEMENT	SPECIFICATIONS	CONSTRUCTION QUALITY CONTROL (CQC)	CONSTRUCTION QUALITY ASSURANCE (CQA)
	size >1 inches, which meets the permeability requirements.	3) Sieve analysis-#4, #10, #40, #200; 4) Percent fines -#200, ASTM 1140; 5) Atterburg Limits, ASTM D4318; 6) Moisture Content ASTM D2216 or ASTM D4643; 7) Moisture Density, ASTM D698 or ASTM D1557; 8) Hydraulic Conductivity, ASTM D5084 or other method approved by ODEQ. Advise the contractor which materials may be used and which are unsuitable. Record compliance, deficiencies and corrective action in "Daily Construction Report." Provide CQA officer with copies of the "Daily Construction Report." Ensure that corrective actions required by CQA officer are accomplished.	documentation is adequate, correct, and has been accepted by CQA.
	CLAY LINER PLACEMENT: Prior to placement, the surface will be inspected, cleared of any foreign objects. The clay liner will be constructed in maximum six inch compacted lifts. Each lift shall be compacted to a minimum of 95% of the Standard Proctor Density. After compaction the moisture content shall be optimum or above the optimum.	Observe the clay liner placement. Conduct or supervise in-place moisture and density tests at a rate of 3/acre/lift. Testing is to be conducted according to the nuclear density method (ASTM D2922), the drive cylinder method (ASTM 2937), the rubber balloon method (ASTM D2167, the sand-cone method (ASTM D1356, the microwave drying method (ASTM D4643, or the conventional oven drying method (ASTM D2216). If the nuclear density method is used, the conventional oven drying method	Review density and moisture test results. 1. Verify the frequency of tests. 2. Verify that test results meet the specifications. 3. Verify that the moisture content in areas accepted are at or above the optimum moisture content.

WORK ELEMENT	SPECIFICATIONS	CONSTRUCTION QUALITY CONTROL (CQC)	CONSTRUCTION QUALITY ASSURANCE (CQA)
		shall be used once for every ten nuclear density tests.	
	The Clay Liner will be 36 inches thick with a permeability equal to or less than $1x10^{-5}$ cm/second.	Conduct or supervise laboratory permeability tests on the upper 12 inches at a rate of two per acre on the bottom and one per acre on the slopes. The test shall be performed on the upper twelve inches of finished liner according to ASTM D5084 and D1857, the sealed double ring infiltrometer test, or other method approved by ODEQ. Accept lots with moisture tests indicating a moisture content at or above the optimum moisture content. Accept lots with density tests of greater than 95% of the Standard Proctor Density. Accept lots with density tests of greater than 95% of the Standard Proctor Density. Accept lots with a permeability of equal to or less than 1×10^{-5} cm/sec. Require that the contractor bring the lot into compliance by reworking the lot, by removing and replacing the material, or by isolating and reworking the unacceptable portions of the lot. Retest all reworked areas. Record all results and corrective actions taken. Provide CQA officer with copies of the test results and "Daily Construction	Review the reports generated by CQC personnel. Report deficiencies (if any) to CQC personnel. Verify that corrective action has been taken (where required) and recorded on CQC "Daily Construction Report." Countersign "Daily Construction Report" indicating documentation is adequate, correct, and has been accepted by CQA.

WORK ELEMENT	SPECIFICATIONS	CONSTRUCTION QUALITY CONTROL (CQC)	CONSTRUCTION QUALITY ASSURANCE (CQA)
		Report."	
	To prevent the clay surface from drying, water will be applied to the clay surface as directed by the Construction Manager.	Observe clay liner surface for drying. Advise contractor of deficiencies. Record observations and corrective actions taken on the "Daily Construction Report." Provide CQA officer with copies of the "Daily Construction Report". Ensure that corrective actions required by CQA officer are accomplished.	Review the reports generated by CQC personnel. Report deficiencies (if any) to CQC personnel. Countersign "Daily Construction Report" indicating documentation is adequate, correct, and has been accepted by CQA.
	Final grading and finishing efforts on the surface of the clay liner shall leave the surface free from cracking, abrupt breaks in grade, rocks, cobbles, boulders, debris and other foreign materials that would damage the liner. The surface of the compacted clay liner shall be smooth, uniform, free from cracks into which a pencil barrel can be inserted and abrupt changes in grade. The clay liner may be approved in increments.	Observe the final clay surface. Advise contractor of deficiencies. Record observations and corrective actions taken on the "Daily Construction Report." Provide CQA officer with copies of the "Daily Construction Report". Ensure that corrective actions required by CQA officer are accomplished.	Review the reports. Report deficiencies (if any) to CQC personnel. Countersign "Daily Construction Reports" indicating documentation is adequate, correct, and has been accepted by CQA.
	Final grading shall be from zero to plus two tenths of a foot on the cell floor and zero to plus four tenths of a foot on the slope.	Conduct survey measurement at completion on a maximum 100 foot grid to verify liner thickness. Survey shall be conducted by a surveyor licensed in the state of Oklahoma. Surveyor shall indicate where the clay liner meets design line and grade. Deficiencies shall be noted by	Review final survey data. Verify that the surveyor certified that the construction is to the specified line and grade. Report deficiencies (if any) to CQC personnel.

WORK ELEMENT	SPECIFICATIONS	CONSTRUCTION QUALITY CONTROL (CQC)	CONSTRUCTION QUALITY ASSURANCE (CQA)
		CQC personnel and rectified by the soils contractor. Once corrective action has been taken, the deficient area will be re-surveyed to verify line and grade. Final survey measurements will be documented and certified by the surveyor.	
PROTECTIVE WASTE COVER	After construction the liner will be protected by a 12-inch soil protective layer. Satisfactory protective cover materials are defined as materials that will not penetrate the liner. No compaction or moisture requirements are specified for the protective cover. The grading tolerance limit for the surface of the protective cover is minus 1/10 ft. Grade for the protective cover will be established installing a minimum of five PVC grade poles per acre. After the grade for the cover has been checked and approved by CQC personnel, the poles must be removed.	Observe placement of protective cover. Verify that moisture content was maintained in the liner until placement of the protective cover. Verify that the required grading tolerance is achieved. Record observations and corrective actions taken on the "Daily Construction Report." Provide CQA officer with copies of the "Daily Construction Report". Ensure that corrective actions required by CQA officer are accomplished.	Review the reports generated by CQC personnel. Report deficiencies, if any, to CQC personnel. Countersign Daily Construction Report" indicating documentation is adequate, correct, and has been accepted by CQA.

Appendix G

Operations Plan

Appendix G
Operations Plan

Northeast C&D Landfill

Prepared for:

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405-495-0800

Prepared by:

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August 2023
File No. 16219107.00

TABLE OF CONTENTS AND CERTIFICATION PAGE

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Attachments

Certification

This Operations Plan has been prepared in accordance with good engineering practice, including consideration of industry standards and the requirements of the Oklahoma Department of Environmental Quality, as defined in the applicable sections of Oklahoma Administrative Code (OAC) 252:515-19, Parts 1, 3, 5, and 7.

Prepared by:

Sandeep Saraf, P.E.
Senior Project Manager
SCS Engineers

1.0 GENERAL INFORMATION

This Operations Plan (Plan) is intended to assist the Owner/Operator of the Northeast Landfill (landfill) in operating the facility in accordance with the solid waste permit documents and Oklahoma Administrative Code (OAC) Rules and Regulations as promulgated by the Oklahoma Department of Environmental Quality (DEQ).

This Plan will provides operational guidance for the landfill. Any reference to “Owner/Operator” in this Plan will mean the individual responsible for the facility on any given day or shift. The individual in responsible charge may assign operational tasks to various personnel. In addition, this Plan will be available to employees for reference to operations of the facility. It is the Owner/Operator’s responsibility to keep this information current. If changes to this Plan are to be made affecting the operations of the facility, then Owner/Operator will notify the DEQ within 5 working days prior to implementing the change.

1.1 OPERATING HOURS

The landfill will accept waste for disposal from 7:00 a.m. to 5:00 p.m. Monday through Friday and Saturday from 7:00 a.m. to 1:00 p.m. The landfill will be closed on Sundays. Daily operations of equipment necessary for compaction and covering waste will normally begin one hour prior to acceptance of waste and cease within one hour after closing the landfill each operating day.

1.2 TRAFFIC SIGNS

Signs may be posted at the landfill, as necessary, to facilitate proper traffic flow at the facility. These signs may include:

- Directions to active face of landfill;
- Speed limits; and
- Cautionary signs.

1.3 PERSONNEL

The operation of the landfill will be under the direction of a certified solid waste operator. The typical staffing level is listed below:

- Landfill Manager/Operator,
- Equipment Operators,
- Scale house Attendant, and
- General Laborers.

Staff will be modified as necessary to accommodate changes to operations or to meet increased waste flows, as necessary. A properly trained equipment operator or other landfill employee will be present at the working face of the landfill to observe the unloading of waste and to perform and document random inspections of the waste.

1.4 EQUIPMENT

The equipment to be used on the site will include, but not necessarily be limited to, the following (or equivalent):

- Dozer;
- Backhoe or excavator;
- Haul truck;
- Compactor; and
- Water truck.

Available equipment will be modified as necessary to accommodate changes in operations or waste flows. All equipment will receive mechanical service on a routine basis. Fire extinguishers will be provided on all landfill equipment.

The manufacturer's recommendations on equipment maintenance will be followed for each piece of landfill equipment. Regularly scheduled equipment maintenance is essential if the landfill equipment is to be dependable. In addition, at the end of each operating day, the equipment operator will remove trash that may be lodged in the operating portion of the equipment tracks or the compaction equipment.

1.5 ACCESS CONTROL

The existing and proposed C&D disposal areas are located in Spencer, Oklahoma, on North Midwest Boulevard and N.E. 23rd Street (State Highway 62). The landfill is accessed from Midwest Boulevard, which is located on the east side of the existing C&D landfill. Owner/Operator will continue using this entrance into the facility for accessing the proposed expansion area.

In accordance with OAC 252:515-19-32, artificial and/or natural barriers will be used to discourage unauthorized traffic and uncontrolled dumping. Access to the landfill is controlled by a lockable entrance gate and perimeter fence. A natural dense vegetation is present along the north property boundary, which will be maintained as much as practical and will provide a natural screening barrier and will discourage access to unauthorized traffic along the northern property boundary of the proposed C&D expansion area. Landfill personnel will place appropriate signs directing waste hauling vehicles to the working face of the disposal area. Scale house and other landfill operating personnel will prohibit any unauthorized access and will record all incidences of unauthorized access. At the conclusion of each operating day, the entrance gate will be locked to prohibit unauthorized vehicle access.

2.0 SOLID WASTE ACCEPTED/EXCLUDED

This section outlines accepted and excluded wastes, waste screening procedures, waste measuring requirements, and quantity limitation requirements which are applicable to the landfill under OAC 252:515.

2.1 WASTE ACCEPTANCE AND EXCLUSION

In accordance with OAC 252:515-1-2, the landfill will only accept C&D waste for disposal. Any waste that does not meet the criteria for acceptable waste for C&D will be rejected from disposal at this landfill. The following materials will be accepted at the landfill:

- Asbestos-free waste from construction and/or demolition projects that may include such materials as metals, concrete, brick, asphalt, glass, roofing materials, limited amounts of packing materials, sheetrock, or lumber;
- Wood waste that may include such materials as yard waste, lumber, woodchips, wood shavings, sawdust, plywood, tree limbs, or tree stumps;
- Yard waste that may include such materials as grass clippings, tree limbs, tree stumps, shrubbery, flowers, or other vegetative matter results from land clearing or landscaping operations; and
- Residential lead-based paint waste (dried and/or passing paint filter test according to testing procedures provided in Attachment D).

The following materials will not be accepted at the landfill:

- Municipal solid waste (MSW);
- Non-hazardous industrial solid waste (NHIW);
- Special waste;
- Regulated hazardous wastes;
- Regulated polychlorinated biphenyl (PCB) wastes;
- Radioactive wastes;
- Regulated untreated infectious biomedical wastes;
- Bulk or non-containerized liquid; and
- Friable and non-friable asbestos.

Waste will be visually screened at the scale house and/or working face to determine if the shipment contains acceptable waste. Shipments received at the facility will be rejected if the waste is not deemed acceptable. Shipments of waste entering the State of Oklahoma that are subsequently rejected will be removed from the State by those persons who transported the waste into the State.

Additional information such as sources of waste, amount received, transporters used, and any special handling or management practices to be employed will be recorded at the scale house and filed within the Site Operating Record. Detailed information on acceptable and unacceptable wastes; screening procedures; recordkeeping and reporting requirements; and training requirements associated with waste acceptance at the site is detailed in the facility's approved Waste Exclusion Plan (WEP), which will be maintained in the Site Operating Record.

2.2 WASTE SCREENING

The scale house attendant and/or equipment operators at the working face will be responsible for screening incoming waste to make certain that prohibited wastes are identified and handled properly. If the scale house attendant or other landfill staff refuses such wastes, they will inform customers of the proper disposal alternatives, such as directing them to local facilities that would accept those wastes. This practice is intended to avoid illegal dumping of refused wastes.

Personnel at the site will conduct routine procedures for the screening and removal of wastes which are not acceptable for receipt at the landfill for disposal. These procedures consist of both routine load screening procedures and random load inspections. Routine load screening procedures include:

- Identifying incoming vehicles by company and vehicle number. Any placards will be noted.
- Review of paperwork included with incoming wastes by the scale house attendant.
- Visually inspecting each load as it is pushed into the working face by operators trained to recognize unacceptable waste.
- Notifying the DEQ if unacceptable waste is discovered at the site by the end of the next working day. The Waste Exclusion Plan (see Appendix I) will be referenced for information to include with the notification.

Random load inspections will consist of:

- Conducting random inspections of incoming loads for unacceptable wastes at a frequency of a minimum of three random load inspections per month. Inspection of vehicles which contain uncompacted or open top loads will primarily occur at the scale house. Enclosed vehicles, such as commercial refuse vehicles, will be inspected at the working face. Loads will be visually observed for unacceptable waste when deposited at the working face by a landfill employee.
- Confirming records are maintained on all random inspections that are performed. Information maintained in the records will include, at a minimum, the company or person delivering the waste, type of vehicle, date and time, type of waste delivered, and person performing the inspection. These records will be maintained in the Site Operating Record of the facility.

Should a particular hauler or waste from a particular waste generator be suspected of being a source of prohibited waste, routine or planned inspections will be made of the suspected waste at a pull-off area near the truck scale. The facility's Waste Exclusion Plan (see Appendix I) will be referenced for waste screening training requirements as well as additional information regarding the waste screening procedures at the landfill.

2.3 WASTE MEASURING

The landfill personnel operate and maintain truck scales used to determine the weight of waste disposed at the landfill. A permanent record will continue to be made of the weight of all waste that is disposed of in the landfill. The scales will continue to be tested and certified annually in accordance with the requirements of the Oklahoma Department of Agriculture, Food, and Forestry (ODAFF) in accordance with OAC 252:515-19-33(a)(2).

In accordance with OAC 252:515-19-33(a)(3), if the scales are inoperative, tonnage will be estimated on a volume basis where one cubic yard of waste will be calculated to weigh one-third (1/3) ton.

In accordance with OAC 252:515-19-33(4), solid waste disposal fees will be collected and remitted to the DEQ, except for solid waste received from emergencies or other special events, with prior approval from the DEQ. Monthly reports will be filed in the operating record and submitted to the DEQ no later than the 15th of the month following the reporting period. A copy of the monthly and quarterly reporting forms to be submitted to the DEQ are included in Attachment A of this Plan. Copies of submitted forms should be maintained in the Site Operating Record.

2.4 LIMITATIONS ON WASTE RECEIVED

2.5 RECYCLING OPERATIONS

In accordance with OAC 252:515-19-39(a), the Owner/Operator will submit a recycling and salvaging plan to DEQ for approval prior to conducting any salvage and/or recycling operations at the landfill. Once approved, salvage and/or recycling activities will be conducted away from the working face of the landfill, in accordance with OAC 252:515-19-39(b).

3.0 SURVEY CONTROL

Horizontal and vertical control will continue to be maintained at the landfill in order to construct the landfill according to the approved permit documents. Permanent boundary markers designating horizontal and vertical control are already in place at the landfill with surveyed, permanently stamped, information. Evidence of permanent boundary markers placed by a registered land surveyor are shown on boundary survey drawing provided in Appendix A, which will be maintained in the facility's operating record.

Boundary markers have been established designating the 73.2-acre expansion property. In the event a boundary marker is damaged or destroyed, a registered land surveyor shall re-establish it.

Construction staking will be used to mark individual phases where waste is to be placed. Staking will be utilized during landfilling operations to maintain slopes and check filling elevations, as necessary. Stakes will generally be made of wood or some other suitable material for use on a landfill. Construction stakes and temporary benchmarks will be replaced during the landfill operations, as needed. The landfill will comply with the requirements of OAC 252:515-19-50, pertaining to slope limits, as discussed in Section 7.

If established benchmark or horizontal control markers are disturbed over the life of the facility, these markers shall be replaced or re-established by or under the supervision of a registered land surveyor.

4.0 WET WEATHER MANAGEMENT

Wet weather should not adversely impact landfill operations due to all-weather access roads. Throughout the landfill operation, adequate temporary landfill roads will be constructed to ensure access to the working face of the landfill during all weather conditions. Crushed stone, concrete rubble, masonry demolition debris, or other similar material will be delivered to the site on an as-needed basis for use in maintaining passable onsite access roads during wet weather. All onsite access roads will be maintained in a clean and safe condition. Site access roads will be regraded on an as-needed basis, to minimize depressions, ruts and potholes.

Soil material from the borrow area or an approved alternate daily cover (ADC) will be utilized to meet weekly cover requirements. A copy of approved ADC for the landfill is provided in Attachment B of this Operation Plan.

5.0 LANDFILLING PROCEDURES

5.1 LANDFILL PROGRESSION AND SEQUENCE OF FILL

Waste haulers will deposit waste in the area identified as the working face. The working face will be a sloped surface upon which the waste is compacted in layers. The waste will be compacted by the landfill compactor as it is spread on ground. The interior waste slopes of the working face will be no more than three feet horizontal to one foot vertical (3:1) and exterior waste slopes of the working face will be no more than four feet horizontal to one foot vertical (4:1) in accordance with OAC 252:515-19-50. The waste will be spread and compacted in lifts or layers as it is received, and will be compacted by multiple passes over the waste lift by a landfill compactor. The height of each waste lift will generally be between fifteen (15) feet to twenty (20) feet in height. The width of the working face will be kept as small as practical.

