HARDEE COUNTY LANDFILL
OPERATION PERMIT

SEQUENCE MOD. –

MAY 2001

LETTER OF TRANSMITTAL

3012 U.S. Highway 301 North
Suite 700
Tampa, FL 33619-2242

813 621-0080
FAX 813 623-6757

SCS ENGINEERS

TO: Susan Pelz, P.E.
FDEP – SW District

DATE: May 14 2001

JOB NO.: 09199033.03

ATTENTION:

Re: Hardee County
Permit Modification
Response to Question

WE ARE SENDING YOU

☑ Attached ☐ Under separate cover via

☐ Shop drawings ☐ Prints

☐ Copy of letter ☐ Change order

the following items: ☐ Plans ☐ Samples

☐ Specifications ☐ Hand Delivered

D.E.P.
MAY 14 2001
Southwest District Tampa

COPIES	DATE	DESCRIPTION
2	May 14 2001	24" x 36" 9 sheet Plan Set
2	May 14 2001	Response to Comments

THESE ARE TRANSMITTED as checked below:

☑ For approval ☐ Approved as submitted ☐ Resubmit ____ copies for approval

☐ For your use ☐ Approved as noted ☐ Submit ____ copies for distribution

☐ As requested ☐ Returned for corrections ☐ Return ____ corrected prints

☐ For review and comment ☐ ____

☐ FOR BIDS DUE ____ 19 ____ ☐ PRINTS RETURNED AFTER LOAN TO US

REMARKS

Susan,

– Attached are the response to comments for the Hardee County Permit Modification

– The County is currently working on obtaining as-built coordinates for the monitoring wells, gas probes, piezometers

– Thank you

COPY TO ____

SIGNED: [signature]

If enclosures are not as noted, kindly notify us at once.

Environmental Consultants
3012 U.S. Highway 301 North
Suite 700
Tampa, FL 33619-2242
813 621-0080
FAX 813 623-6757

SCS ENGINEERS

May 14, 2001
File No. 09199033.03

Ms. Susan J. Pelz, P.E.
Solid Waste Section
Division of Waste Management
Florida Department of Environmental Protection
3804 Coconut Palm Drive
Tampa, Florida 33619

D.E.P.
MAY 14 2001
Southwest District Tampa

Subject: Response to the Florida Department of Environmental Protection Comments
Hardee County Class I Landfill Modification of Sequence of Filling
Pending Modification #38414-004-SO to Operation Permit 38414-0020SO

Dear Ms. Pelz:

On behalf of the Hardee County (County), SCS Engineers (SCS) is pleased to provide the following additional information requested in your correspondence dated February 20, 2001. For ease of review, we have provided the Florida Department of Environmental Protection (FDEP) comment or question in bold, followed by SCS' response.

Initial Comment – The unit weight for the waste material, baled and loose, used during the initial geotechnical calculations was approximated to be 64.8 pound per cubic foot (pcf) or 1750 pounds per cubic yard (pcy). This initial unit weight is typical of very well compacted solid waste materials or ash. This initial unit weight assumption was very conservative because the bales are compacted to 1750 pounds per bale not 1750 pounds per cubic yard.

Using the average bale size, the revised unit weight of the balefill was approximated to be 43.75 pcf (1181.25 pcy). Refer to Attachment A for approximate unit weights. The County uses a CAT D7H dozer to place and compact loose waste fill. Loose fill compacted using only a tracked dozer is typically 40-50 pcf (1100 – 1300 pcy). Therefore, SCS revised the geotechnical calculations using a typical waste density of 50 pcf (1350 pcy). This unit weight is consistent with the Hardee County's typical landfill operations and the previous landfill life estimates. The revised geotechnical calculations are included in Attachment B.

The revised geotechnical comparison between the "current" PBSJ design and the "revised" SCS design is as follows:

FILE

TABLE 1. SLOPE STABILITY FACTORS OF SAFETY WITH EQUIPMENT LOADS

North/South		East/West		Comment
Current	**Revised**	**Current**	**Revised**	
2.0	1.6	2.1	1.9	Failure through foundation
1.6	1.3	1.7	1.3	Failure through waste material

Comment: The "revised" slope stability factors of safety are acceptable and the waste mound is stable during operations.