Waste placement will generally follow the area fill method, where waste will be placed in rows corresponding to the working face size and lift thickness. Waste will continue to be placed next to the previous day's waste placement until an established row length is reached. Another row will then start parallel to the previously constructed row. As the rows form lifts over each area, the top of each landfill lift will slope in such a manner to allow surface runoff to drain away from the working face. After a number of rows have been constructed (creating a lift), subsequent lifts will be constructed over previously placed lifts until the landfill final grades are achieved.

Waste will not be placed in areas where the presence of water would prohibit proper spreading and compaction of the waste.

5.1.1 Placement of Initial Layer of Waste

The landfill may begin placing waste in a new disposal phase upon completion of landfill construction and receipt of approval from the DEQ. Filling will begin at the lowest elevations of each phase and work toward higher elevations to prevent excess leachate generation. The initial lift of waste placed in a phase will be comprised of "select" waste that will not damage the liner system and will provide an additional protective layer against freeze/thaw effects. This lift of select waste will be comprised of waste which does not contain long, sharp objects, or bulky material. When placing this select waste lift, a compactor will not be used until a minimum of five feet of select waste has been placed over the protective cover layer. A dozer or other suitable equipment will be used to spread waste into the phase while operating on already-placed waste.

5.1.2 Storm Water Management

In accordance with OAC 252:515-19-38(a), solid waste will not be placed or allowed to enter, accidentally or otherwise, waters that communicate with waters of the state located outside the permit boundary. Surface water run-on onto the working face will be controlled using temporary diversion berms and ditches. Diversion berms will be constructed on the up-hill side of the working face to divert stormwater away from the working face. Additionally, to promote runoff and prevent ponding, the landfill cover will be graded and maintained to divert surface water away from the working face of the landfill.

6.0 COVER AND BORROW SOIL

6.1 WEEKLY COVER

Weekly soil cover or ADC will be applied at the end of each operating week, regardless of weather, as required by DEQ, to deter disease vectors, fires, odors, and blowing litter in accordance with OAC 252:515-19-51. The weekly soil cover material will consist of nominally compacted earthen material free of garbage, trash, or other unsuitable material. The minimum thickness of the weekly soil cover will be six inches. The frequency of weekly cover application may need to be increased in order to provide adequate control of disease vectors, fires, odors, blowing litter, or scavenging.

Waste that is received at the landfill that may cause a nuisance with blowing litter, dust, or odors will be covered immediately rather than waiting for cover at the end of the week.

6.2 INTERMEDIATE COVER

In accordance with OAC 252:515-19-52(a), intermediate cover will be applied over all disposal areas in the landfill that are not protected by final cover meeting the requirements of OAC 252:515-19-53 or managed with runoff control structures meeting the requirements of OAC 252:515-17-2(2). The intermediate cover will consist of 12 inches of nominally compacted earthen material free of garbage, trash, or other unsuitable materials.

The landfill may submit a permit modification to the DEQ to approve the use of an alternative intermediate cover, demonstrating the alternative is capable of controlling fires, odors, and blowing litter without presenting a threat to human health or the environment. If an alternative intermediate cover is approved by the DEQ for use at the landfill, this Plan will be revised to discuss the use of the approved alternate intermediate cover.

6.3 FINAL COVER

When the landfill has been filled to final waste elevations, the final cover will be constructed in accordance with OAC 252:515-19-53(a) and 252:515-19-53(b). Stormwater management structures will be constructed at the same time that the final cover is installed. The final cover at the landfill will be constructed in accordance with the Closure and Post-Closure Care (C-PC) Plan (Appendix I) and Final Cover QA/QC Plan (Attachment B in Appendix I). Cover system material conformance testing, general construction procedures, and testing requirements are included in the Final Cover QA/QC Plan.

A description of various final cover system options are provided in the C-PC Plan. At a minimum, the final cover system options will consist of a barrier layer component and a 12-inch erosion layer (topsoil). The erosion layer will be constructed to support vegetative growth.

To prevent ponding, the final cover gradient on top of the fill (as measured from the center of the fill area to the break in slope between the top and sides of the fill) shall be four (4) percent (25:1), unless otherwise approved by the DEQ. The final side slope gradient will not exceed twenty-five (25) percent (4:1). Final cover surface contours will be graded to prevent ponding water and erosion of fill areas.

The DEQ shall be notified in writing prior to the beginning of final closure of the facility or closure of a disposal cell. Closure activities will begin no later than 90 days after final receipt of wastes at the facility. Closure activities shall be completed within 180 days after closure activities are initiated. Extensions of the closure period may be granted by the DEQ if the Owner/Operator demonstrates that closure will, of necessity, take longer than 180 days and that all steps have been taken, and will continue to be taken, to prevent threats to human health or the environment from the cell or facility.

Upon closing the facility, a survey plat will be prepared by a registered professional land surveyor depicting, at a minimum, the following: final contours of the entire site; permit boundary and boundaries of the disposal areas; location of gas monitoring probes; location of groundwater monitoring wells; location of permanent surface drainage structures; aesthetic enhancements; and other relevant information. The facility's C-PC Plan will be referenced for additional information required for a Certification of Final Closure submittal.

6.4 VEGETATIVE COVER

Final cover vegetation will be effective, long-lasting, and capable of self-regeneration and plant succession. Vegetation will consist of species that are equal or equivalent to native vegetation during each season of the year. Permanent or interim vegetation will be established in areas that have been undisturbed for 90 days or more.

Vegetation will be established during the first possible growing season. Maintenance of the permanent vegetation will typically consist of protection, replanting, maintaining existing grades, repair of erosion damage, and mowing. After the seeds have sprouted, the site will inspect the slopes for areas with no grass or with thin grass. These areas will be reseeded, watered, and fertilized to establish an acceptable permanent vegetation layer. If there are areas where establishing vegetation is unsuccessful, an alternative plan will be developed. Deep-rooted plants, trees, or other similar vegetation will not be used as vegetative cover.

6.5 BORROW SOURCE

Borrow areas for the landfill will be located within the area to be developed for landfill disposal and/or imported from off-site sources as needed. On-site borrow areas which are no longer active or not planned for future construction of a disposal area will be reshaped and re-vegetated or otherwise reclaimed to blend with surrounding terrain within 180 days of the date the area ceased being used. On-site borrow areas will be maintained as outlined in the facility's current Storm Water Pollution Prevention Plan (SWPPP).

7.0 VECTORS AND AESTHETICS

7.1 VECTORS

In general, vectors are not expected to be present within C&D landfills due to the nature of the waste being disposed at the landfill. However, if a vector problem should arise, an assessment of the operating conditions will be made and necessary corrective actions will be implemented. If the vector problem persists after initial corrective action, a professional exterminator will be hired to mitigate the problem.

7.2 LITTER CONTROL

Windblown litter will be controlled by unloading waste to minimize scattering of waste; applying weekly soil cover during facility operation and as dictated by the nature of the waste; and the use of litter fences near the working face of the landfill.

Additionally, all landfill users will be required to adequately cover their loads to prevent blowing litter.

Landfill personnel will inspect the entire site and the approach roadways within one-half mile of the landfill entrance for litter at least once a week, and collect and dispose of litter at the working face of the landfill associated with the inspections.

8.0 ENVIRONMENTAL MONITORING

8.1 SURFACE WATER MONITORING

Surface water will be monitored in accordance with the facility's SWPPP. A copy of the SWPPP will be maintained within the Site Operating Record.

8.2 STORMWATER STRUCTURE MAINTENANCE

Stormwater drainage control structures will be constructed at the landfill in accordance with the Surface Water Management System Design Plan (Appendix E). These structures include perimeter drainage channels, downchutes (letdown channels), drainage swales, and detention basins. Routine maintenance will be conducted on these structures for proper operation. These drainage structures will be inspected in accordance with the facility's SWPPP. If erosion damage has occurred to a drainage structure, it will be repaired as soon as practical.

8.3 GROUNDWATER MONITORING

Groundwater will be monitored in accordance with the Groundwater Monitoring Plan, as described in Section 6 of the Hydrogeological and Geotechnical Investigation (Appendix B) for the site, and maintained in the Site Operating Record.

8.4 GAS MONITORING

Landfill gas will be monitored in accordance with the approved Explosive Gas Monitoring Plan (Appendix D) for the site. This plan and monitoring results will be maintained in the Site Operating Record.

9.0 AIR QUALITY

9.1 DUST CONTROL

Open burning of solid waste at the landfill will be prohibited in accordance with OAC 252:515-19-36(b). Additionally, in accordance with OAC 252:515-19-36(c), the landfill will be operated to prevent the discharge of visible fugitive dust emissions beyond the property boundaries. Fugitive dust emissions will not damage or interfere with the use of adjacent properties or cause air quality standards to be exceeded. Landfill personnel will spray water on haul roads using a water truck, as needed, when the landfill is in operation.

10.0 SAFETY

10.1 FIRES

Protection against fires will include providing fire extinguishers on landfill equipment and proper maintenance and cleaning of the equipment to remove trash that may be ignited by equipment exhaust.

Landfill personnel will be on alert for indication that an arriving load of solid waste may be smoldering or have the potential to ignite. If a smoking or smoldering load is observed, the solid waste will immediately be pushed or directed away from the active working face and spread out as much as possible. A thick layer of soil will then be spread over the solid waste and compacted to effectively smother the fire. The covered solid waste will be observed for several days, and if signs of smoke appear, more soil will be spread and compacted over the solid waste. It may be necessary to leave the "hot" solid waste covered for an extended period of time before incorporating it into the active working face.

If an area of the working face ignites or show signs of smoldering, the area will be excavated to ensure that all of the hot material is segregated from the active face. The excavated solid waste will be pushed as far as possible from the working face and coved with soil as described above.

10.2 EMERGENCY CONTACTS

In the event of an emergency at the landfill, personnel will dial 911 in order to direct the appropriate assistance to the site. Fire, police, and ambulance assistance is available to the site by dialing 911.

10.3 COMMUNICATION EQUIPMENT

All vehicles, including the compactor, will have a two-way radio capable of communicating with the landfill office. Telephone service is available at the landfill office and can be used for calling emergency personnel (fire, police, or ambulance) in the event of an accident or other emergency. Additional emergency telephone numbers will be clearly posted at the landfill office.

11.0 RECORDKEEPING AND REPORTING

In accordance with OAC 252:515-19-40(a), the Owner/Operator will maintain a Site Operating Record at the facility and designated offsite location upon final closure. The Site Operating Record will contain records concerning the planning, construction, operation, monitoring, closing, and post-closure care monitoring of the facility. These records will be maintained until the end of post-closure care monitoring period. A list of recordkeeping and reporting that will be completed by the Owner/Operator is included in the DEQ Guidance on Recordkeeping and Reporting attached in Attachment C of this plan.

Attachment A

Monthly and Quarterly Reporting Forms

Monthly Report for Solid Waste Disposal Facilities

version 1.3

(Submission #: HPR-4ARQ-Y6AE5, version 1)

Details

Originally Started By	Robert Starke
Alternate Identifier	3555050: Northeast C&D Landfill January 2023
Submission ID	HPR-4ARQ-Y6AE5
Status	Draft

Form Input

Facility Information

Permit Number
3555050

Facility Information

Facility Name
Northeast C&D Landfill

<u>Facility Mailing Address</u>

1001 S. Rockwell Ave.

Oklahoma City, OK 73128

County (Facility Location)
Oklahoma (55)

Point of Contact

First Name	**Middle Name**	**Last Name**
Charles	*NONE PROVIDED*	*Woods*

Title
Operations Supervisor

Phone Type	**Number**	**Extension**
Business	405-201-8099	

Email
cwoods@gflenv.com

Would you like to revise the Point of Contact?
No

Alternate Point of Contact

First Name	Middle Name	Last Name
Robert	*NONE PROVIDED*	*Starke*

Title
Operations Supervisor II

Phone Type	Number	Extension
Business	405-317-3912	

Email
rstarke@gflenv.com

Would you like to revise the Alternate Point of Contact?
No

Daily Waste Processed

Report Period

Month	Year
January	2023

Did you process waste under any of the following circumstances this period?
NONE PROVIDED

Weight Handled (tons)

Day of Month	Open?	Total Weight Handled (tons)	Reused / Recycled (tons)	Emergency or Special Event Fee Waiver (tons)	Large Industrial Generator Exemption (tons)
1	No				
2	Yes	281.94			
3	Yes	867.72			

Day of Month	Open?	Total Weight Handled (tons)	Reused / Recycled (tons)	Emergency or Special Event Fee Waiver (tons)	Large Industrial Generator Exemption (tons)
4	Yes	837.77			
5	Yes	924.51			
6	Yes	793.73			
7	Yes	381.49			
8	No				
9	Yes	907.93			
10	Yes	832.63			
11	Yes	1,130.05			
12	Yes	925.34			
13	Yes	984.87			
14	Yes	361.83			
15	No				
16	Yes	894.23			
17	Yes	968.89			
18	Yes	616.49			
19	Yes	940.88			
20	Yes	980.60			
21	Yes	242.04			
22	No				
23	Yes	994.64			
24	Yes	291.93			
25	Yes	314.46			
26	Yes	463.06			

Day of Month	Open?	Total Weight Handled (tons)	Reused / Recycled (tons)	Emergency or Special Event Fee Waiver (tons)	Large Industrial Generator Exemption (tons)
27	Yes	861.24			
28	Yes	460.34			
29	No				
30	Yes	81.41			
31	No				
		Sum: 17,340.02	Sum: NaN	Sum: NaN	Sum: NaN

Were your scales out of service at any point within this reporting period?
No

Monthly Report for Solid Waste Disposal Facilities

version 1.3

(Submission #: HPR-TBCQ-CJE99, version 1)

Details

Originally Started By	Robert Starke
Alternate Identifier	3555050: Northeast C&D Landfill February 2023
Submission ID	HPR-TBCQ-CJE99
Status	Draft

Form Input

Facility Information

Permit Number
3555050

Facility Information

Facility Name
Northeast C&D Landfill

Facility Mailing Address

1001 S. Rockwell Ave.

Oklahoma City, OK 73128

County (Facility Location)
Oklahoma (55)

Point of Contact

First Name	Middle Name	Last Name
Charles	*NONE PROVIDED*	*Woods*

Title
Operations Supervisor

Phone Type	Number	Extension
Business	405-201-8099	

Email
cwoods@gflenv.com

Would you like to revise the Point of Contact?
No

Alternate Point of Contact

First Name	Middle Name	Last Name
Robert	*NONE PROVIDED*	*Starke*

Title
Operations Supervisor II

Phone Type	Number	Extension
Business	405-317-3912	

Email
rstarke@gflenv.com

Would you like to revise the Alternate Point of Contact?
No

Daily Waste Processed

Report Period

Month	Year
February	2023

Did you process waste under any of the following circumstances this period?
NONE PROVIDED

Weight Handled (tons)

Day of Month	Open?	Total Weight Handled (tons)	Reused / Recycled (tons)	Emergency or Special Event Fee Waiver (tons)	Large Industrial Generator Exemption (tons)
1	Yes	729.39			

Day of Month	Open?	Total Weight Handled (tons)	Reused / Recycled (tons)	Emergency or Special Event Fee Waiver (tons)	Large Industrial Generator Exemption (tons)
2	Yes	489.31			
3	Yes	842.99			
4	Yes	491.35			
5	No				
6	Yes	1,042.51			
7	Yes	623.77			
8	Yes	306.83			
9	Yes	337.42			
10	Yes	749.30			
11	Yes	355.97			
12	No				
13	Yes	1,017.67			
14	Yes	459.46			
15	Yes	972.06			
16	Yes	856.07			
17	Yes	869.26			
18	Yes	298.20			
19	No				
20	Yes	874.78			
21	Yes	1,120.86			
22	Yes	702.56			
23	Yes	868.30			
24	Yes	855.09			
25	Yes	217.56			
26	No				
27	Yes	697.39			
28	Yes	898.95			
29	No				
30	No				
31	No				

Day of Month	Open?	Total Weight Handled (tons)	Reused / Recycled (tons)	Emergency or Special Event Fee Waiver (tons)	Large Industrial Generator Exemption (tons)
		Sum: 16,677.05	Sum: NaN	Sum: NaN	Sum: NaN

Were your scales out of service at any point within this reporting period?
No

Monthly Report for Solid Waste Disposal Facilities

version 1.4

(Submission #: HPS-M8Q3-DKX8X, version 1)

Details

Originally Started By	Robert Starke
Alternate Identifier	3555050: Northeast C&D Landfill March 2023
Submission ID	HPS-M8Q3-DKX8X
Status	Draft

Form Input

Facility Information

Permit Number
3555050

Facility Information

Facility Name
Northeast C&D Landfill

Facility Mailing Address

1001 S. Rockwell Ave.

Oklahoma City, OK 73128

County (Facility Location)
Oklahoma (55)

Point of Contact

First Name	Middle Name	Last Name
Charles	*NONE PROVIDED*	*Woods*

Title
Operations Supervisor

Phone Type	Number	Extension
Business	405-201-8099	

Email
cwoods@gflenv.com

Would you like to revise the Point of Contact?
No

Alternate Point of Contact

First Name	Middle Name	Last Name
Robert	*NONE PROVIDED*	*Starke*

Title
Operations Supervisor II

Phone Type	Number	Extension
Business	405-317-3912	

Email
rstarke@gflenv.com

Would you like to revise the Alternate Point of Contact?
No

Daily Waste Processed

Report Period

Month	Year
March	2023

Did you process waste under any of the following circumstances this period?
NONE PROVIDED

Weight Handled (tons)

Day of Month	Open?	Total Weight Handled (tons)	Reused / Recycled (tons)	Emergency or Special Event Fee Waiver (tons)	Large Industrial Generator Exemption (tons)
1	Yes	985.84			

Day of Month	Open?	Total Weight Handled (tons)	Reused / Recycled (tons)	Emergency or Special Event Fee Waiver (tons)	Large Industrial Generator Exemption (tons)
2	Yes	875.77			
3	Yes	851.07			
4	Yes	296.64			
5	No				
6	Yes	1,325.52			
7	Yes	1,150.73			
8	Yes	426.16			
9	Yes	322.64			
10	Yes	659.99			
11	Yes	582.31			
12	No				
13	Yes	882.79			
14	Yes	1,118.20			
15	Yes	1,207.15			
16	Yes	815.88			
17	Yes	476.94			
18	Yes	344.72			
19	No				
20	Yes	987.26			
21	Yes	925.37			
22	Yes	922.57			
23	Yes	903.79			
24	Yes	466.94			
25	Yes	253.40			
26	No				
27	Yes	977.99			
28	Yes	1,083.73			
29	Yes	1,097.32			
30	Yes	1,024.08			
31	Yes	587.82			

Day of Month	Open?	Total Weight Handled (tons)	Reused / Recycled (tons)	Emergency or Special Event Fee Waiver (tons)	Large Industrial Generator Exemption (tons)
		Sum: 21,552.62	Sum: NaN	Sum: NaN	Sum: NaN

Were your scales out of service at any point within this reporting period?
No

Monthly Report for Solid Waste Disposal Facilities

version 1.4

(Submission #: HPT-ACCC-GV1CJ, version 1)

Details

Originally Started By	Charles Woods
Alternate Identifier	3555050: Northeast C&D Landfill April 2023
Submission ID	HPT-ACCC-GV1CJ
Status	Draft

Form Input

Facility Information

Permit Number
3555050

Facility Information

Facility Name
Northeast C&D Landfill

Facility Mailing Address

1001 S. Rockwell Ave.

Oklahoma City, OK 73128

County (Facility Location)
Oklahoma (55)

Point of Contact

First Name	**Middle Name**	**Last Name**
Charles	*NONE PROVIDED*	*Woods*

Title
Operations Supervisor

Phone Type	**Number**	**Extension**
Business	405-201-8099	

Email
cwoods@gflenv.com

Would you like to revise the Point of Contact?
No

Alternate Point of Contact

First Name	**Middle Name**	**Last Name**
Robert	*NONE PROVIDED*	*Starke*

Title
Operations Supervisor II

Phone Type	**Number**	**Extension**
Business	405-317-3912	

Email
rstarke@gflenv.com

Would you like to revise the Alternate Point of Contact?
No

Daily Waste Processed

Report Period

Month	Year
April	2023

Did you process waste under any of the following circumstances this period?
NONE PROVIDED

Weight Handled (tons)

Day of Month	Open?	Total Weight Handled (tons)	Reused / Recycled (tons)	Emergency or Special Event Fee Waiver (tons)	Large Industrial Generator Exemption (tons)
1	Yes	356.50			

Day of Month	Open?	Total Weight Handled (tons)	Reused / Recycled (tons)	Emergency or Special Event Fee Waiver (tons)	Large Industrial Generator Exemption (tons)
2	No				
3	Yes	966.15			
4	Yes	917.31			
5	Yes	978.45			
6	Yes	1,102.61			
7	Yes	1,016.08			
8	Yes	300.39			
9	No				
10	Yes	857.13			
11	Yes	1,146.92			
12	Yes	1,311.69			
13	Yes	1,214.97			
14	Yes	1,194.22			
15	Yes	308.89			
16	No				
17	Yes	1,044.43			
18	Yes	1,012.30			
19	Yes	975.02			
20	Yes	848.36			
21	Yes	1,514.57			
22	Yes	553.06			
23	No				
24	Yes	1,021.50			
25	Yes	552.62			
26	Yes	315.80			
27	Yes	266.98			
28	Yes	433.75			
29	Yes	162.53			
30	No				
31	No				

Day of Month	Open?	Total Weight Handled (tons)	Reused / Recycled (tons)	Emergency or Special Event Fee Waiver (tons)	Large Industrial Generator Exemption (tons)
		Sum: 20,372.23	Sum: NaN	Sum: NaN	Sum: NaN

Were your scales out of service at any point within this reporting period?
No

Quarterly Return for Solid Waste Disposal Facilities

version 1.6

(Submission #: HPS-M9T2-NB4P2, version 1)

Details

Originally Started By	Robert Starke
Alternate Identifier	3555050: Northeast C&D Landfill 1st Quarter (Jan - Mar) 2023
Submission ID	HPS-M9T2-NB4P2
Status	Draft

Form Input

Facility Information

Permit Number
3555050

Facility Information

Facility Name
Northeast C&D Landfill

Facility Mailing Address

1001 S. Rockwell Ave.

Oklahoma City, OK 73128

County (Facility Location)
Oklahoma (55)

Point of Contact

First Name	Middle Name	Last Name
Charles	*NONE PROVIDED*	*Woods*

Title
Operations Supervisor

Phone Type	Number	Extension
Business	405-201-8099	

Email
cwoods@gflenv.com

Would you like to revise the Point of Contact?
No

Alternate Point of Contact

First Name	Middle Name	Last Name
Robert	*NONE PROVIDED*	*Starke*

Title
Operations Supervisor II

Phone Type	Number	Extension
Business	405-317-3912	

Email
rstarke@gflenv.com

Would you like to revise the Alternate Point of Contact?
No

Quarterly Report Detail

Report Period

Quarter	Year
1st Quarter (Jan - Mar)	2023

Number of operating days this quarter:
76

Total weight, in tons, of waste received during this quarter
55,569.69

Did you process waste under any of the following circumstances this period?
NONE PROVIDED

Were your scales out of service at any point within this reporting period?
No

Total weight received that is subject to state disposal fee (tons)
55,569.69

Are you utilizing a capital investment waiver this quarter?
No

Total Capital Investment Fees Retained as of previous quarter ($)
40,000.00

Allowed Capital Investment Fees Retained This Quarter ($)
0.00

Capital Investment Fees Retained to Date ($)
40,000.00

Handling Waiver ($)
6,946.21

Total Allowable Waivers ($)
6,946.21

Penalties ($)
0.00

Total State Disposal Fee Due ($)
62,515.90

Please indicate the planned payment method:
Mail-in Check

Attachment B

Copy of Approved Alternate Daily Cover (ADC)

May 11, 2017

By Electronic Mail Only

Oklahoma Department of Environmental Quality
Land Protection Division
P.O. Box 1677
Oklahoma City, OK 73101-1677

Attention: Ms. Hilary Young, P.E.
Chief Engineer

RE: **Tier I Permit Modification for Alternative Daily Cover**
Northeast Landfill
WCA of Oklahoma, LLC
Spencer, Oklahoma County, Oklahoma
ODEQ Permit No.: 3555050
SEDCo Project No.: 17035

Dear Ms. Young:

On behalf of our client, WCA of Oklahoma, LLC – Northeast Landfill, we are submitting this Tier I Permit Modification for the use of different types of material as alternative daily cover. As per OAC 252:515-19-51(a), all landfills shall cover solid waste with at least six inches of compacted earthen material. We are applying for a Tier I Permit Modification, under OAC 252:515-19-51(d), to use different types of materials as a replacement of the 6-inches of earthen material for an alternative daily cover. These different types of materials that we are proposing to be used as alternative daily cover include the following:

- Tarps;
- Wood chips; and
- Hay/Barn Waste.

Shepherd Engineering Design Co., Inc.
510 East Memorial Road, Suite C-1
Oklahoma City, OK 73114
(405) 996-5301 T | jeff@shepherd.design E

Tarps

Northeast Landfill is proposing to use tarps as alternate daily cover. The tarps maybe deployed using the landfill equipment or by hand using the landfill personnel. The tarps would be removed prior to the placement of the next lift of waste.

Tarps will be constructed from woven PVC and shall be dense enough to keep the waste covered in windy conditions. Northeast Landfill may use whole tires as additional weight to keep the tarps anchored over the working face.

Wood chips/compost

The Northeast Landfill accepts a large amount of wood debris waste per year. This waste would be separated and stockpiled at a location located within the permitted area. Approximately once per year, a grinding operator will be employed to grind the wood waste into wood chips or shredded wood. This material would then be stockpiled on-site within the permitted boundary and used for daily cover. Also, the wood chips or shredded wood might come from a large wood debris disaster such as an ice storm or tornado.

Once the material is ready to be used as ADC, Northeast Landfill will mix the wood chips or shredded wood with soil on a 1:1 ratio. This will be accomplished by placing one scope of wood chips/shredded wood into a dump truck and then placing one scope of soil into the same dump truck. This will be done on an equal basis until the dump truck is full. Once the dump truck is full it will haul the material to the working face, where it will be dumped and spread. The spreading operation will sufficiently mix the soil and wood chip/shredded wood.

Hay/Barn Waste

The Northeast Landfill currently accepts hay/barn waste from the Remington Park Horse Racing Facility. This waste usually is transported to the landfill using roll-off containers. Northeast Landfill is proposing to use this waste as daily cover when it is brought to the site for that particular day. Northeast Landfill does not propose to stockpile this material but to only use on the day that it arrives from Remington Park. This material would be spread over the exposed waste in a 6-inch thick layer to form the daily cover. The hay/barn waste will only be used as daily cover on interior slopes.

We appreciate your review and approval of this Tier I Permit Modification. We trust that the information contained herein is complete. However, if you need additional information, please do not hesitate to contact the undersigned at (405) 996-5301.

Sincerely,
Shepherd Engineering Design Co., Inc.

Jeff A. Shepherd

Jeff A. Shepherd, P.E.
Senior Engineer

Cc: Mr. Joe Miller – Northeast Landfill General Manager
Mr. Ethan Shackelford – Region 1 Engineering and Compliance

Attachment C

DEQ Guidance on Recordkeeping and Reporting

DEQ Guidance on Recordkeeping and Reporting

Regulatory Reference: OAC 252:515-19-40

Applicability. All solid waste disposal facilities.

Purpose. To provide guidance on the records to be maintained in the facility operating record and submitted to the DEQ.

Technical Discussion. All solid waste disposal facilities are required to maintain an operating record containing all records concerning the planning, construction, operation, closing and, if applicable, post-closure monitoring of the facility.[1] Preferably, the operating record should be maintained at the disposal facility; however, an off-site location near the facility which is under the direct control of the owner/operator and accessible during DEQ inspections can be used. For the purposes of this rule, facility records maintained by consultants cannot be considered part of the operating record.

Various Subchapters of OAC 252:515 identify records that must be maintained and/or submitted to the DEQ. This guidance will identify those records so that owner/operators can ensure all required records are being maintained and submitted in a timely manner.

Subchapters 3 through 31 - Permit Applications and Related Documents

- All applications for new and modified permits must be submitted to the DEQ and maintained in the operating record. The permit application includes all text related to the application as well as all maps, drawings, construction plans, QA/QC reports, legal access documents, public notices, etc. required by other Subchapters.
- All correspondence to/from the DEQ related to the permit application must be maintained in the operating record.
- A copy of the approved permit and all associated modifications must be maintained in the operating record.

Subchapter 9 - Groundwater Monitoring and Corrective Action

- Within 60 days of groundwater sampling, a copy of groundwater monitoring results and associated statistical analysis (or cumulative analysis data for C/D landfills) must be placed in the operating record and submitted to the DEQ.
- Within 14 days of determining there is a statistically significant increase (SSI) in one or more monitoring constituents, the DEQ must be notified of the SSI in writing and a copy of the notice placed in the operating record.
- Within 90 days of determining there is a statistically significant increase, either an assessment monitoring program, or a demonstration that the increase was not caused by the facility, must be submitted to the DEQ and placed in the operating record.

[1] This includes all correspondence to/from the DEQ.

- Within 14 days of receiving the results from an assessment monitoring event, the DEQ must be notified of the constituents that were detected.
- Prior to a public meeting to discuss an assessment of corrective measures, the DEQ must be provided with:
  - an affidavit (with a copy of the published notice) showing that public notice of the meeting was published in a local newspaper;
  - copies of certified mail receipts showing that the entities identified in OAC 252:515-9-113(b) were notified of the public meeting; and
  - property and mineral ownership maps covering the area within a 2 mile radius of the facility.
- Within 60 days of the public meeting to discuss an assessment of corrective measures, a proposed remedy must be submitted to DEQ for approval and a copy placed in the operating record.
- When the remedy is complete, a certification signed by the owner/operator and a qualified groundwater scientist must be submitted to the DEQ for approval and the approved certification placed in the operating record.

Subchapter 13 - Leachate Collection and Management

- Documentation must be submitted to the DEQ and maintained in the operating record showing any underground storage tanks used to store leachate meet the requirements of the Oklahoma Corporation Commission at OAC 165:25, Subchapter 1, Part 8.
- Plans for leachate recirculation and/or irrigation must be submitted to the DEQ and maintained in the operating record, as well as all correspondence to/from DEQ related to those plans.
- Any testing results required by leachate recirculation/irrigation plans must be submitted to DEQ and maintained in the operating record.
- If leachate is discharged to a POTW, a copy of a letter from the POTW stating it will accept the leachate must be placed in the operating record and submitted to the DEQ.
- The results of any testing required by the POTW must be maintained in the operating record.
- If leachate is discharged under an OPDES permit, a copy of the permit must be maintained in the operating record.
- Any testing required by the OPDES permit must be submitted to DEQ and maintained in the operating record.

NOTE: Quarterly leachate reports are no longer required to be maintained or submitted.

Subchapter 15 - Methane Gas Monitoring and Control

- Within 30 days of monitoring, gas-monitoring results should be submitted to the DEQ and placed in the operating record.[2]

[2] While the rules don't give a specific time to submit the gas monitoring results, the rules require a remediation plan to be submitted within 30 days of detecting an exceedance. Therefore, it would make sense that the gas monitoring results would be submitted at the same time.

- Within 7 days of detection of an exceedance, submit a written notice to the DEQ of the exceedance and the steps taken to protect human health. A copy of this notice must also be placed in the operating record.
- Within 30 days of detection of an exceedance, a remediation plan must be submitted to the DEQ and a copy placed in the operating record.
- Written notification must be provided to the DEQ when the remediation plan is implemented, and a copy of that notice placed in the operating record.

Subchapter 17 - Stormwater Management

- A copy of the Stormwater Pollution Prevention Plan and OPDES Sector L permit must be maintained in the operating record.
- A copy of the OPDES stormwater permit for construction sites must be maintained in the operating record for any on- or off-site soil borrow areas of 5 acres or more in size.
- OPDES Sector L visual monitoring and Numeric Effluent Limitation Monitoring results must be maintained in the operating record.
- The Annual Comprehensive Site Compliance Evaluation Report must be submitted to the DEQ's WQD no later than December 1st of each year.
- All NELM monitoring results must be submitted to the DEQ no later than October 29th of each year for the period October 2nd of the previous year to October 1st of the current year.

Subchapter 19 - Operational Requirements

- Copies of random waste screening inspections must be maintained in the operating record.[3]
- Monthly waste receipt reports must be submitted to the DEQ and a copy placed in the operating record no later than the 15th of the month following the reporting month.[4]
- To avoid penalties, quarterly returns and fees for landfills must be submitted to the DEQ within 30 days of the end of the quarter.[5] A copy of the quarterly return must be maintained in the operating record.
- Copies of approved out-of-state waste disposal plans must be on file with the DEQ and maintained in the operating record, as well as all correspondence to/from DEQ related to the development of the approved plan.
- The DEQ must be notified at least 5 working days in advance of any proposed changes to an approved out-of-state waste disposal plan.
- Copies of initial design capacity reports required by the New Source Performance Standards (NSPS), as well as required updates to the design capacity, must be submitted to the DEQ and placed in the operating record.
- Copies of all test results required by NSPS must be submitted to DEQ and maintained in the operating record.

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[3] An example of a waste screening checklist is included with this guidance.
[4] Monthly reports are not required to be submitted to the DEQ for large NHIW generator landfills, generator owned and operated NHIW monofills, transfer stations, and processing facilities (including incinerators and regulated medical waste facilities). However, records identifying the amount of waste received must be maintained in the operating record and made available to DEQ upon request.
[5] Returns and fees submitted later than this are subject to penalties and are not eligible for the handling waiver.

- Landfills accepting asbestos must maintain the records identified in the Management of Friable Asbestos guidance document.
- Composting facilities must maintain records documenting when windrows were turned, windrow temperatures, and the amount of waste received, processed, and distributed.

Subchapter 21 - Waste Tire Processing, Certification, Permits, and Compensation

Waste tire facilities

- Records of gross and tare weights of each vehicle must be maintained in the operating record.
- A daily log for each load of tires received must be maintained in the operating record. The daily log must include the name and address of the hauler, the number of tires from each tire source, the name and address of each tire source, the number of tires processed each day, and the use and destination of each daily outbound load of processed tire material.
- No later than the 10th of each month, a monthly report must be submitted to the DEQ identifying the following for the previous month: the number of tires received, the number of tires from community-wide clean up events, the number of tires from PCL dumps, a summary of destinations and intended uses of processed tire material, the number of tons of processed tire material provided for each market category, and the number of tires provided to waste tire incinerators that were not useable by the incinerator. The monthly report must also be maintained in the operating record.
- No later than the 10th of the month following the end of each calendar quarter, a quarterly report must be submitted to the DEQ identifying the following for the previous quarter: statewide collection efforts and documentation the scales were certified in accordance with Department of Agriculture requirements. The quarterly report must also be maintained in the operating record.
- All copies of waste tire manifests must be maintained in the operating record.
- All records required by the Oklahoma Tax Commission for reimbursement purposes must be maintained in the operating record.

Entities installing river bank stabilization or other conservation projects[6]

- A copy of the permit or other authorization for the project must be maintained.
- A copy of the project completion report must be submitted to the DEQ and retained by the installer.
- Copies of any letters to/from the DEQ related to the project must be retained by the installer.

Waste tire baling entities[7]

- A copy of a waste tire baling plan must be submitted to the DEQ and maintained in the operating record.
- A copy of the project completion report must be submitted to the DEQ and retained by the entity.
- Copies of any letters to/from the DEQ related to the plan must be maintained in the operating record.

---

[6] Records must be maintained by the entity for at least 3 years after completion of the project.
[7] Records must be maintained by the entity for at least 3 years after completion of the project.

Subchapter 23 - Regulated Medical Waste Facilities

- A copy of the approved certificate of need must be in the operating record.
- Copies of emergency response agreements must be maintained in the operating record.
- The operating record must include records of when waste was placed into and removed from storage.
- Records of any tests done on a regulated medical waste incinerator must be maintained in the operating record.
- Incinerator monitoring data must be maintained for at least 2 years. Such data includes waste feed rates, fuel and combustion gas flows, oxygen and carbon monoxide, and temperature.
- Testing and disposal records for incinerator ash must be maintained in the operating record.
- For regulated medical waste incinerators, an NHIW notification/certification form and associated documentation showing the ash is non-hazardous must be submitted to the DEQ.

Subchapter 25 - Closure and Post-Closure Care

- Copies of closure and post-closure plans, all amendments, maps, drawings, construction plans, QA/QC reports, legal access documents, etc. required by the plans must be submitted to the DEQ and maintained in the operating record. All correspondence to/from the DEQ related to the permit application must also be maintained in the operating record.
- Documentation of all activities performed for closure must be submitted to the DEQ with the final closure report and placed in the operating record.
- A copy of the land records notice as recorded must be submitted to the DEQ at the conclusion of closure activities.
- All correspondence to/from the DEQ related to closure and/or post-closure activities must be maintained in the operating record.
- No later than April 1st of each year, a post-closure maintenance and monitoring report must be submitted to the DEQ, and a copy placed in the operating record.
- At the conclusion of post-closure, a Certification of Post-closure Performance must be submitted to the DEQ.