TABLE 2. ESTIMATED SETTLEMENT

Settlement in middle of landfill		
Current Permit	Revised Permit	Difference
0.47 ft (5.6 in.)	0.54 ft (6.5 in.)	0.07 ft (0.84 in.)

Comment: The "revised" settlements are acceptable and are not anticipated to affect operations.

TABLE 3. BEARING CAPACITY

Revised Permit	
Excess Bearing capacity	4,200 psf

Comment: The "revised" bearing capacity is in excess of pressures estimated to induce excess settlements in the middle of the landfill, therefore the landfill foundation is sufficient to support the increased height of the landfill.

1. **Rule 62-701.500(2) (f), F.A.C. Method and Sequence of Filling.**

   a. **The information states, "due to the rectangular shape of the bale, loose unbaled material will be placed along the sideslopes to achieve the grades shown on the drawings." (page 1) This method of filling does not correlate with the current Operations Plan. Since the bale lift height is less than 6 feet (see Operations Plan, Figure 7-1), it does not seem likely that loose waste can be placed and adequately compacted in the "steps" created by the bales at the slopes. An evaluation of the slope stability under this condition was not provided.**

<u>Response</u> - Please refer to the figure in Attachment C for the proposed placement along the sideslope. The loose fill will be placed and compacted along the sideslope to efficiently utilize airspace using the County's CAT D7H dozer. The initial placement of bales will be offset from the slope approximately 20 feet, minimum, to allow the dozer working room. The following bales will be offset from the initial bales, as shown on the figure, to roughly approximate the sideslopes. The dozer will place loose waste along the sideslope to achieve the sideslope shown on the drawings.

SCS computed the track pressure for the County's dozer and estimated slope stability of this proposed configuration. To estimate the "sliding" potential of adjacent bales, SCS approximated current conditions at the landfill. As shown on the recent aerial topography survey the south and east slopes are approximately at a 3(h):(1V) sideslope and bales are located in the area. No failures have occurred, using the dozer, so the slope stability Factor of Safety must be a minimum of 1.0. A sliding friction angle of approximately 30 degrees achieves a F.S. equal to 1.0. Therefore the use of 25 degrees was assumed to be conservative for initial bale "sliding" and would be conservative as the waste bales degrade and intermingle.

Using a 25 degree friction angle, with no cohesion between materials (another conservative assumption), slope stability estimates were computed for the dozer pushing on the sideslopes and global "sliding" of bales. The estimated F.S. were 1.25 and 1.32, respectively. Both slope stability scenarios are considered by SCS to be acceptable. Slope stability calculations are contained in Attachment D.

b. The information indicates that the (former) dewatering ditch will "be filled and compacted with a mix of solid waste and C&D debris based upon availability." (page 2) This does not appear to correlate with the current Operations Plan, Section 7.0.3. Please clarify this. Please be reminded that the C&D debris must be disposed in an area separate from the Class I waste.

<u>Response</u> – During a recent site visit by FDEP, it was noted that the County receives a very small amount of C&D material. The small amount of C&D debris and the limited working space currently available to the County makes segregation of C& D debris and solid waste difficult. Due to the limited quantities of C&D debris material it was agreed by FDEP and the County to allow a mixture of materials to be placed in the dewatering ditch.

c. **Please describe the method of placing bales to a 3H:1V slope with the facility's equipment.**

Response – The County uses a Front End loader with a tool attachment to stack bales. The County will use a dozer to place loose fill along the sideslopes to match the proposed landfill grading.

d. **Attachment A, Volume Estimate. Please provide calculations for the annual estimate of facility design life (in years).**

Response – The estimated design life of the facility was based upon the proposed grading, an estimated in-place waste density of 50 pcf, and an estimated daily incoming waste stream of 55 tons per day.

The estimated design life for the final operation grades is 8.8 years. Refer to Attachment E for life estimates.

The estimated life for the individual filling phases, as shown on the drawings is as follows:

- From Existing to Phase 1 - Estimated life 2.0 years
- From Phase 1 to Phase 2 - Estimated Life 0.4 years
- From Phase 2 to Phase 3 - Estimated Life 1.7 years
- From Phase 3 to Phase 4 - Estimated Life 0.8 years
- From Phase 4 to Final - Estimated Life 3.9 years

e. **Attachment C, Geotechnical Analysis.**

1) **Please explain why 200 feet was added to the existing elevations for modeling purposes.**

Response – The 200 feet was added to the existing elevations because initially SCS thought circular failure planes may extend below elevation zero. Negative elevations could interfere with the computations. Therefore for modeling purposes, adding 200 feet to all the elevations was based upon professional engineering judgment and does not effect the results.