Subchapter 27 - Cost Estimates and Financial Assurance

- Copies of all cost estimates and financial assurance documents must be submitted to the DEQ and maintained in the operating record. This includes all correspondence to/from DEQ related to these documents.
- When a surety bond, letter of credit, certificate of deposit, or insurance[8] is used as the financial assurance mechanism, an original and one copy of the instrument must be submitted to the DEQ.
- No later than April 1st of each year, life of site calculations must be submitted to the DEQ, identifying the life of the site as of December 31st of the previous year. The calculations must also be placed in the operating record. This includes all correspondence to/from DEQ related to this calculation.

[8] The actual policy, not a certificate, must be submitted to DEQ.

- No later than April 1st of each year, cost estimates must be recalculated or adjusted for inflation, and the new figures submitted to the DEQ. The calculations must also be placed in the operating record. This includes all correspondence to/from DEQ related to this calculation.
- For all financial assurance mechanisms except the corporate test/guarantee and local government test/guarantee, no later than April 9th of each year, documentation must be submitted to the DEQ to demonstrate financial assurance mechanisms were updated and/or payments made based on the revised cost estimates. The documentation must also be placed in the operating record.
- If the corporate test/guarantee is used as a financial assurance mechanism, no later than 90 days after the end of the corporate fiscal year, the records identified in OAC 252:515-27-81(c) must be submitted to the DEQ and placed in the operating record.
- If the local government test/guarantee is used as a financial assurance mechanism, no later than 180 days after the end of the local government fiscal year, the records identified in OAC 252:515-27-82(h) must be submitted to the DEQ and placed in the operating record.

Subchapter 29 - Exclusion of Prohibited Wastes

- A copy of the Waste Exclusion Plan must be maintained in the operating record and submitted to the DEQ. This includes all correspondence to/from the DEQ related to the plan.
- Copies of all random inspections must be maintained in the operating record. Such records must include the date and time of the inspection, the name of the person conducting the inspection, and the results of the inspection.[9]
- No later than the next working day, the DEQ must be notified of any rejected loads.[10] The notification must include: (1) the date of rejection; (2) the name, address, and phone number of the waste generator; (3) the name of the driver; (4) transporter tag number and (5) transporter name, address, contact name, and phone number. This information must also be maintained in the operating record.
- When necessary, documentation to verify proper disposal of rejected wastes must be maintained in the operating record.
- Copies of personnel training must be maintained in the operating record.[11]

Subchapter 31 - NHIW Management

- Generators disposing of more than 10 cubic yards of NHIW per calendar month off site in an Oklahoma landfill must submit an NHIW Notification/Certification to the DEQ for each NHIW to be disposed.
- No later than the last day of the month, commercial landfills accepting NHIW must submit a report to the DEQ itemizing the type, quantity, and source of NHIW received from persons disposing of more than 10 cubic yards of NHIW the previous month. This report must also be maintained in the operating record.

[9] Attachment 1 is an example of a random inspection sheet that will meet the requirements of the rule.
[10] Telephone notification will suffice.
[11] This includes the training dates, curriculum, and attendees.

XYZ LANDFILL
RANDOM WEP INSPECTION CHECKLIST [EXAMPLE]

Use checklist for all suspicious loads and for 5% of all incoming loads of solid waste.

Date: ________________ **Time:** ________________ **am/pm**

Customer Name: ____

Vehicle License Plate # and State:________________

Type of Waste (check all that apply):

- ☐ **Household** ☐ **Commercial**
- ☐ **Construction / Demolition** ☐ **Industrial**
- ☐ **Other** ____________________________

Identify All Unauthorized Wastes Present

- ☐ **Hazardous (corrosive, ignitable, reactive, TCLP toxic, or listed hazardous waste)**
- ☐ **Radioactive** ☐ **Untreated Regulated Medical**
- ☐ **PCB** ☐ **Automobile Batteries**
- ☐ **Unauthorized Liquid** ☐ **Non-conforming NHIW**
- ☐ **Other** ____________________________

Waste accepted?

- ☐ **Yes**
- ☐ **No**

If no, what was done with the waste?

Additional Comments

_____________________________ _____________________________
Inspector's Name (Print) **Driver's Name (Print)**

_____________________________ _____________________________
Inspector's Signature **Driver's Signature**

Notification of unauthorized waste:

- ☐ **DEQ Land Protection Division (405.702.5100)**
  Name / Date
- ☐ **Waste Hauler**
  Name / Date
- ☐ **Waste Generator**
  Name / Date

Attachment D

Paint Filter Liquids Test Procedure

METHOD 9095B

PAINT FILTER LIQUIDS TEST

1.0 SCOPE AND APPLICATION

1.1 This method is used to determine the presence of free liquids in a representative sample of waste.

1.2 The method is used to determine compliance with 40 CFR 264.314 and 265.314.

2.0 SUMMARY OF METHOD

2.1 A predetermined amount of material is placed in a paint filter. If any portion of the material passes through and drops from the filter within the 5-min test period, the material is deemed to contain free liquids.

3.0 INTERFERENCES

3.1 Filter media were observed to separate from the filter cone on exposure to alkaline materials. This development causes no problem if the sample is not disturbed.

3.2 Temperature can affect the test results if the test is performed below the freezing point of any liquid in the sample. Tests must be performed above the freezing point and can, but are not required to, exceed room temperature of 25 °C.

4.0 APPARATUS AND MATERIALS

4.1 Conical paint filter -- Mesh number 60 +/- 5% (fine meshed size). Available at local paint stores such as Sherwin-Williams and Glidden.

4.2 Glass funnel -- If the paint filter, with the waste, cannot sustain its weight on the ring stand, then a fluted glass funnel or glass funnel with a mouth large enough to allow at least 1 in. of the filter mesh to protrude should be used to support the filter. The funnel should be fluted or have a large open mouth in order to support the paint filter yet not interfere with the movement, to the graduated cylinder, of the liquid that passes through the filter mesh.

4.3 Ring stand and ring, or tripod.

4.4 Graduated cylinder or beaker -- 100-mL.

5.0 REAGENTS

5.1 None.

6.0 SAMPLE COLLECTION, PRESERVATION, AND HANDLING

A 100-mL or 100-g representative sample is required for the test. If it is not possible to obtain a sample of 100 mL or 100 g that is sufficiently representative of the waste, the analyst may use larger size samples in multiples of 100 mL or 100 g, i.e., 200, 300, 400 mL or g. However, when larger samples are used, analysts shall divide the sample into 100-mL or 100-g portions and test each portion separately. If any portion contains free liquids, the entire sample is considered to have free liquids. If the sample is measured volumetrically, then it should lack major air spaces or voids.

7.0 PROCEDURE

7.1 Assemble test apparatus as shown in Figure 1.

7.2 Place sample in the filter. A funnel may be used to provide support for the paint filter. If the sample is of such light bulk density that it overflows the filter, then the sides of the filter can be extended upward by taping filter paper to the <u>inside</u> of the filter and above the mesh. Settling the sample into the paint filter may be facilitated by lightly tapping the side of the filter as it is being filled.

7.3 In order to assure uniformity and standardization of the test, material such as sorbent pads or pillows which do not conform to the shape of the paint filter should be cut into small pieces and poured into the filter. Sample size reduction may be accomplished by cutting the sorbent material with scissors, shears, a knife, or other such device so as to preserve as much of the original integrity of the sorbent fabric as possible. Sorbents enclosed in a fabric should be mixed with the resultant fabric pieces. The particles to be tested should be reduced smaller than 1 cm (i.e., should be capable of passing through a 9.5 mm (0.375 inch) standard sieve). Grinding sorbent materials should be avoided as this may destroy the integrity of the sorbent and produce many "fine particles" which would normally not be present.

7.4 For brittle materials larger than 1 cm that do not conform to the filter, light crushing to reduce oversize particles is acceptable if it is not practical to cut the material. Materials such as clay, silica gel, and some polymers may fall into this category.

7.5 Allow sample to drain for 5 min into the graduated cylinder.

7.6 If any portion of the test material collects in the graduated cylinder in the 5-min period, then the material is deemed to contain free liquids for purposes of 40 CFR 264.314 and 265.314.

8.0 QUALITY CONTROL

8.1 Duplicate samples should be analyzed on a routine basis.

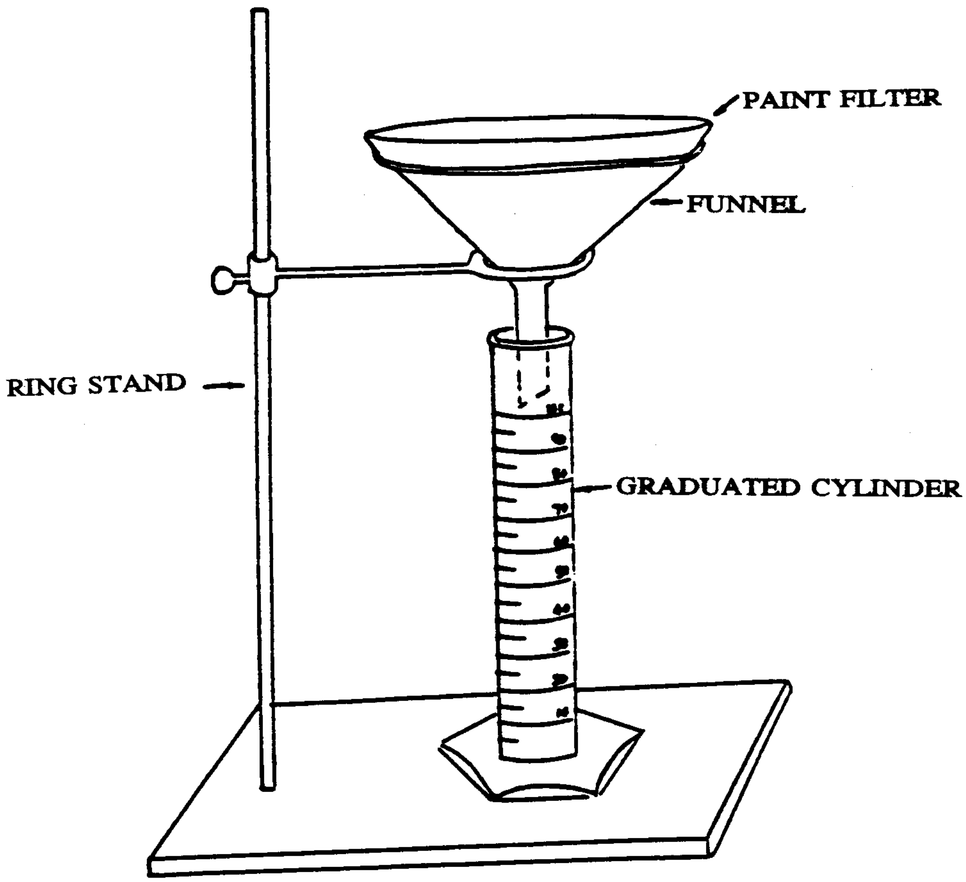
9.0 METHOD PERFORMANCE

9.1 No data provided.

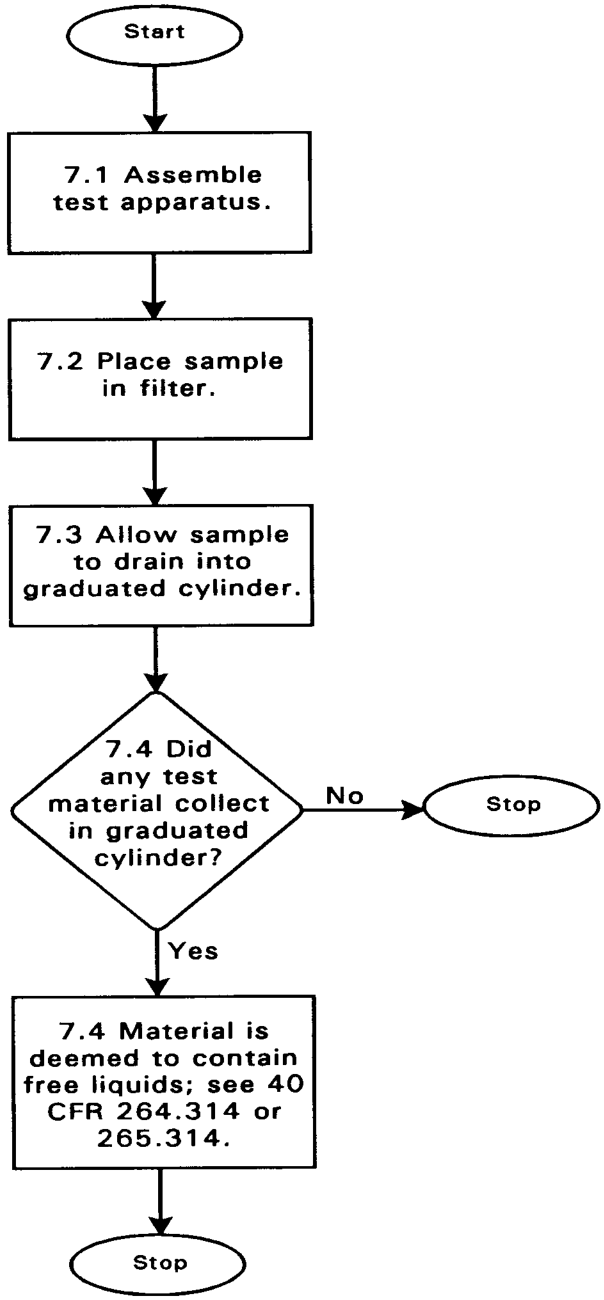
10.0 REFERENCES

10.1 None provided.

FIGURE 1
PAINT FILTER TEST APPARATUS



METHOD 9095B
PAINT FILTER LIQUIDS TEST



Appendix H

Waste Exclusion Plan

January 6, 2011

By Hand Delivery on January 7, 2011

Oklahoma Department of Environmental Quality
Land Protection Division
707 North Robinson
Oklahoma City, OK 73101

Attn: Mr. Saba Tahmassebi, Ph.D., P.E.
Chief Engineer – Land Protection Division

RE: Tier I Permit Modification
Waste Exclusion Plan
Northeast C&D Landfill
Waste Corporation of Oklahoma, LLC
ODEQ Permit No.: 3555050
SEDCo Project No.: 10010032

Dear Sir:

On behalf of our client, Waste Corporation of Oklahoma, LLC – Northeast C&D Landfill, we are submitting the attached Tier I Permit Modification in response to new Oklahoma Department of Environmental Quality (ODEQ) regulations. This Tier I Permit Modification is for a Waste Exclusion Plan for the Northeast C&D Landfill. Please review the attached and provide any comments you might have.

We hope the attached is sufficient for your approval. If you have any questions, please feel free to call me at the number listed below.

Sincerely,
Shepherd Engineering Design Co., Inc.

Jeff A Shepherd

Senior Engineer/President

Cc: Jim Kent – Landfill General Manager (2 copies)

Shepherd Engineering Design Co., Inc.
4000 North Classen Blvd., Suite 110-S
Oklahoma City, OK 73121
(405) 996-5301 T | (405) 488-0029 F | jashepherd@sedcousa.net

NORTHEAST C&D Landfill

WASTE CORPORATION of OKLAHOMA, LLC

SPENCER, OKLAHOMA

TIER I PERMIT APPLICATION

ODEQ PERMIT NO.: 3555050

WASTE EXCLUSION PLAN

Prepared for:

Northeast C&D Landfill

Waste Corporation of Oklahoma, LLC

2601 N. Midwest Blvd.

Spencer, Oklahoma 73084

Prepared by:

Shepherd Engineering Design Co., Inc

4000 North Classen, Suite 110-S

Oklahoma City, Oklahoma 73118

405-996-5300

SEDCo Project No.: 10010032

TABLE OF CONTENTS

1.0 INTRODUCTION

1.1 Purpose

This Waste Exclusion Plan (WEP) outlines the acceptance requirements which shall be used to ensure the Northeast Construction and Demolition (C&D) Landfill (NELF) only accepts C&D Waste. The Northeast C&D Landfill is owned and operated by Waste Corporation of Oklahoma, LLC. This plan is designed to define procedures which will be followed in determining whether or not NELF is permitted to accept a specific C&D material for disposal as well as outlining procedures for identifying and preventing the disposal of unacceptable waste which are delivered to NELF. This plan is prepared to meet the requirements of OAC 252:515-29.

The objectives of the WEP are as follows;

- Verify that the waste is not regulated Municipal Solid Waste (MSW);
- Verify that the waste is not a regulated hazardous waste;
- Verify that the waste meets permit criteria for acceptance at the NELF;
- Verify that the waste meets Waste Corporation of Oklahoma's (WCO) criteria for acceptance at the NELF; and
- Establish any conditions which may be necessary to ensure the safe and environmentally sound management (collection, storage, transportation, disposal) of the waste.

The Oklahoma Department of Environmental Quality (ODEQ) rules specifically state that Construction and Demolition Waste landfills or processing facilities shall only accept the following waste: asbestos-free waste from construction and/or demolition projects that may include such materials as metal, concrete, brick, asphalt, glass, roofing materials, limited amounts of packing materials, sheetrock, or lumber; wood waste that may include such materials as yard waste, lumber, wood chips, wood shavings, sawdust, plywood, tree limbs, or tree stumps; yard waste that may include such materials as grass clippings, tree limbs, tree stumps, shrubbery, flowers, or other vegetative matter resulting from land clearing or landscaping operations; and/or residential lead-based paint waste. The WEP was developed to detect and prevent the disposal of other non-approved wastes.

1.2 General Site Information

The Northeast C&D Landfill is submitting this WEP as part of a Tier I Permit Application as required by the new ODEQ regulations.

2.0 DEFINITIONS

Listed below are definitions of some common terms as used in this plan. Terms not defined below carry the common industry definition. Note that if any of the definitions listed below conflict with a definition listed in a federal, state or local regulation applicable to the NELF, the regulatory definition will govern.

Biosolid – Municipal waste water treatment plant Class A or B sludge.

Commercial Solid Waste - all types of solid waste generated by stores, offices, restaurants, warehouses, and other non-manufacturing activities, excluding residential and industrial wastes.

Construction and Demolition Waste – asbestos-free waste from construction and/or demolition projects that may include such materials as metal, concrete, brick, asphalt, glass, roofing materials, limited amounts of packing materials, sheetrock, or lumber; wood waste that may include such materials as yard waste, lumber, wood chips, wood shavings, sawdust, plywood, tree limbs, or tree stumps; yard waste that may include such materials as grass clippings, tree limbs, tree stumps, shrubbery, flowers, or other vegetative matter resulting from land clearing or landscaping operations; and/or residential lead-based paint waste.

Hazardous Waste - waste materials and by-products, either solid or liquid or containerized gas, which are:

- To be discarded by the generator or recycled; toxic to human, animal, aquatic or plant life; and generated in such quantity that they cannot be safely disposed of in properly operated, state-approved solid waste landfills or waste, sewage or wastewater treatment facilities.

- Defined as hazardous waste by the state hazardous waste management regulations (OAC 252:205).

- Defined as hazardous waste by the US EPA regulation 40CFR.

The term "hazardous waste" may include but is not limited to explosives, flammable liquids, spent acids, caustic solutions, poisons, containerized gases, sludge, tank bottoms containing heavy metallic ions, toxic organic chemicals, and materials such as paper, metal, cloth or wood which are contaminated with hazardous waste. The term "hazardous waste" shall not include domestic sewage.

Household Waste - any solid waste (including garbage, trash, and sanitary waste in septic tanks) derived from households (including single and multiple residences, hotels and motels, bunkhouses, ranger stations, crew quarters, campgrounds, picnic grounds, and day-use recreation areas).

Industrial Solid Waste - see non-hazardous industrial solid waste.

Leachate - a liquid that has passed through or generated by solid waste which contains soluble, suspended, or miscible materials leached from that waste.

Municipal Solid Waste Landfill (MSWLF) unit - a discrete area of land or an excavation that receives household waste and that is not a land application unit, surface impoundment, injection well, or waste pile. A MSWLF unit also may receive other types of RCRA subtitle D wastes, such as commercial solid waste, non-hazardous sludge, NHIW, special waste, and construction/demolition waste. Such a landfill may be publicly or privately owned. A MSWLF unit may be a new MSWLF unit, an existing MSWLF unit or a lateral expansion.

Non-Hazardous Industrial Solid Waste (NHIW) - any of the following wastes deemed by the Department to require special handling:

- Unusable industrial or chemical products;
- Solid waste generated by the release of an industrial product to the environment; and
- Solid waste generated by a manufacturing or industrial process.

The term "non-hazardous industrial solid waste" shall not include waste that is regulated as hazardous waste or is commonly found as a significant percentage of residential solid waste.

RCRA - Resource Conservation and Recovery Act of 1976, as amended, 42 U.S.C. Section 6901 et seq.

Semi-Solid Waste - means any waste (for example, sludges, grease trap pumpings, or septic tank pumpings) which contains at least twenty (20) percent solids by weight. Liquid waste may be bulked with soil, kiln dust, fly ash, or other suitable material to become semi-solid waste.

Sludge - any solid, semi-solid, or liquid waste generated from a municipal, commercial, or industrial wastewater treatment plant, water supply treatment plant, or air pollution control Facility exclusive of the treated effluent from a wastewater treatment plant.

Solid Waste - all putrescible and non-putrescible refuse in solid or semisolid form including, but not limited to, garbage, rubbish, ashes or incinerator residue, street refuse, dead animals, demolition wastes, construction wastes, solid or semisolid commercial and industrial wastes including explosives, biomedical wastes, chemical wastes, herbicide and pesticide wastes. The term "solid waste" shall not include the following.

- Scrap materials which are source separated for collection and processing as industrial raw materials, except when contained in the waste collected by or in behalf of a solid waste management system.

- Used motor oil, which shall not be considered to be a solid waste, but shall be considered a deleterious substance, if the used motor oil is recycled for energy reclamation and is ultimately destroyed when recycled.

Special Wastes - those wastes that are not hazardous wastes but which, because of their nature or volume, process-generating waste, require special or additional handling aside from that given to routine household refuse. This includes but is not limited to: sludge, septic tank pumpings, grease trap wastes, dead animals, packing house offal and tankage, waste fats and oils, hatchery wastes, cannery wastes, NHIW, tires, and asbestos wastes.

US EPA - United States Environmental Protection Agency.

Wastestream - A separate and distinct waste type generated from a particular process at a generating location.

3.0 EVALUATION GUIDELINES

Since Northeast C&D Landfill only accepts C&D waste, the Evaluation Guidelines are simple. The NELF only accepts C&D Waste as defined by the ODEQ and listed in Section 2.0 definitions.

3.1 Solid Waste Determination

In accordance with the ODEQ regulations, municipal solid waste cannot be accepted at the Facility. Municipal solid waste is defined as the following:

- All putrescible and non-putrescible refuse in solid, semisolid, or liquid form including, but not limited to, garbage, rubbish, ashes or incinerator residue, street refuse, dead animals, solid or semisolid commercial and industrial wastes including explosives, biomedical wastes, chemical wastes, herbicide and pesticide wastes.
- scrap materials which are source separated for collection and processing as industrial raw materials; and/or
- used motor oil, which shall not be considered to be a solid waste, but shall be considered a deleterious substance, if the used motor oil is recycled for energy reclamation and is ultimately destroyed when recycled.

3.2 Other Wastes Not Permitted

Since the NELF is a C&D Landfill other wastes that will not be accepted are household hazard wastes, hazardous wastes, liquid wastes, non-hazardous industrial wastes (NHIN), regulated medical wastes and special wastes. These wastes are defined in Section 2.0 Definitions of this WEP.

4.0 COORDINATION WITH GENERATOR AND HAULER, GATE ACCEPTANCE PROCEDURES, AND RECORDKEEPING

4.1 Coordination with Generator and Hauler

The C&D Waste Generator will contact (e.g., phone, e-mail, fax or visit) the NELF for the NELF's operating requirements and restrictions prior to disposal of the C&D Waste. Generator and hauler inquiries will be directed to the gate attendant, salesman or other NELF personnel who have been trained, as required in Section 7.0 of the WEP. NELF personnel will assist the generator or hauler to properly complete the required paperwork. The hauler will work directly with the generator and the NELF to understand the requirements of the WEP. A copy of the WEP will be available to further educate the generator and hauler of the requirements of the WEP. Additional NELF rules and requirements will also be available at the site.

4.2 Gate Acceptance Procedures

For each load of C&D Waste that arrives at the site, the gate attendant responsibilities include the following:

- Verify that the waste is C&D Waste only; and
- Verify load volume or weight.

4.3 Random Load Inspections

The NELF Manager is responsible for determining the random inspection schedule, but a minimum five (5) load inspection per week should occur. For each random inspection, NELF personnel performing the inspection will complete the Waste Inspection Report included in Appendix A. The driver of the randomly selected load will be notified at the Gate House and instructed to proceed to the evaluation area. NELF personnel will compare the material presented for disposal to verify that the physical characteristics (i.e., color, odor appearance) of the material match those detailed in this WEP. In the event that the physical characteristics of the waste differ from the approved waste stream or known prohibited waste are identified, the waste load will be rejected (see Section 6.0 - Waste Discrepancies and Rejected Loads). The hauler will be notified of the reasons for rejecting the load. Records of load inspections will be maintained in the Site Operating Record.

In addition, all incoming loads will be visually inspected by a spotter at the tipping face. Should any indication of prohibited waste be detected, appropriate NELF personnel will be summoned to conduct a thorough evaluation of the load. Properly trained NELF personnel will break up the waste pile and inspect the material for any hazardous or prohibited wastes. Known prohibited waste will be placed back into the vehicle and the driver will be instructed to depart the site. Should any regulated, hazardous waste be detected, the entire load will be refused.

4.4 Recordkeeping

NELF must keep records of all loads accepted and copies of all random waste inspection in the Site Operating Record.

5.0 DISPOSAL PROCEDURES

The NELF personnel will exercise appropriate care and safeguards when disposing of the C&D Waste. Only onsite personnel who have appropriate training will be utilized for placing and compacting of the C&D Wastes at the tipping face.

6.0 WASTE DISCREPANCIES AND REJECTED LOADS

Documentation for acceptable C&D Waste that arrives for disposal is reviewed at the NELF. In the event that unacceptable wastes arrive they will be rejected. A Random Inspection Checklist (Appendix A) will be used as a guide for NELF personnel to evaluate the inspected load arriving at the gate and to ensure proper documentation. Discrepancies which will cause a load to be rejected include but are not limited to the following:

- A non-hazardous industrial solid waste arrives;
- A non-hazardous industrial solid waste arrives, and the waste does not match the description on the waste tracking document or manifest.
- A hazardous industrial waste arrives;
- A load of municipal solid waste arrives; and
- There is no signed Customer Service Agreement.

Regulated hazardous waste, PCBs (equal to or greater than 50 ppm), infectious waste, radioactive, or other prohibited waste are not authorized for disposal. If such wastes are suspected or discovered, they will be isolated until the material can be adequately identified. Appropriate handling procedures will be used to manage the material.

If the suspect material is determined to be a regulated hazardous waste, a solid waste, contain regulated levels of PCB, radioactive or other prohibited material, the ODEQ will be notified within the next working day of the incident and the planned disposition/remediation of the material. The NELF will supply to the ODEQ reason and date for rejection, name of the driver, tag number of the vehicle, carrier name, address, telephone number, and contact person (if available). Also, the name, address, and phone number and contact person of the generator (if available) will be supplied to the ODEQ. A rejected load form will be completed for each rejected load.

In addition, the ODEQ will be notified within the next working day of any non-residential waste that is identified as hazardous or containing regulated PCB material prior to receipt at the NELF, based on information supplied by the generator.

The proper disposition/remediation of the prohibited waste will be specific to the waste and will be implemented upon ODEQ concurrence and approval. Verification of proper disposal of the prohibited waste will be submitted to the ODEQ and a copy maintained in the operating record.

7.0 PERSONNEL TRAINING

Appropriate NELF personnel will receive initial training on unacceptable waste identification, screening, and management procedures. Annual refresher training will be provided to appropriate personnel. The training will be conducted by either in-house staff or outside specialists familiar with proper management procedures and the requirements of this WEP. Documentation of the training will be retained in the site operating record. A discussion of the training requirements for the landfill Manager or Supervisor and onsite personeel are discussed below.

Landfill Manager/Supervisor - Prior to acceptance of C&D Waste at the NELF, the owner/operator must document that the waste was evaluated by trained personnel and determined acceptable. The Landfill Manager or Supervisor will be responsible for such evaluation and will have training and/or experience in the following areas.

- The NELF's program and procedures for C&D Waste acceptance including: the definition of C&D Waste, waste evaluation, waste approval procedures, waste inspections, recordkeeping, and monthly report submission and other notifications to the ODEQ (i.e.; notification of receipt of restricted wastes, verification of proper disposal, etc.).

- Waste identification and evaluation. Training should include basic understanding of the definition of hazardous waste and exclusions, and basic chemistry related to the physical characteristics of wastes and waste constituents.

- The current regulatory procedures for notification, certification, and handling of unapproved wastes.

- The NELF's approved programs for PCB exclusion, radioactive waste exclusion, solid waste exclusion, untreated infectious biomedical waste exclusion, asbestos waste exclusion, and other special wastes that are excluded.

Onsite Personnel - Gate attendants and NELF operators shall receive basic training in waste exclusion, as related to the WEP. This shall include a minimum of 8 hours per the first year of training. The training curriculum will include at a minimum a review of regulatory definitions, (e.g., hazardous waste, etc.) recognition of solid waste, hazardous, radioactive, regulated PCBs, regulated infectious waste, and requirements for handling of waste as well as the NELF's WEP implementation procedures. A minimum of four hours of refresher training will be held at least annually with training documentation placed into the Site Operation Record. Trained personnel shall be on site during all hours the landfill is open to accept wastes.

8.0 MONTHLY REPORTS

Monthly reports shall be submitted to the ODEQ itemizing the type, quantity, and source of C&D waste received the previous month from generators.

APPENDIX A
WASTE EXCLUSION PLAN
RANDOM INSPECTION REPORT AND
REJECTED LOAD FORM

RANDOM INSPECTION REPORT

1. Date:______________________________

2. Time:_________________a.m./p.m.

3. Generator:____

4. Hauler:____

5. Name of Driver:____

6. Hauling Permit No. (if applicable):____

7. Vehicle License No.:____

8. Inspection: (Circle) Random or Scheduled

9. Does the waste meet the requirements of the disposal at this Facility?
   (Circle) Yes or No

10. Extraneous and/or unauthorized materials were found in the waste shipment.
    (Circle) Yes or No

11. Photograph or video tape identification No.____

BASED ON MY EXAMINATION, LOAD WAS INSPECTED AND NO UNAUTHORIZED WASTE WAS FOUND.

____ ____________________

Signature of Site Inspector Date

REJECTED LOAD FORM

1. Date of Rejection______________________________

2. Generator Name:______________________________

3. Generator Contact:____________________ Phone No.:______________

4. Generator Address: ______________________________
____
____

5. Hauler Name:____________________ Phone No.:______________

6. Hauler Contact:______________________________

7. Vehicle License Number:______________________________

8. Driver's Name:______________________________

9. Hauler Address: ______________________________
____
____

10. Reason(s) for Rejection:

____

____

____

______________________________ ______________________________
Signature of Site Inspector Date

Appendix I

Closure and Post-Closure Care Plan

Appendix I
Closure and Post-Closure Care Plan

Northeast C&D Landfill

Prepared for:

N.E. Land Fill, LLC
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Spencer, OK 73084
405-495-0800

Prepared by:

SCS ENGINEERS
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817-571-2288

August 2023
File No. 16219107.00

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Certification

This Closure and Post-Closure Care Plan has been prepared in accordance with sound engineering practices, including consideration of industry standards and the requirements of the Oklahoma Department of Environmental Quality, as defined in the Oklahoma Administrative Code (OAC) 252:515-25 and 27.

Prepared by:

Sandeep Saraf, P.E.
Senior Project Manager
SCS Engineers

1.0 INTRODUCTION

This Closure and Post-Closure Care (C-PC) Plan provides the criteria necessary to properly close and maintain the entire disposal area during post-closure for the Northeast landfill in accordance with OAC 252:515-25. The Closure Plan includes the necessary actions to be completed at the site before the facility can be certified closed and sets forth the maintenance and monitoring during the post-closure period.

The Post-Closure Plan will be in effect for a minimum 8-year period to ensure that the closed Northeast landfill will retain its integrity and will not pose a threat to human health or the environment in accordance with OAC 252:515-25-51(b).

2.0 REGULATIONS

This C-PC Plan has been prepared pursuant to OAC 252:515-25, as promulgated by the Oklahoma Department of Environmental Quality (DEQ).

2.1 CLOSURE REQUIREMENTS

The facility will be closed in accordance with the provisions included in this Closure Plan and in a manner that minimizes the need for further maintenance and controls and minimizes post-closure escape of waste and waste constituents into the environment.

OAC 252:515-25 requires that all landfills install a final cover system that is designed to minimize infiltration and erosion. DEQ regulations require closure to begin a minimum of 90 days after final receipt of waste at the facility or for the disposal area, as applicable, in accordance with OAC 252:515-25-33(b). To comply with the requirements of OAC 252:515-25-33, GFL will provide a notice of intent to close the site prior to beginning final closure of the facility or closure of a disposal area at the landfill. Subsequently, Owner/Operator will comply with the requirements of OAC 252:515-25-33(c) by completing of closure activities within 180 days following the beginning of closure unless otherwise approved.

Consistent with the requirements of OAC 252:515-25-34(a), a Certification of Final Closure Report will be submitted to the DEQ after completion of final closure. This report will be prepared and sealed by an independent professional engineer licensed in the State of Oklahoma to comply with the requirements of OAC 252:515-25-34(c) and signed by Owner/Operator to comply with the requirements of OAC 252:515-25-34(a)(1).

Consistent with the requirements of OAC 252:515-25-36(a), a notice will be recorded in the property deed stating that the land has been used as a solid waste disposal facility, upon approval of final closure. The notice will specify the type, location, and quantity of wastes disposed of at the facility in accordance with OAC 252:515-25-36(b). In addition, the notice will state that a survey plat and a record of disposal area locations and elevations has been filed with the DEQ and with an identified city or county, and future uses may be restricted in accordance with OAC 252:515-25-57, as specified in 252:515-25-36(c)(2) and 252:515-25-36(c)(3). A file stamped copy of the notice will be provided to the DEQ as required by 252:515-25-36(d).

2.2 POST-CLOSURE CARE REQUIREMENTS

Consistent with OAC 252:515-25-51(b), the facility will comply with an 8-year post-closure maintenance period, including maintenance of the integrity and effectiveness of the final cover, monitoring groundwater, and maintaining gas venting, collection, or monitoring systems.

Also in accordance with OAC 252:515-25-56(c), a Certification of Post-Closure Performance will be prepared and sealed by an independent professional engineer licensed in the State of Oklahoma.

3.0 FINAL COVER SYSTEM

3.1 FINAL COVER SYSTEM DESIGN

The final cover consists of the following:

- 12-inch vegetated erosion layer, and
- 24-inch-thick compacted clay barrier layer ($k \leq 1x10^{-5}$ cm/sec).

3.2 FINAL COVER SYSTEM INSTALLATION

Testing, evaluation, and documentation of the installation of the final cover system materials will be performed in accordance with Attachment B – Quality Assurance/Quality Control (QA/QC) Plan for Final Cover System Installation.

Individual areas of the landfill may be closed in phases. For construction of each final cover phase, project specific design plans will be prepared and sealed by an independent professional engineer licensed in the State of Oklahoma, in accordance with the site's current permit documents and QA/QC Plan for Final Cover Installation provided in Attachment B. At this time, it is anticipated the final cover will be constructed in individual phases. To reduce financial assurance for the disposal area closed in a phased closure scenario, a certification prepared and sealed by an independent professional engineer licensed in the State of Oklahoma will be submitted to DEQ. Financial assurance may be reduced after receiving approval from DEQ of the closure area. The certification will:

- Certify that the area was closed according to the approved permit documents, design plans, QA/QC Plan, and applicable rules and regulations; and

- Contain a closure report with related drawings, plans, or specifications describing how closure was performed.

4.0 CLOSURE PROCEDURES

4.1 CLOSURE SEQUENCE

The Owner/Operator of the landfill may conduct ongoing closure of the landfill throughout its active life. This procedure allows for successive closures of fill areas by placement of final cover, construction of drainage and erosion control features, and establishment of vegetative cover.

If the site needs to initiate premature closure, closure activities will be required for only the areas of the site that have been constructed and received waste. In the event final grades differ from the permitted final grades, a permit modification application will be submitted to DEQ showing the redesigned final contours and permanent stormwater structures in accordance with the OAC rules and regulations prior to premature closure of landfill.

4.2 CLOSURE DURING ACTIVE LIFE

As described above, the final cover may be constructed as fill areas achieve the design final grades. Should closure of the landfill become necessary at any time during the active life of the landfill, the following steps will be taken:

- Engineering plans will be developed to address site closure at the time of discontinued waste filling;
- The final waste received will be placed and properly compacted;
- Excavations will be filled with suitable material, and the site will be graded to promote runoff and prevent ponding;
- The final cover system will be constructed according to specifications and QA/QC Plan (Attachment B);
- The top of the landfill will be graded and reshaped as needed to provide the proper slope for positive drainage;
- During the first growing season following installation of final cover, the landfill will be vegetated with permanent vegetation;
- A surface water management system will be constructed to minimize erosion consistent with Appendix E – Surface Water Drainage Design Plan;
- A closure certification will be prepared by an independent registered professional engineer and submitted to the DEQ for approval; and
- All proper notices and documentations will be filled with the appropriate agencies.