2) **Please provide the reference for the friction angle for the waste (25 degrees). Since the facility is a balefill and the waste layers are not "kneaded" (compacted) together, please explain how the friction**

angle of the bales was determined. It seems that the interface between bale layers would tend to slide (horizontally) more readily than a traditional compacted waste mass.

Response –

SCS used a block failure model to simulate sliding along the bales. However, the failure plane would shear bales diagonally which is the strongest direction of the bale. The bales will be staggered during placement and a "zig-zag" failure along the staggered bales would occur only if the outer bales were displaced away from the landfill sideslope.

An acceptable slope stability Factor of Safety equal to 1.3 was computed using the proposed modification to the fill sequence sideslopes, placement of the bales in a staggered pattern, and use of the County's equipment.

3) **The "existing" case includes 3H:1V sideslopes. However, Sheet 7, "Sequencing Plan, Sequencing Plan, Sequence 7 and Details," dated June 26, 1997, prepared by PBSJ, shows the maximum slopes are 4H:1V (north and east slopes). Please revise the "existing case" calculations to reflect these slopes. Please note also that the west and south slopes ("existing") are much less steep are not considered to be the "worst case" slopes of concern.**

Response - SCS has recomputed the "existing" or "current" permitted sideslope design into the slope stability calculations. The electronic files received from PBS&J have sideslopes on the south and east side varying from 3.5 to 4 (H): 1(V). SCS used 4(H):1(V) sideslopes in the recomputed "existing" slope stability. A 4(H):1(V) is the best case scenerio and the Factor of Safety for steeper sideslopes would be between the "existing" 4(h):1(V) design and the proposed 3(H):1(V) design. The proposed design by SCS is stable with 3(H):1(V) sideslopes.

4) **Please provide calculations which demonstrate that the slopes will be stable considering the method of placing bales to a 3H:1V slope with the facility's equipment.**

Response - Please refer to Attachment D.

f. **Drawings.**

1) **Please provide drawings which include contours more recent than October 1999.**

Response - I.F. Rooks and Associates recently completed an aerial topography survey of the active waste disposal area. The current topography features in this area is shown on the Drawings.

2) **Cross-Section B-B shown on Sheet 3 does not appear to correlate with the section shown on Sheet 8. Please verify, and provide revised drawings as appropriate.**

Response - The cross section has been updated to include the existing topography and operational grades.

3) **Please provide drawings which illustrate the sequence of filling, including estimated timeframes. The plans provided do not clearly show the sequence of filling, purpose, placement or movement of the temporary berms or leachate/stormwater separation methods.**

Response - Estimated filling timeframes are shown on the drawings. The filling sequence and direction of filling are clearly indicated on Drawings with fill arrows. The temporary berms are shaded to highlight the approximate locations. The berms will move as the waste fill progresses. Notes to the Drawings have been added to help clarify berm placement.

4) **Please provide cross-sections which show the sequence of filling.**

Response - The cross-sections have been updated to show filling.

5) **Notes on Sheets 4, 5, 6 and 7 state, "Final grades are shown. Subtract closure cap from shown to obtain operational elevations." Since the pending modification is for the operation of the site, the drawings for sequences other than the final sequence, should show "operational elevations."**

Response - Drawings have been updated to show operational grades.

2. **Rule 62-701.500(13) (c), F.A.C. Annual Estimate of Facility Life. Please provide a topographic survey more recent than October 1999. Please provide calculations for the annual estimate of facility design life (in years) based on this survey.**

   Response – Please refer to response to comment numbers 1.d and 1.F.1.

This following comment is for information only, at this time, and does not require an immediate response:

1. **The Solid Waste Section has not reviewed the stormwater drainage calculations. Please contact Mr. Randy Cooper in the Department's stormwater management section (813-744-6100 x 470) or SWFWMD concerning the requirements for a stormwater management system system permit modification.**

   Response – During a recent conversation with Mr. Randy Cooper he indicated that as long as the offsite discharge structure or locations have not changed since the permitting of the original facility's stormwater plan, no permit modifications were required for internal stormwater management systems. He also indicated that FDEP would coordinate with SWFWMD and convey FDEP opinion on the modification.