4.3 ADDITIONAL CLOSURE INFORMATION

The area for waste disposal encompasses 53.5 acres, excluding buffer zones, drainage areas, and unsuitable areas. The estimated maximum capacity of the landfill is 10,277,000 cubic yards, inclusive of weekly and intermediate cover. A final cover grading plan showing contours of the site at final closure is provided as Drawing 7 of the Permit Drawings.

The following procedures will be following to comply with OAC 252:515-25-32(a)(3) and (4)(A) and (F):

- Any temporary structures that are on-site at the time of final closure will be removed or decommissioned from the site. All equipment used during the operation and closure of the landfill will be decontaminated and removed from the site after final closure has been certified as complete.
- All ground and surface water monitoring and sampling, as applicable, will be conducted through the C-PC period in accordance with the approved groundwater sampling and analysis plan (GWSAP) and Oklahoma Discharge Elimination System (OPDES) general permit. Any groundwater monitoring wells and gas monitoring probes found to be defective during closure or post-closure period will be repaired or replaced in accordance with the approved GWSAP and explosive gas monitoring plan (EGMP).
- Site security and access control will be maintained throughout the active life and post-closure period of the landfill. Facilities at the site, including the perimeter fencing, will be maintained throughout the post-closure period.
- Final wastes or affected soils remaining on-site at the time final closure has been completed, will be transported to a facility permitted to handle the wastes and/or affected soils.
- Final closure certification and other required documents and notices will be prepared as discussed in Section 5.1.
- Prior to initiating closure, the existing conditions and applicable regulations will be re-evaluated to ensure that this C-PC Plan is still applicable.
- C-PC cost estimates for the largest area of the landfill that will require final cover during the active life is provided in Attachment A.
- A detailed description of the final cover design is provided in Section 3. Soil for use in the final cover installation will be obtained from excavation of stormwater system, unconstructed future phases, and/or from offsite borrow areas. This soil and other final cover system components will be tested in accordance with methods described in the QA/QC Plan for final cover installation, provided in Attachment B, to confirm that the soil and materials meet the requirements of the DEQ regulations and this plan.
- Soil Mass balance calculations, provided in Attachment C, demonstrate that the facility does not have sufficient soil available onsite for use in final cover installation from on-site borrow sources. As such, soil from offsite borrow sources will be obtained by the Owner/Operator to meet the soil needs of the facility and for final cover installation.
- On-site and off-site soil used in the final cover installation will comply and be placed in accordance with methods described in the QA/QC Plan for final cover installation (Attachment B).
- Any former improper closure or waste placement will be remedied at the time of the last phase of final cover installation at the landfill.
- A final closure survey will be performed by a surveyor, registered in the State of Oklahoma, and will be included with the final cover certification report submitted to the DEQ for approval.

4.4 BORROW AREAS

This section applies to on-site and off-site soil borrow areas that are not permitted and/or used for future waste disposal. On-site borrow areas are related to drainage features or future disposal areas excavated prior to a forced closure scenario. Off-site borrow areas may be acquired and owned by the Owner/Operator of the landfill in future.

To comply with OAC 252:515-19-55 and OAC 252:515-25-32(b)(3), on-site and off-site soil borrow areas will be re-shaped and re-vegetated to blend in with the surrounding terrain within 180 days of the time that excavation activities have been completed. Excess surface water flow into the borrow areas will be handled through means of pumping during development to allow continued excavation of solid material. All surface water discharge locations will be included in the facilitiy Stormwater Pollution Prevention Plan (SWPPP).

After vegetation is established in the borrow areas, these areas will be routinely inspected throughout the life of the site and the C-PC periods. The vegetation cover will be capable of self-regeneration and will require no maintenance. If bare spots develop, then the area will be re-seeded and maintained (e.g., watered and fertilized) until the vegetation is re-established. Also during these inspections, the slopes will be inspected and if necessary re-shaped to maintain their grades.

5.0 CLOSURE SCHEDULE

The site will be closed in an orderly fashion, consistent with OAC 252:515-25-33. The final closure schedule will be as follows:

- DEQ will be notified in writing prior to beginning final closure of the landfill or closure of a disposal area at landfill;
- Closure activities will begin no later than 90 days after final receipt of wastes or final receipt of wastes into a disposal area;
- Closure activities will be completed according to the approved C-PC Plan within 180 days after closure activities are initiated; and
- Extensions of the closure period may be granted by DEQ if the Owner/Operator demonstrates that closure will, of necessity, take longer than 180 days, and that all steps have been taken, and will continue to be taken, to prevent threats to human health or the environment from the unclosed area or facility.

5.1 CERTIFICATION OF FINAL CLOSURE

Upon completion of closure activities, a professional engineer registered in the State of Oklahoma will submit a certification of final closure to the DEQ, certifying that the facility or disposal area was closed in accordance with approved permit documents and this plan, in accordance with OAC 252:515-25-34. The certification of final closure will:

- Be signed by the Owner/Operator;
- State the facility was closed according to the approved closure plan, permit documents, and applicable rules;
- Contain a closure report with related drawings, plans, or specifications describing how closure was performed;
- Indicate whether inspection of gas, groundwater, or surface water monitoring has shown the presence of elevated levels of any constituent or if any evidence of contamination related to site operations has been found and, if so, what corrective measures were taken; and
- Include a final closure map. The final closure map will show as-built conditions at the time of closure including but not limited to:
    - Final contours of the entire site;
    - The final permit boundary and boundaries of disposal areas;
    - The location of gas monitoring probes;
    - The location of groundwater monitoring wells;
    - The location of permanent surface drainage structures;
    - Aesthetic enhancements; and
    - Other relevant information.

5.2 COUNTY LAND RECORDS NOTICE

Upon approval of the final closure of the facility, a notice will be recorded in the land records of the property for Oklahoma County giving notice in perpetuity that the site was used for the disposal of C&D waste and is now closed, in accordance with 252:515-25-36. The notice will specify the type, location, and quantity of wastes disposed. The notice will also identify the required post-closure monitoring period and state that the facility will be monitored for at least 8 years; that a survey plat and record of the disposal area's locations and elevations have been filed with DEQ and with an identified city or county; and that future uses may be restricted in accordance with OAC 252:515-25-57. The Owner/Operator will be responsible for providing a file-stamped copy of the notice to DEQ.

6.0 CLOSURE COST ESTIMATE

A closure cost estimate, including costs for the activities described above, is provided in Attachment A. This closure cost estimate was approved by DEQ on March 9, 2023 and is based on 67.7 acres of permitted landfill footprint that will require final cover.

Closure estimates and the amount of financial assurance provided will be increased if, at any time during the active life, changes to the closure plan of the facility increase the maximum cost of closure. Proposals for reduction of closure cost estimates and the amount of financial assurance required will be submitted to DEQ for approval. To qualify for a reduction, the cost estimate must be demonstrated to exceed the minimum cost of closure during the remaining life of the facility, the amount of security remaining after the reduction must adequately cover the estimated closure cost yet to be performed, and financial assurance will not be reduced until DEQ approval has been granted.

At a minimum, cost estimates for closure will be adjusted no later than April 1st of each year; the adjustment will be submitted to DEQ for approval. In the adjustment, maximum costs of closure may be recalculated, in current dollars, in accordance with OAC 252:515-27-51. If there are no significant changes to the C-PC Plan, the cost estimate may be adjusted by use of an inflation factor derived from the most recent annual *Implicit Price Deflator for Gross National Product* or the *Implicit Price Deflator for Gross Domestic Product* published by the U.S. Department of Commerce in its *Survey of Current Business* in a year for which the adjustment is made. The approved adjusted cost estimate will be placed in the Site Operating Record.

7.0 POST-CLOSURE CARE ACTIVITIES

7.1 MONITORING AND MAINTENANCE

In accordance with OAC 252:515-25-51(b), post-closure care maintenance will commence immediately upon DEQ approval of final closure. Post-closure activities will continue for a period of 8 years, unless the DEQ approves a post-closure period of a different duration. Documentation pursuant to OAC 252:515-3-34 is included in Appendix A of the permit application showing that N.E. Land Fill, LLC owns and has legal right to access all property subject to post-closure care requirements.

To comply with the requirements of OAC 252:515-25-53(3), the Owner/Operator of the landfill will perform post-closure inspections on a quarterly basis during the first three years of the post-closure period. Subsequent inspections will be performed semi-annually for the next two years and annually for the remainder of the post-closure period. Additional inspections may be conducted to observe repairs or evaluate problem areas discovered during prior inspections.

The quarterly, semi-annual, and annual post-closure inspections will consist of the inspection and evaluation of the final cover system and vegetative cover, drainage and erosion control structures, and site security. The frequency and specific inspections associated with the gas monitoring program is addressed in the EGMP provided in Appendix D. Frequency and specific inspections associated with groundwater monitoring will be addressed in the facility's updated Groundwater Monitoring and Sampling Program (GWSAP) that will be submitted to DEQ for approval once the final permit is issued.

In accordance with OAC 252:515-25-52, post-closure monitoring and care period may be extended by DEQ if:

- Sampling shows the presence of elevated levels of any constituent;
- Evidence of contamination resulting from site operations is found to exist;
- Prior maintenance or monitoring of the site is found to be inadequate; or
- If any other conditions are present that indicate a need for additional post-closure monitoring and care.

7.1.1 Drainage and Erosion Controls Structures

In accordance with OAC 252:515-25-53(4)(A), drainage and erosion controls will be inspected throughout the post-closure period to ensure that surface water is conveyed away from the landfill to the perimeter drainage system. Items or conditions to be examined include:

- Erosion;
- Settlement;
- Structural integrity of berms, letdown structures, and other drainage and erosion control structures; and
- Silt and sediment buildup.

Maintenance and repairs should be conducted as soon as practical, and may consist of the following activities:

- Replacement of riprap or other structural lining installed for erosion protection;

- Removal of obstructions to permit conveyance of surface water;
- Placement of fill and re-grading of drainage swales;
- Removal of silt and sediment;
- Repairs to berms; and
- Repair or replacement of stacked hay bales or silt fencing.

7.1.2 Site Security and Access Control

Post-closure site security will be necessary to control unauthorized access and prevent illegal dumping of wastes. Inspection of site security will be performed during the post-closure inspections. Signs will be posted on the outer perimeter indicating the site is a closed landfill, as required by OAC 252:515-25-54(a)(1). The closed facility will be maintained as necessary to provide access to the closed areas throughout the post-closure period.

Maintenance and repairs will be implemented as soon as practical and may include the repair of access roads and repairs or replacement of fencing and locks.

7.1.3 Groundwater Monitoring System

To comply with the requirements of OAC 252:515-25-54(b)(1)(A), semi-annual groundwater monitoring of the monitoring network wells will be completed in accordance with the most recently approved GWSAP, unless reduced in accordance with OAC 252:515-9-73(c).

7.1.4 Landfill Gas Monitoring System

In accordance with OAC 252:515-25-54(b)(1)(B), monitoring of explosive gas monitoring probes located along the site boundary will be conducted on a semi-annual basis during the post-closure period as outlined in the EGMP (Appendix D).

7.1.5 Final Cover

In accordance with OAC 252:515-25-54(b)(3), the integrity and effectiveness of the final cover will be maintained in compliance with OAC 252:515-19-53. The following conditions will be examined during the inspection:

- Settlement;
- Cracking;
- Erosion;
- Animal burrows; and
- Other disturbances affecting either the thickness or configuration of the final cover.

Maintenance and repairs will be conducted as soon as practical and may consist of filling in areas of settlement, re-grading, and slope re-stabilization. In areas of substantial settlement of the final cover, the integrity of the cap will be re-evaluated and any necessary repairs made. The final cover will be maintained to provide the proper slope to promote surface water runoff and prevent ponding of water to minimize infiltration. Settlement that occurs on sideslopes of the landfill will generally not require re-grading or placement of additional cover to maintain surface drainage. Sideslopes are designed no greater than 4:1 (horizontal: vertical) slope, and the crown of the landfill area slopes at a minimum of four (4) percent to minimize the effect of settlement. With these slope conditions, it is anticipated that minimal soil will be required during the post-closure care period for final cover maintenance.

As part of the final cover system inspection, the integrity of the vegetation and its ability to minimize infiltration and erosion will be examined. The following conditions will be examined during the inspection:

- Erosion;
- Overgrowth of shrubs, trees, and other deep-rooted vegetation; and
- Patches of dead vegetation.

Maintenance and repairs of the vegetative cover may consist of the following activities:

- Reseeding, fertilizing, liming, and mulching of washed out areas;
- Brush removal; and
- Mowing.

Reseeding will be conducted as necessary to ensure proper vegetative growth over all areas of the final cover. Mowing and removal of deep-rooted brush and vegetation will be performed as necessary during the growing season.

7.1.6 Annual Post-Closure Care Report

In accordance with OAC 252:515-25-54(a)(2), beginning one year after the DEQ's approval of the certification of final closure, Owner/Operator will submit an annual post-closure maintenance and monitoring report to DEQ until the post-closure period ends. This report will document the maintenance performed at the site and summarize all monitoring data for the previous year. The report will be submitted by April 1st of each year after DEQ's certification of final closure.

8.0 POST-CLOSURE USE OF PROPERTY

There are no current planned uses for the landfill after closure. Should use of the closed landfill not associated with solid waste activities be considered, plans will be prepared and submitted to the DEQ for review and approval as per OAC 252:515-25-55.

9.0 CERTIFICATION OF POST-CLOSURE PERFORMANCE

In accordance with OAC 252:515-25-56, Owner/Operator may submit a certification of post-closure period performance in lieu of the annual post-closure report. This certification will be prepared and sealed by a professional engineer registered in the State of Oklahoma certification and will indicate the following:

- That the landfill was maintained and monitored in accordance with the approved post-closure plan, the permit, and applicable regulations.
- Whether monitoring throughout the post-closure period has shown the presence of elevated levels of any constituent or if any evidence of contamination related to site operations has been found and, if so, what corrective measures were taken.
- That the certification will be maintained in the Site Operating Record.

10.0 POST-CLOSURE CARE COST ESTIMATE

A cost estimate for post-closure care of the landfill, including costs for the activities described above, is provided in Attachment A. This estimate has been prepared in accordance with OAC 252:515-27-32, OAC 252:515-27-51(a), and include the following costs:

- Quarterly site inspection,
- Site security and access control,
- Final cover erosion and seeding repair,
- Semi-annual groundwater monitoring,
- Surface water control structure maintenance,
- Semi-annual explosive gas monitoring,
- Annual reporting, and
- Certification and recordkeeping.

Post-closure estimates and the amount of financial assurance provided will be increased if, at any time during the active life, changes to the closure plan of the facility increase the maximum cost of post-closure. Proposals for reduction of post-closure cost estimates and the amount of financial assurance required will be submitted to the DEQ for approval. To qualify for a reduction, the cost estimate will be demonstrated to exceed the minimum cost of post-closure during the remaining post-closure care period, the amount of security remaining after the reduction must adequately cover the estimated post-closure cost yet to be performed, and financial assurance will not be reduced until DEQ approval has been granted.

At a minimum, cost estimates for post-closure will be adjusted no later than April 1st of each year; the adjustment will be submitted to the DEQ for approval. In the adjustment, maximum costs of post-closure may be recalculated, in current dollars, in accordance with OAC 252:515-27-51. If there are no significant changes to the post-closure plan, the cost estimate may be adjusted by use of an inflation factor. The inflation factor can be derived from the most recent annual Implicit Price Deflator for Gross National Product or the Implicit Price Deflator for Gross Domestic Product published by the U.S. Department of Commerce in its Survey of Current Business in a year for which the adjustment is made. The approved adjusted cost estimate will be placed in the Site Operating Record.

If corrective action is required at the landfill, cost estimates for corrective action will be submitted to the DEQ for approval. The cost estimates will be a detailed written estimate, in current dollars, of the cost of hiring a third party to perform the corrective action in accordance with an approved corrective action plan. The corrective action cost estimate will be set by the DEQ and account for the total costs of corrective action activities as described in an approved corrective action plan for the entire corrective action period. The amount of financial assurance provided must be increased to account for corrective action costs.

11.0 ECONOMIC LIFE OF FACILITY

In accordance with OAC 252:515—27-8, the economic life of the proposed landfill has been calculated as follows:

$$L = \frac{\{[V - (P \; x \; V)] \; x \; D}{W}$$

where, L = Life of the disposal facility, in years;

V = Total volume of air space in cubic yards available for waste, weekly, and intermediate cover,

P = Anticipated percentage of V that will be taken up by weekly and intermediate cover,

D = Anticipated density of waste compacted in place in pounds per cubic yard,

W = Amount of waste expected to be received during one year of operation in pounds per year

In accordance with OAC 252:515-27-8(a)(2), the following values were used to estimate the life of the landfill:

V = 10,302,689 cy

P = 0.15

D = 1,000 lbs/cy

W = 269,261.4 tons received in 2022.

Using these parameters, life of the landfill is estimated as follows:

$$L = \frac{\{[10{,}302{,}689 \text{ cy} - (0.15 \; x \; 10{,}302{,}689)] x \; 1{,}000 \frac{lb}{cy}}{269{,}261.4 \frac{tons}{year} * 2{,}000 \frac{lb}{cy}}$$

Therefore, L =

$$L = 16.3 \; years$$

12.0 FINANCIAL ASSURANCE MECHANISM

At a minimum, the Financial Assurance Mechanism (FAM) will be updated no later than April 9th of each year. Updates will address modifications to the landfill's C-PC requirements, if any, and the associated cost estimates. If there are no significant changes to the C-PC Plan, the cost estimate may be adjusted by use of an inflation factor. The inflation factor can be derived from the most recent annual *Implicit Price Deflator for Gross National Product* or the *Implicit Price Deflator for Gross Domestic Product* published by the U.S. Department of Commerce in its *Survey of Current Business* in a year for which the adjustment is made. The current FAM will be placed in the Site Operating Record.

Attachment A

Closure and Post-Closure Cost Estimates

Saraf, Sandeep

From:	Eduardo Choquis <echoquis@gflenv.com>
Sent:	Thursday, March 9, 2023 12:51 PM
To:	Kaylee Daneshmand; Robert Starke
Cc:	Saraf, Sandeep; Marcos Elizondo; David Bahrenburg
Subject:	RE: Northeast C&D Landfill 2023 C-PC Cost Estimates

Good afternoon Kaylee – thank you for the approval. Original hardcopy of the bonds were submitted to:

Carol Bartlett
Oklahoma Department of Environmental Quality
707 North Robinson
P.O. Box 1677
Oklahoma City, OK 73101-1677

Rob – please go ahead and start using Cell 9B-10 West for waste disposal.

Eduardo Choquis | Region Field Engineer
GFL Environmental
2050 W. Sam Houston Parkway S, Houston, TX 77042
| **C** (281) 910-0593 |
echoquis@gflenv.com | www.gflenv.com

From: Kaylee Daneshmand <Kaylee.Daneshmand@deq.ok.gov>
Sent: Thursday, March 9, 2023 10:14 AM
To: Eduardo Choquis <echoquis@gflenv.com>
Cc: Saraf, Sandeep <SSaraf@scsengineers.com>; Robert Starke <rstarke@gflenv.com>; Marcos Elizondo <melizondo@gflenv.com>; David Bahrenburg <dbahrenburg@gflenv.com>
Subject: RE: Northeast C&D Landfill 2023 C-PC Cost Estimates

Eduardo,

Northeast may begin placing waste in the new cell. Please submit the original hardcopy of the bond as well.

Thank you,

Kaylee

From: Eduardo Choquis <echoquis@gflenv.com>
Sent: Tuesday, March 7, 2023 1:56 PM
To: Kaylee Daneshmand <Kaylee.Daneshmand@deq.ok.gov>
Cc: Saraf, Sandeep <SSaraf@scsengineers.com>; Robert Starke <rstarke@gflenv.com>; Marcos Elizondo <melizondo@gflenv.com>; David Bahrenburg <dbahrenburg@gflenv.com>
Subject: [EXTERNAL] Re: Northeast C&D Landfill 2023 C-PC Cost Estimates

Good afternoon Kaylee- attached are the updated closure and post closure bonds for Northeast landfill. Could you please confirm we're able to use the recently constructed cell 9B-10? We're just about out of airspace. Thank you

Sent from my iPhone

Eduardo Choquis | Region Field Engineer
GFL Environmental
2050 W. Sam Houston Parkway S, Houston, TX 77042
| **C** (281) 910-0593 | echoquis@gflenv.com | www.gflenv.com

On Feb 23, 2023, at 15:46, Kaylee Daneshmand <Kaylee.Daneshmand@deq.ok.gov> wrote:

Thank you for the submittal Sandeep. I will get this reviewed and approved ASAP.

Thanks,

Kaylee

From: Saraf, Sandeep <SSaraf@scsengineers.com>
Sent: Tuesday, February 21, 2023 7:01 PM
To: Eduardo Choquis <echoquis@gflenv.com>; Kaylee Daneshmand <Kaylee.Daneshmand@deq.ok.gov>
Cc: Robert Starke <rstarke@gflenv.com>; Marcos Elizondo <melizondo@gflenv.com>; David Bahrenburg <dbahrenburg@gflenv.com> <dbahrenburg@gflenv.com>
Subject: [EXTERNAL] Northeast C&D Landfill 2023 C-PC Cost Estimates

Kaylee,

Attached, for your review/approval, are the 2023 closure/post-closure cost estimates for Northeast C&D Landfill which include addition of Phases 9B and 10 and removal of GP-5.

Please feel free to contact me if you need additional information related to the attached.

Regards,

February 21, 2023
File No. 16223015.00

Ms. Kaylee Daneshmand, E.I.
Land Protection Division,
Oklahoma Department of Environmental Quality,
707 N. Robinson Avenue,
Oklahoma City, OK 73102

Subject: **2023 Updated Closure and Post Closure Cost Estimates**
Northeast C&D Landfill; N.E. Land Fill, LLC
DEQ Permit No.: 3555050

Dear Ms. Daneshmand:

On behalf of N.E. Land Fill, LLC (a subsidiary of WCA of Oklahoma, LLC, a GFL Environmental [GFL] company), please find the attached updated Closure and Post-Closure (C-PC) cost estimates for the Northeast C&D Landfill (landfill).

The C-PC cost estimates have been updated in accordance with the requirements of Oklahoma Administrative Code (OAC) 252:515-27, using the Oklahoma Department of Environmental Quality (DEQ) 2023 Worksheet for calculating C-PC cost estimates, and are included in Attachment A. C-PC care activities will be performed in accordance with the landfill's approved permit and C-PC Plans. The updated surety bonds will be submitted by GFL separately.

If you have any questions regarding the information contained in this report, please contact me at telephone number (407) 923-7013.

Sincerely,

Sandeep Saraf, P.E.
Senior Project Manager
SCS Engineers

Attachments: A – Closure and Post-Closure Cost Estimates for 2023

cc: Marcos Elizondo – GFL
David Bahrenburg – GFL
Eduardo Choquis – GFL
Robert Starke – GFL

Attachment A

Closure and Post-Closure Cost Estimates

Table H.1 2023 Site Data
Facility Name: Northeast C&D Landfill
Facility Owner: N.E. Land Fill, LLC
Permit Number: 3555050

Description	Quantity	Units	Notes
Total Permitted Area	85.00	acres	
Active Portion			
Composite Lined	-	acres	Not Required for a C&D Landfill
Phase I (Clay Lined)	8.58	acres	Cardinal Eng. LIT Report 2000
Phase II and III (Clay Lined)	19.30	acres	Carel Corp. LIT Report December 2002
Phase 4 (Clay Lined)	5.00	acres	Golder Associates Report June 2009
Phase 5 (Clay Lined)	5.00	acres	SEDCo Report September 2010
Phase 6 (Clay Lined)	10.30	acres	SEDCo Report June/ August 2013
Phase 7 (Clay Lined)	3.65	acres	SEDCo CQA Report dated June 2016
Phase 8 (Clay Lined)	3.90	acres	SEDCo Tier I Permit Mod Feb. 2018
Phase 9A (Clay Lined)	5.00	acres	SCS Engineers LIT Report March 12, 2020
Phases 9B and 10 (Clay Lined)	8.00	acres	Phase 9B and 10 West LIT prepared by SCS in February 2023. Phase 9B and 10 East (4.0 ac) currently under construction. C-Plans for Phase 9B and 10 prepared by SCS in September 2022
Total Liner Constructed	68.73	acres	Total permitted waste disposal footprint
Area of Lagest Cell/Phase Requiring Final Cap			Using C-P/C Plan Created by Cardinal Engineers in October 2005
Composite Lined	-	acres	Not Required for a C&D Landfill
Soil Lined	68.73	acres	See above
Perimeter Fencing	10,500	LF	
Groundwater Monitoring Wells	347.1	VLF	Stuever & Associates Permit Mod 10/01
Methane Gas Probes	553.0	VLF	None specified in original permit. Reflects GP-5 removal in November 2022
Terraces	-	LF	None specified in original permit
Letdown Channels	-	LF	None specified in original permit
Perimeter Drainage Ditches	7,100.0	LF	SCS Engineers Phase 9A October 2019
2022 Tons Received	269,261.4	tons	Based on incoming waste report for 2022
Operating Days/Year	286.0	days	5 full days and 1 half day per week
Average Daily Waste Tonnage	941.5		
Landfill Disposal Cost	$ 20.38	$/ton	Average Gate Rate

VLF= Vertical Linear Feet. The sum of the depths of all monitoring wells.

Table H.2 2023 Closure Cost Estimate
Facility Name: Northeast C&D Landfill
Facility Owner: N.E. Land Fill, LLC
Permit Number: 3555050

	Task/Service	Quantity	Units	Multiplier	Unit Cost for 2023	Subtotal
1	**PRELIMINARY SITE WORK**					
1.1	Conduct Site Evaluation	1.00	LS	1	$4,222.39	$4,222.39
1.2	Dispose Final Waste					
	Average Daily Flow	941.50	tons/day			
	Disposal Cost	941.50	tons/day	5	$20.38	$95,938.85
1.3	Remove Temporary Building(s)	1.00	LS	1	$3,871.95	$3,871.95
1.4	Remove Equipment	1.00	LS	1	$3,160.64	$3,160.64
1.5	Repair/Replace Perimeter Fencing	10,500.00	LF	0.25	$4.14	$10,867.50
1.6	Clean Leachate Line(s)	0.00	LS	1	$1,912.44	$0.00
2	**MONITORING EQUIPMENT**					
2.1	Rework/Replace Monitoring Well(s)	347.10	VLF	0.25	$88.78	$7,703.88
2.2	Plug Abandoned Monitoring Well(s)	347.10	VLF	0.25	$35.54	$3,083.98
2.3	Rework/Replace Methane Probe(s)	553.00	VLF	0.25	$76.68	$10,601.01
2.4	Plug Abandoned Methane Probe(s)	553.00	VLF	0.25	$28.02	$3,873.77
2.5	Rework/Replace Remediation and/or Gas Control System	1.00	LS	0.05	$0.00	$0.00
3	**CONSTRUCTION**					
3.1	Complete Site Grading	68.73	AC	1	$1,674.07	$115,058.83
3.2	Construct Final Cap					
	Compacted On-Site Clay or	221,768.80	CY	1	$6.01	$1,332,830.49
	Compacted Off-Site Clay or		CY	1	$9.77	$0.00
	Install Geosynthetic Clay Liner Cap		SF	1	$0.63	$0.00
3.3	Construct Landfill Gas Venting Layer					
	Place Sand or	0.00	AC	1	$44,762.88	$0.00
	Install Net and Geotextile	0.00	SF	1	$0.44	$0.00
3.4	Install Passive Landfill Gas Vents	0.00	AC	1	$1,072.36	$0.00
3.5	Install Flexible Membrane Liner	0.00	SF	1	$0.49	$0.00

	Task/Service	Quantity	Units	Multiplier	Unit Cost for 2023	Subtotal
3.6	Drainage Layer					
	Place Sand or		AC	1	$44,762.88	$0.00
	Install Net and Geonet	0.00	SF	1	$0.44	$0.00
3.7	Place On-Site Topsoil	110,884.40	CY	1	$2.59	$287,190.60
	Place Off-Site Topsoil	0.00	CY	1	$20.69	$0.00
3.8	Establish Vegetative Cover, Including On- and Off-Site Borrow Areas	68.73	AC	1	$1,193.06	$81,999.01
4	**DRAINAGE/EROSION CONTROL**					
4.1	Construct Terrace (Swale)	0.00	LF	1	$10.84	$0.00
4.2	Construct Letdown Channels (Downchute)	0.00	LF	1	$118.51	$0.00
4.3	Clean Perimeter Drainage Ditches (Channels)	7,100.00	LF	0.50	$8.26	$29,323.00
5	**TASK NOT IDENTIFIED**					
5.1	Grinding Wood Waste	1.00	LS	1	$116,500.22	$116,500.22
6	**SUBTOTAL**					$2,106,226.12
7	**ADMINISTRATIVE SERVICES**	1.00	LS	0.10	$2,106,226.12	$210,622.61
8	**TECHINCAL and PROFESSIONAL SERVICES**	1.00	LS	0.12	$2,106,226.12	$252,747.13
9	**CLOSURE CONTINGENCY**	1.00	LS	0.10	$2,106,226.12	$210,622.61
10	**TOTAL FINAL CLOSURE**					**$2,780,218.48**

Table H.3 2023 Post-Closure Cost Estimate
Facility Name: Northeast C&D Landfill
Facility Owner: N.E. Land Fill, LLC
Permit Number: 3555050

	Task/Service	Quantity	Units	Multiplier	Unit Cost for 2023	Subtotal
1	**SITE MAINTENACE**					
1.1	Site Inspection	4.00	LS	8	$768.10	$24,579.20
1.2	General Maintanace	1.00	LS	8	$2,302.81	$18,422.48
1.3	Remediation and/or Gas Control Equipment	0.00	LS	0.30	$0.00	
2	**MONITORING EQUIPMENT**	0.00				$0.00
2.1	Rework/Replace Monitoring Well(s)	347.10	VLF	0.25	$88.78	$7,703.88
2.2	Plug Abandoned Monitoring Well(s)	347.10	VLF	0.25	$35.54	$3,083.98
2.3	Final Plugging of Monitoring Well(s)	347.10	VLF	1	$35.54	$12,335.93
2.4	Rework/Replace Methane Probe(s)	553.00	VLF	0.25	$76.68	$10,601.01
2.5	Plug Abandoned Methane Probe(s)	553.00	VLF	0.25	$28.02	$3,873.77
2.6	Final Plugging of Methane Probe(s)	553.00	VLF	1.00	$28.02	$15,495.06
2.7	Final Plugging of Piezometer(s)	0.00	VLF	1.00	$28.02	$0.00
3	**SAMPLING and ANALYSIS**	0.00				$0.00
3.1	Groundwater Monitoring Wells	6.00	Wells	16	$204.44	$19,626.24
3.2	Methane Gas Probes	17.00	Probes	60	$53.75	$54,825.00
3.3	Surface Water Monitoring Points	0.00	Points	60	$99.81	$0.00
3.4	Leachate	0.00	Sample	60	$160.84	$0.00
4	**FINAL COVER MAINTENANCE**					
4.1	Mow and Fertilize Vegetative Cover	68.73	AC	8	$254.10	$139,714.34
4.2	Repair Erosion, Settlement, and Subsidence for On-Site Soils	68.73	AC	16	$3.69	$4,057.82
	Repair Erosion, Settlement, and Subsidence for Off-Site Soils	0.00	AC	8	$22.04	$0.00
4.3	Re-Seed Vegetative Cover	68.73	AC	0.20	$1,193.06	$16,399.80

	Task/Service	Quantity	Units	Multiplier	Unit Cost for 2023	Subtotal
5	**LEACHATE MANAGEMENT**					
5.1	Clean Leachate Line(s)	0.00	Per Year	30	$1,969.62	$0.00
5.2	Maintain Leachate Collection System and Equipment	0.00	Per Year	30	$3,059.88	$0.00
5.3	Collect, Treat, Transport and Dispose Leachate	0.00	Gallons/Year	30	$0.39	$0.00
6	**TASK NOT IDENTIFIED**					
7	**SUBTOTAL**					$330,718.52
8	**ADMINISTRATIVE SERVICES**	1.00	LS	0.06	$330,718.52	$19,843.11
9	**TECHINCAL and PROFESSIONAL SERVICES**	1.00	LS	0.07	$330,718.52	$23,150.30
10	**POST-CLOSURE CONTINGENCY**	1.00	LS	0.10	$330,718.52	$33,071.85
11	**TOTAL POST-CLOSURE**					**$406,783.78**

Total Closure Cost Estimate (from Closure Worksheet) =	**$2,780,218.48**
Total Post-Closure Cost Estimate (from PC Cost Estimate Worksheet) =	**$406,783.78**
Total Closure and Post-Closure Cost Estimate =	**$3,187,002.26**

Attachment B

Quality Assurance/Quality Control Plan for Final Cover System Installation

Scott A. Thompson
Executive Director

OKLAHOMA Environmental Quality

Kevin Stitt
Governor

October 13, 2022

Mr. David Bahrenburg
WCA Waste Corporation – Northeast Landfill
1001 S. Rockwell Ave.
Oklahoma City, Oklahoma 73128

Re: Tier I Permit Modification Application for a QA/QC Plan for Final Cover System Installation
Northeast C&D Landfill, Oklahoma County
Solid Waste Permit No. 3555050

Dear Mr. Bahrenburg:

The Oklahoma Department of Environmental Quality (DEQ) received the Tier I Permit Modification Application for a QA/QC Plan for Final Cover System Installation via email from SCS Engineers on behalf of WCA Waste Corporation – Northeast Landfill on September 2, 2022.

The submittal includes revisions to reference the QA/QC plan during completion of final closure installation activities and add the QA/QC plan into the permit application. The QA/QC Plan was prepared in accordance with OAC 252:515-32(b)(2)(F). DEQ approves the QA/QC Plan for Final Cover System Installation and revisions to the Closure Plan.

Thank you for the submittal. This letter serves as the Tier I Modification. If you have any questions, please contact Kaylee Shiplet at (405) 702-5196 or Kaylee.shiplet@deq.ok.gov.

Sincerely,

Hillary Young

Hillary Young, P.E.
Chief Engineer
Land Protection Division

HY/ks

cc: Sandeep Saraf, P.E., SCS Engineers
Mr. Eduardo Choquis, P.E., WCA Engineer

SCS ENGINEERS

Environmental Consulting & Contracting

September 2, 2022
File No. 16222045.00

Ms. Hillary Young
Oklahoma Department of Environmental Quality
Division of Land Protection
707 N. Robinson
Oklahoma City, Oklahoma 73101-1677

Subject: **Tier I Permit Modification Application for a QA/QC Plan for Final Cover System Installation**
Northeast Landfill
ODEQ Permit No. 3555050

Dear Ms. Young:

On behalf of N.E. Land Fill, LLC. (a subsidiary of WCA of Oklahoma, LLC., a GFL Environmental company), SCS Engineers is submitting two (2) copies of the attached Tier I permit modification application for the Northeast Landfill to incorporate a Quality Assurance/Quality Control (QA/QC) Plan for final cover system installation into the permit application in accordance with Oklahoma Administrative Code (OAC) 252:515-25-32(b)(2)(F). This Tier I permit modification application has been prepared in accordance with OAC 252:515-3-41-7, and includes the following information:

1. Permit Application Form #515-020
2. Permit Modification Application, which includes the following attachments to address the above-mentioned revisions to the approved permit application:
    a. Attachment 10 – Closure and Post-Closure Plan was revised to reference the QA/QC plan during completion of final closure installation activities.
    b. Attachment 10, Attachment 2 – QA/QC for Final Cover System Installation was added into the permit application.

Information that was previously submitted and is being modified with this Tier I permit modification application has been included as marked (Attachment B) and unmarked version (Attachment C) for ease of review. Where possible, we have identified proposed changes from the approved permit application in a redline/strike-out version (i.e. marked version).

We trust that you will find this permit application to be satisfactory. If you have any questions regarding the information contained in this report, please contact Sandeep Saraf, P.E. at telephone number (407) 923-7013.

Sincerely,

Sandeep Saraf, P.E.
Senior Project Manager
SCS Engineers

Brett DeVries, Ph.D.
Project Manager
SCS Engineers

Attachments: Attachment A – Permit Application Form #515-020
Attachment B – Permit Revisions (Marked)
Attachment C – Permit Revisions (Unmarked)

cc: David Bahrenburg – GFL
Eduardo Choquis – GFL
Robert Starke – GFL
Matt Sanders - GFL

Attachment 2
Quality Assurance/Quality Control Plan for Final Cover System Installation

Northeast Landfill

Permit No. 3555050

Prepared for:

N.E. Land Fill, LLC.
2601 North Midwest Blvd
Spencer, OK 73084
405-495-0800

Prepared by:

SCS ENGINEERS
1901 Central Drive, Suite 550
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August 2022
File No. 16222045.00

Offices Nationwide
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This Quality Assurance/Quality Control (QA/QC) Plan for final cover system installation has been prepared in accordance with good engineering practice, including consideration of industry standards and the requirements of the Oklahoma Department of Environmental Quality, as defined in the applicable sections of Oklahoma Administrative Code (OAC) 252:515-25-32(b)(2)(F), related to the QA/QC for final cover system components.