The County respectively submits that the internal stormwater management system, proposed under this modification, flow into the existing stormwater pond and ultimately discharges offsite in the same location. Therefore no stormwater permit modification is required at this time.

We trust that the above responses will satisfactorily address your comments. Please feel free to contact us if you have questions.

Very truly yours,

Joseph H. O'Neill, P.E.
Senior Engineer

May 14 2001

Raymond J. Dever, P.E.
Vice President
SCS ENGINEERS

RJD:cms

TABLE OF CONTENTS

TABLE OF CONTENTS (Continued)

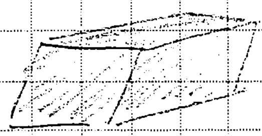
ATTACHMENT A

SCS ENGINEERS

SHEET 1 OF 1

CLIENT Handee Co	PROJECT Permit Modification	JOB NO. 09199033.03
SUBJECT Estimated Bale fill Density	BY [illegible] DATE April 2001	CHECKED [illegible] DATE 5/10/01

<u>Bales</u> (information supplied by Handee Co)



Bale size 2' x 4' x 5'

Bale weight set (by machine) @ 1750 lb/bale

Therefore Bale Density = $\dfrac{1750 \text{ lb/bale}}{(2' \times 4' \times 5') \text{ ft}^3\text{/bale}}$

$= \dfrac{1750 \text{ lb}}{40 \text{ ft}^3}$

$= 43.75 \text{ lb/ft}^3$ (1181.25 lb/cy)

To include daily cover and loose fill

say unit weight of waste approx

50 lb/ft³ (1350 lb/cy typical)

ATTACHMENT B

SHEET 1

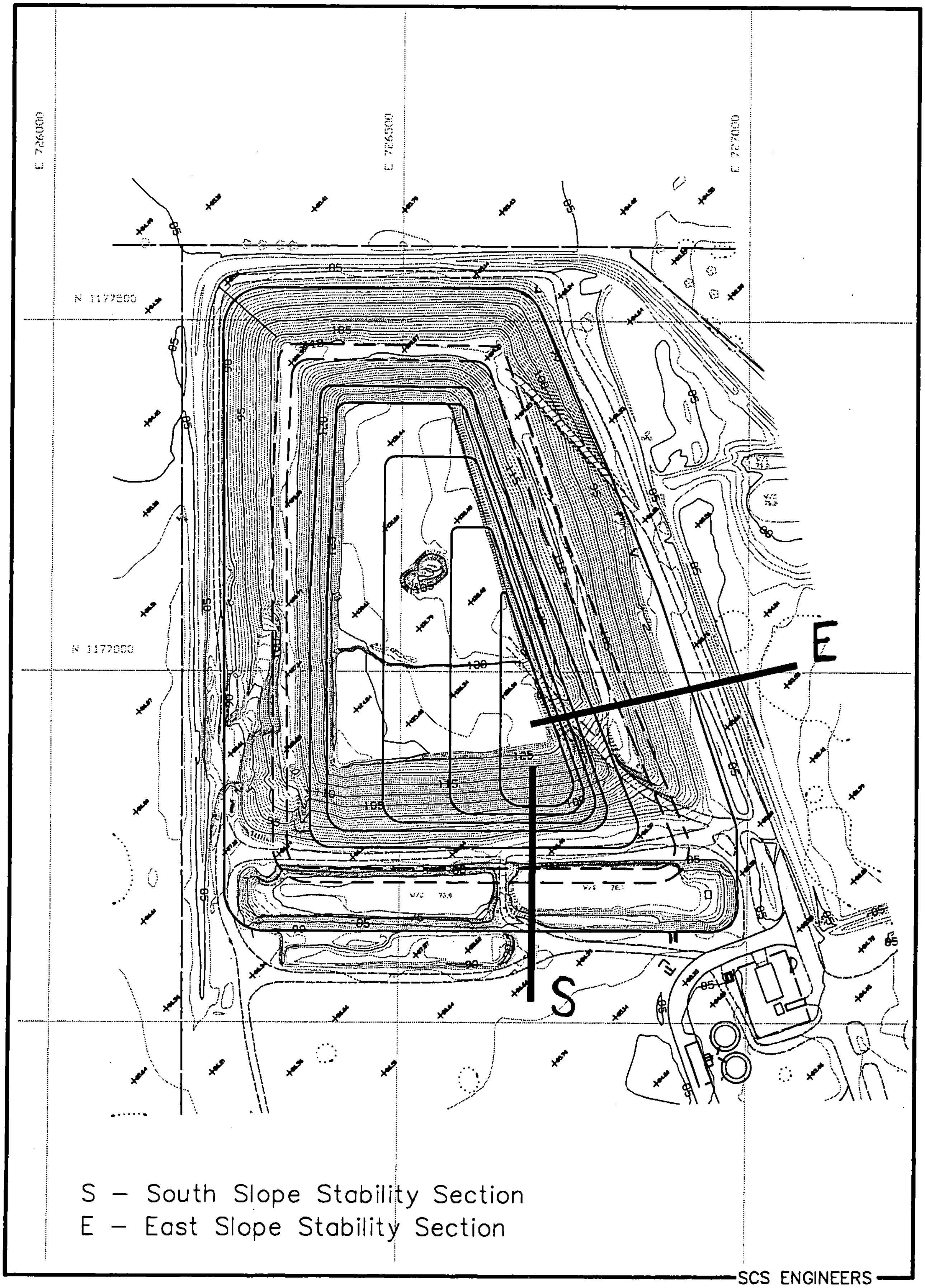
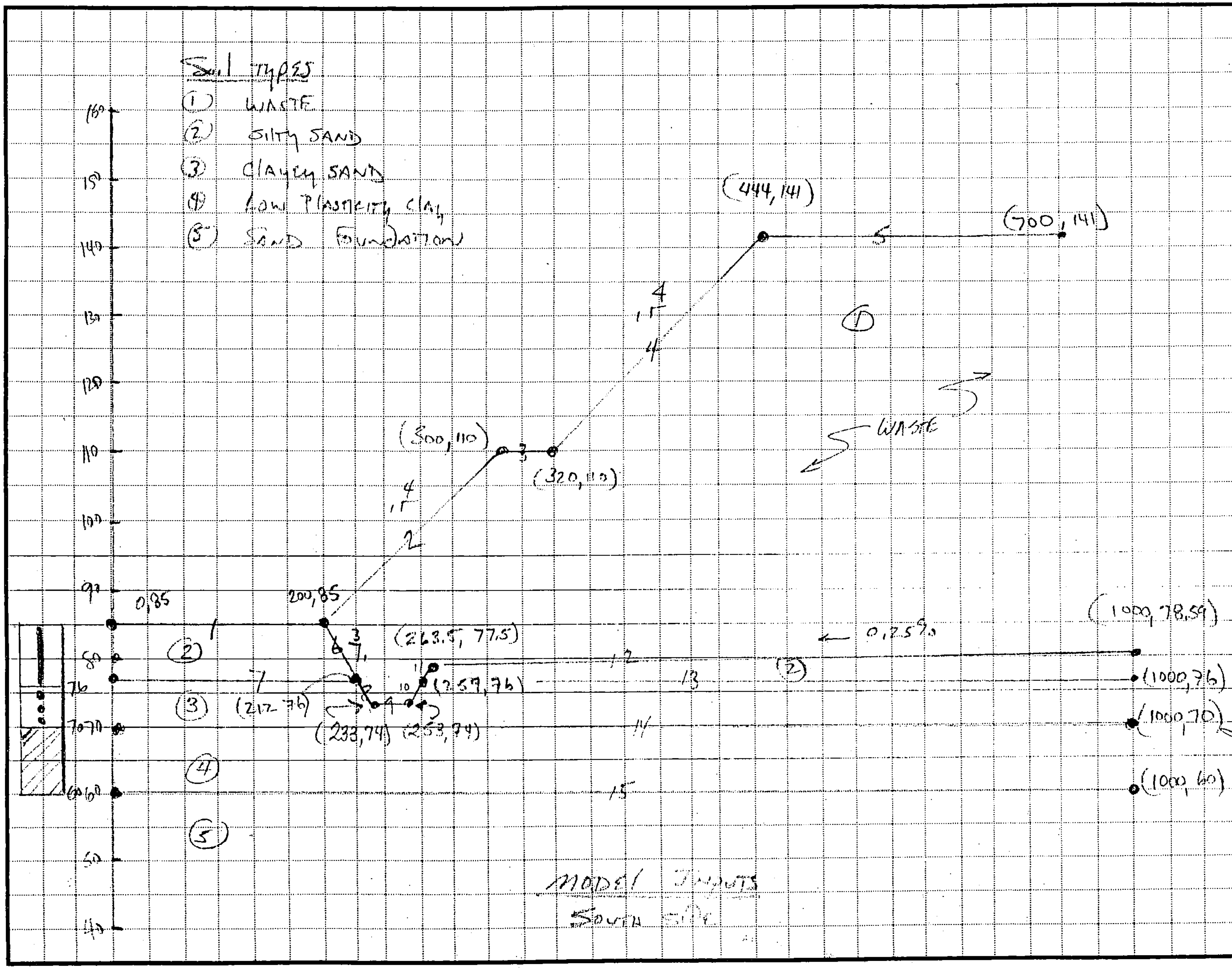