Prepared by:

Saraf Sandeep, P.E.
Senior Project Manager
SCS Engineers

1.0 INTRODUCTION

1.1 PURPOSE

The purpose of this Quality Assurance/Quality Control (QA/QC) Plan is to describe the quality control and assurance procedures to be used during construction of the final cover system components at the Northeast Landfill (landfill) in accordance with OAC 252:515-25-32(b)(2)(F) as promulgated by the Oklahoma Department of Environmental Quality (DEQ). The primary goals of the quality assurance program are to:

- Determine if proper construction techniques, materials, and procedures are used;
- Determine if the intent of the construction documents and project design reports are met; and
- Identify construction problems and provide a mechanism for resolution.

Upon completion of construction, information generated through the quality assurance program will be used to prepare a Final Cover Certification Report (FCCR).

The final cover will consist of the following components from top to bottom:

- 12-inch vegetated erosion layer;
- 24-inch-thick earthen material barrier layer ($k \leq 1x10^{-5}$ cm/sec)
- Intermediate cover (foundation layer).

This QA/QC Plan, which will be followed during the installation and testing of the final cover system components, outlines materials selection and evaluation, laboratory test requirements, field test requirements and treatment of problems for the components described above. This QA/QC Plan also includes reporting requirements for the FCCR for the construction quality assurance of the erosion layer and barrier layer.

1.2 DEFINITIONS

Whenever the terms listed below are used, the intent and meaning shall be interpreted as indicated.

1.2.1 ASTM

This means the American Society for Testing and Materials.

1.2.2 Construction Quality Assurance (CQA)

A planned system of activities that provides the Landfill Owner/Operator and permitting agency assurance that the final cover will be constructed as specified in the design, construction plans and technical specifications (collectively referred to as the Contract Documents) prepared for the cover construction. CQA includes observations and evaluations of materials and workmanship necessary to assess and document that construction has been performed consistent with the applicable contract and permit documents. CQA refers to measures taken by the CQA professional of record and/or CQA monitor to assess if the final cover system construction has been in compliance with the permit drawings and this QA/QC Plan for the site.

1.2.3 CQA Professional of Record (POR)

The POR is an authorized representative of the owner (but is not an employee of the owner/operator or construction company) and has responsibility for construction quality assurance reporting and confirming that the facility was constructed in general accordance with construction drawings and specifications approved by the permitting agency. The POR is identified as the “Engineer” in the project specifications. The POR must be registered as a Professional Engineer in the State of Oklahoma. The POR may also be known in applicable regulations and guidelines as the CQA Engineer, Resident Project Representative, or Geotechnical Professional (GP).

1.2.4 CQA Monitors

These are representatives of the POR who work under direct supervision of the POR. The CQA Monitor is responsible for quality assurance monitoring and performing on-site tests and observations. Any references to monitoring, testing, or observations to be performed by the GP should be interpreted to mean the POR or CQA Monitor working under the POR’s direction.

1.2.5 Construction Quality Control (CQC)

These actions provide a means to measure the characteristics of an item, material, or service to comply with the requirements of the contract or permit documents. CQC actions will be performed by the Contractor or manufacturer of materials. All quality control testing shall be performed prior to or during construction of the final cover. In no instance shall quality control field or laboratory testing be undertaken after completion of final cover system construction.

1.2.6 Contract Documents

These are the official set of documents provided by the Owner. The documents include bidding requirements, contract forms, contract conditions, technical specifications, construction plans, addenda, and contract modifications.

1.2.7 Technical Specifications (or Specifications)

These are the qualitative requirements for products, materials, and workmanship upon which the construction contract is based.

1.2.8 Contractor

This is the person or persons, firm, partnership, corporation, or any combination, who as an independent contractor, has entered into a contract with the Owner.

1.2.9 Design Engineer

These individuals or firms are responsible for the design and preparation of the project construction drawings and technical specifications; also referred to as "designer" or "engineer."

1.2.10 Earthwork

This is a construction activity involving the use of soil materials as defined in the technical specifications.

1.2.11 Nonconformance

A deficiency in characteristic, documentation, or procedure that renders the quality of an item or activity unacceptable or indeterminate. Examples of nonconformance include, but are not limited to, physical defects, test failures, and inadequate documentation.

1.2.12 Operator

The organization that will operate the landfill disposal unit.

1.2.13 Operator's Representative

This is the person that is an official representative of the operator responsible for planning, organizing, and controlling the construction activities.

1.2.14 Procedure

A document that specifies or describes how an activity is to be performed.

1.2.15 Project Documents

Contractor submittals, construction drawings, record drawings, specifications, shop drawings, construction quality control and quality assurance plans, safety plan, and project schedule.

1.2.16 Record Drawings

Drawings recording the constructed dimensions, details, and coordinates of the project (also referred to as "as-builts").

1.2.17 Surveyor

The individual or firm responsible for grade staking to establish required elevations to construct the project in accordance with the drawings and specifications.

1.2.18 Testing

Verification that materials meet specified requirements by subjecting that material to a set of physical, chemical, environmental, or operating conditions.

1.2.19 Testing Laboratory

A laboratory capable of conducting the tests required by this QA/QC Plan and the specifications. Testing may be done by the same laboratory or by a separate soils testing laboratory and a geosynthetics testing laboratory.

1.2.20 USCS

Unified Soil Classification System (ASTM D2487).

2.0 CONSTRUCTION QUALITY ASSURANCE FOR EARTHWORK

2.1 INTRODUCTION

The overall goal of the earthwork quality assurance program is to assure that proper construction techniques and procedures are used and that the project is built in accordance with the project construction drawings and specifications. Another function of the quality assurance program is to identify problems that may occur during construction and to verify that these problems are avoided or corrected before construction is completed.

Construction must be conducted consistent with the project construction drawings and specifications. To monitor conformance, a quality assurance testing program will be implemented that includes:

- A review of the contractor's quality control submittals,
- Material evaluation,
- Construction testing, and
- Construction observation.

Activities will be conducted in accordance with this plan, and the project construction drawings and specifications.

The following subsections describe general construction procedures to be used for the barrier and erosion layers of the final cover system construction at the landfill.

2.2 BARRIER LAYER

For this landfill, the soil used within the barrier layer will be a 2-foot of earthen material, as described in Section 1.1.

In accordance with OAC 252:515-19-53(a)(1)(A) and (B), soil for the barrier layer will achieve an installed permeability of $1x10^{-5}$ cm/s or less.

During construction, the CQA Monitor will:

- Verify that grade control construction staking is performed prior to work;
- Verify that structures (e.g. surface water drainage components, etc.) are not damaged during placement operations; and
- Verify corrective action measures as determined by the verification survey. (The POR will coordinate with the project surveyor to perform a thickness verification survey of the barrier layer materials upon completion of placement operations).

2.2.1 Pre-Construction Testing

Pre-construction testing will be performed for each soil material borrow source and for each identifiable change in material from an individual borrow source (i.e., change in color and plasticity or gradation based on visual observation by the POR or CQA Monitor). A change in color only (with same gradation and plasticity characteristics) will not be considered a change of material. Density test results will be reported as a percentage of the maximum dry density at a corresponding optimum moisture content. Pre-construction testing for barrier layer will be performed at a frequency summarized in Table 2-1.

For each soil sample, correlations will be developed based on moisture-density tests and permeability tests (performed on soil samples at a calculated density) to demonstrate that the soils will have the required permeability at the specified level of compaction. Soil density test results will be reported as a percentage of the maximum dry density at the corresponding optimum moisture content. Correlation testing will be provided to POR and CQA Monitor for use in the field during soil barrier layer construction.

Table 2-1. Soil Barrier Layer Pre-Construction Testing Schedule

Test	Method	Frequency
Soil Classifications	ASTM D2487	1 per 20,000 cy or change of material or borrow area
Percent Passing No. 200 Sieve	ASTM D1140	
Atterberg Limits	ASTM D4318	
Standard Proctor	ASTM D698	
Hydraulic Conductivity (1)	ASTM D5084(2)(3)	

1. Field testing of permeability (in accordance with ASTM D5093) is optional, and may be replaced by laboratory testing.
2. Testing procedures in Appendix VII of the Corps of Engineers Manual EM 1110-2-1906, November 30, 1970, Laboratory Soils Testing, may be used as an alternative method.
3. Permeability tests will be conducted with tap water or 0.05N solution of CaSO4. Distilled water will not be allowed.

2.2.2 Construction Testing

Construction quality assurance for the soil barrier layer will consist of both laboratory and field testing, as specified in Table 2-2. The POR or CQA Monitor will be on-site during all construction activities. Laboratory testing (conventional oven drying method, and hydraulic conductivity) will be performed by an independent geotechnical laboratory on representative samples of the constructed barrier layer. This testing program will be conducted to verify that the barrier layer complies with the specification provided herein.

Table 2-2. Soil Barrier Layer Construction Testing Schedule

Test	Method	Minimum Frequency
Density of Soil In-Place	ASTM D2922(1)	3 per acre for each approximate 6-inch compacted lift
Hydraulic Conductivity	ASTM D5084(2)(3)	1 per acre (evenly distributed through all lifts)(4)
Thickness	N/A	100-foot square grid with a minimum of 2 reference points with a vertical tolerance of 0.0 feet to +0.4 feet on the top of the barrier surface

1. Driven-cylinder method (ASTM D2937); rubber balloon method (ASTM D2167); sand-cone method (ASTM D1556); microwave drying method (ASTM D4643); or conventional oven dry method (ASTM D2216) may be used as an alternative for ASTM D2922.
2. Hydraulic conductivity tests will be run using tap water or a 0.05N solution of $CaSO_4$. Distilled water will not be allowed.
3. Field testing of permeability (in accordance with ASTM D5093) is optional, and may be replaced by laboratory testing.
4. The requirement of 1 permeability test per surface acre of cover should be met by testing each lift for permeability at a frequency of 1 test per 4 acres.

2.2.3 Thickness Verification

The thickness (minimum 2-foot) of constructed barrier layer will be verified by surveying methods. As described in Table 2-2, thickness verification will be performed for every 100-foot square grid with a minimum of 2 reference points. Elevation calculations necessary for thickness verification will be included in the FCCR submittal.

2.2.4 Construction Procedures

The following guidelines apply during placement of the barrier layer:

- Remove existing vegetation (if necessary);
- The intermediate cover should be scarified (roughened) prior to placing the first lift of the barrier layer, thus providing adequate bonding between the clay and underlying foundation soils. The CQA Monitor will inspect the adequacy of the scarification and compaction effort in providing good lift bonding (i.e., no smooth interface between lifts) during the initial stages of layer installation.
- The soil barrier Layer will be constructed in compacted lifts not exceeding 6 inches. The top of each subsequent lift should be scarified (roughened) to a shallow depth (approximately 1-inch) prior to the spreading and compaction of successive lifts, thereby providing bonding between the lifts.
- The barrier layer material will not be compacted with a bulldozer or any track-mobilized equipment unless it is used to pull a pad-footed roller. The barrier layer material will be compacted with a pad-footed or prong-footed roller only. The maximum clod size of the barrier layer material will be approximately one-inch in diameter. In all cases, soil clods will be reduced to the smallest size necessary to achieve the coefficient of permeability reported by the testing laboratory and to destroy any macrostructure evidenced after the compaction of the clods under density-controlled conditions.

- No loose lift will be thicker than the pads of the compactor so that complete bonding with the top of the previous lift is achieved.

- The barrier layer material will consist of relatively homogeneous cohesive materials, which are free of debris, rock greater than 1-inch in diameter, plant materials, frozen materials, foreign objects, organics, and other deleterious materials. The barrier layer material will be placed in maximum 9-inch loose lifts to produce a compacted lift thickness of approximately 6 inches. The material will be compacted to a minimum of 95 percent of the maximum dry density as determined by standard Proctor (ASTM D698), at a moisture content ranging from 0% to +4% above optimum moisture content in order to achieve a permeability of less than or equal to $1x10^{-5}$ cm/s.

- Water will be applied as necessary to the material and worked evenly into the material. Water used for the barrier layer material will be clean and not contaminated by waste or any objectionable material. Storm water collected on-site may be utilized if it has not come into contact with solid waste.

- Construction of barrier layer will not be conducted in adverse weather conditions (heavy rain, freezing temperatures, etc.).

- Although not anticipated since design grades are not greater than 4H:1V, equipment and safety limitations prohibit finished grades with slopes greater than 3H:1V if the barrier layer is constructed parallel to the surface. Compaction equipment placing sideslope barrier layer material on slopes steeper than 3H:1V results in reduced stability of compaction equipment, and reduction in compaction efficiency.

- Any perforations required for obtaining laboratory samples will be repaired by backfilling the hole with bentonite chips or 50/50 powdered/granulated bentonite/soil/sand mixture hand-tamped into place. If the hole is in the upper lift of barrier layer, the upper 2 inches will be backfilled by clayey soil which will be hand-tamped sufficiently to blend the backfill into the adjacent soil layer lift.

- Construction of barrier layer will be conducted in a systematic and timely manner, such that the soil is not left exposed for an extended period of time. The Contractor will be required to maintain exposed soil in a condition acceptable to the CQA Monitor through the completion and approval of the barrier layer.

- The barrier layer will be prevented from losing moisture prior to placement of the erosion layer. Preserving the moisture content of the barrier layer will be dependent on the earthwork contractor's means and methods and is subject to the POR approval.

- The top of the barrier layer will be surveyed on a 100-foot grid with a minimum of two reference points to provide verification of layer thickness.

2.3 EROSION LAYER

As discussed in Section 1.1, the erosion layer material will consist of a 12-inch thick layer of soil that will be capable of supporting vegetative growth. The erosion layer material will consist of soil materials that have not previously come in contact with solid waste and do not contain materials detrimental to the underlying barrier layer.

The thickness of the erosion layer will be verified with surveying procedures. Thickness will be determined using the same 100-foot grid used for the barrier layer thickness verification with a minimum of two reference points with a vertical tolerance of 0.0 feet to +0.4 feet on the top of the barrier surface. The test results for the erosion layer will be included in the FCCR Report.

During construction, the CQA Monitor will:

- Verify that grade control construction staking is performed prior to work;
- Verify that structures (e.g. gas system, surface water drainage components, etc.) are not damaged during placement operations; and
- Verify corrective action measures as determined by the verification survey. (The POR will coordinate with the project surveyor to perform a thickness verification survey of the erosion layer materials upon completion of placement operations).

2.4 ESTABLISHMENT OF VEGETATION

Vegetation will be established and maintained in accordance with the requirements of OAC 252:515-19-54. Permanent vegetation will be established within 90 days of completion of construction activities. Permanent vegetation will be effective, long-lasting and capable of self-generation and plant succession. Deep-rooted plants, trees, or other noxious vegetation will not be planted. The type of vegetation used will be that of equal or superior utility to native vegetation during each season of the year.

2.5 SUMMARY OF EARTHWORK TESTING SCHEDULE

A summary of testing schedule for barrier layer and erosion layer is provided in Table 2-3.

Table 2-3. Minimum Earthwork Construction Testing Schedule

Test (ASTM No.)	Barrier Layer	Erosion layer
Density of Soil In-Place (D2922)(1)	3 per acre for each approximate 6-inch compacted lift	N/A
Hydraulic Conductivity (D5084) (2)(3)	1 per acre (evenly distributed through all lifts)(4)	N/A
Thickness Verification (N/A)	100-foot square grid with a minimum of 2 reference points with a vertical tolerance of 0.0 feet to +0.4 feet on the top of the barrier layer surface	100-foot square grid with a minimum of 2 reference points with a vertical tolerance of 0.0 feet to +0.4 feet on the top of the erosion layer surface

1. Driven-cylinder method (ASTM D2937); rubber balloon method (ASTM D2167); sand-cone method (ASTM D1556); microwave drying method (ASTM D4643); or conventional oven dry method (ASTM D2216) may be used as an alternative for ASTM D2922.
2. Hydraulic conductivity tests will be run using tap water or a 0.05N solution of $CaSO_4$. Distilled water will not be allowed.
3. Field testing of permeability (in accordance with ASTM D5093) is optional, and may be replaced by laboratory testing.
4. The requirement of 1 permeability test per surface acre of cover should be met by testing each lift for permeability at a frequency of 1 test per 4 acres.

Attachment C

Soil Mass Balance Calculations

NORTHEAST LANDFILL
SOIL BALANCE

Prepared By: SDS
Date: July 2023

	SOIL BORROW SOURCES		
A.	***Landfill Base Grade Excavation*** [1]		
	Landfill Excavated Soil Volume	**1,384,545**	**cy**
B.	***Stormwater Detention Pond*** [2]		
	Pond Excavated Soil Volume	**31,359**	**cy**
C.	***Perimeter Drainage Channel and Road*** [2]		
	Channel and Road Excavated Soil Volume	**44,927**	**cy**
	Total Soil Borrow =	**1,460,831**	**cy**
	SOIL USAGE [3]		
D.	***Liner/Cover Systems***		
(a).	Area of Landfill	53.47	acres
	Bottom Liner, Structural Fill, Clay Liner and Protective Cover	**4**	**ft**
	Subtotal Bottom Liner Soil Volume	**345,060**	**cy**
(b).	Final Cover Area	121.17	acres
	Final Cover, Vegetation/Erosion Layer	3	ft
	Subtotal Final Cover Soil Volume	**586,463**	**cy**
	Total Bottom Liner, Overliner, and Final Cover Soil Volume =	**931,523**	**cy**
E.	***Additional Soil Requirements***		
	Stormwater Ponds	6,864	cy
	Drainage Swales	52,920	cy
	Perimeter Road and Channels	18,572	cy
	Total Additional Soil Volume =	**78,356**	cy
F.	***Weekly Cover Soils***		
	Gross Airspace Volume of the Landfill (Permitted + Expansion)	13,073,695	cy
	Adjusted Gross Airspace Volume (Permitted + Expansion)	12,142,173	cy
	Soil Usage Factor (assuming 15:1 refuse to cover ratio)	0.15	
	Weekly Cover Soil Volume =	**1,821,508**	**cy**
	Total Soil Usage =	**2,831,387**	**cy**
	Soil Balance =	**-1,370,556**	**cy**

Notes:

1. The landfill excavation volume is based on the comparison of existing topography as of January 23, 2023 and proposed excavation grades for the entire conceptual 53.5 acre waste disposal footprint.

2. The volume of soil excavation for stormwater ponds, channels, and roads is based on the comparsion of existing topography as of January 23, 2023 and proposed design grades.

3. The soil usage provided in this soil balance assumes that the material excavated from the waste disposal footprint (see Item A above) will contain sufficient quantities of clay, sandy clay, etc. for construction of the respective landfill components (i.e., clay liner, final cover, berms, etc.).