Figure – Slope Stability – Current Permit BY PBSJ

SCS ENGINEERS



CLIENT Hardee County

PROJECT Permit Modification

SUBJECT Slope Stability
Current Permit H.S

JOB NO.

BY

DATE

CHECKED

DATE 5/10/01

SHEET 2 OF

SHEET 3

WITH EQUIPMENT LOADS

**** PCSTABL5 ****

by
Purdue University

--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer`s Method of Slices

Run By: Joseph O'Neill
Input Data Filename: C:CURNTNS
Output Filename: C:CURNTNS.OUT
Plotted Output Filename: C:CURNTNS.PLT

PROBLEM DESCRIPTION **Current Permit - South side**
Hardee Co. Landfill Hardee Co., FL

BOUNDARY COORDINATES

5 Top Boundaries
15 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	.00	85.00	200.00	85.00	2
2	200.00	85.00	300.00	110.00	1
3	300.00	110.00	320.00	110.00	1
4	320.00	110.00	444.00	141.00	1
5	444.00	141.00	700.00	141.00	1
6	200.00	85.00	227.00	76.00	2
7	.00	76.00	227.00	76.00	3
8	227.00	76.00	233.00	74.00	3
9	233.00	74.00	253.00	74.00	3
10	253.00	74.00	259.00	76.00	3
11	259.00	76.00	263.50	77.50	2
12	263.50	77.50	1000.00	78.60	2
13	259.00	76.00	1000.00	76.00	2
14	.00	70.00	1000.00	70.00	4
15	.00	60.00	1000.00	60.00	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	50.0	50.0	.0	25.0	.00	.0	1
2	105.0	110.0	.0	28.0	.00	.0	1
3	110.0	120.0	.0	30.0	.00	.0	1
4	90.0	105.0	2250.0	.0	.00	.0	1
5	110.0	118.0	.0	32.0	.00	.0	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	.00	79.00
2	1000.00	79.00

BOUNDARY LOAD(S)

1 Load(s) Specified

Load No.	X-Left (ft)	X-Right (ft)	Intensity (lb/sqft)	Deflection (deg)
1	444.00	453.50	1552.3	.0

NOTE - Intensity Is Specified As A Uniformly Distributed Force Acting On A Horizontally Projected Surface.

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

3200 Trial Surfaces Have Been Generated.

80 Surfaces Initiate From Each Of 40 Points Equally Spaced Along The Ground Surface Between X = 150.00 ft. and X = 200.00 ft.

Each Surface Terminates Between X = 444.00 ft. and X = 650.00 ft.

Unless Further Limitations Were Imposed, The Minimum Elevation At Which A Surface Extends Is Y = .00 ft.

10.00 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	309.74	110.00
2	319.67	108.75
3	329.64	107.98
4	339.63	107.69
5	349.63	107.87
6	359.61	108.54
7	369.54	109.69
8	379.41	111.31
9	389.19	113.40
10	398.85	115.96
11	408.39	118.99
12	417.76	122.46
13	426.96	126.38
14	435.96	130.74
15	444.74	135.53
16	453.28	140.73
17	453.67	141.00

Circle Center At X = 340.7 ; Y = 315.9 and Radius, 208.2

FACTOR OF SAFETY = 1.625 (Failure Planes from terrace to top of landfill)

FACTOR OF SAFETY = 1.970 (Failure Planes through Waste and Foundation)

Current Permit - South side Hardee Co. Landfill   Hardee Co., FL

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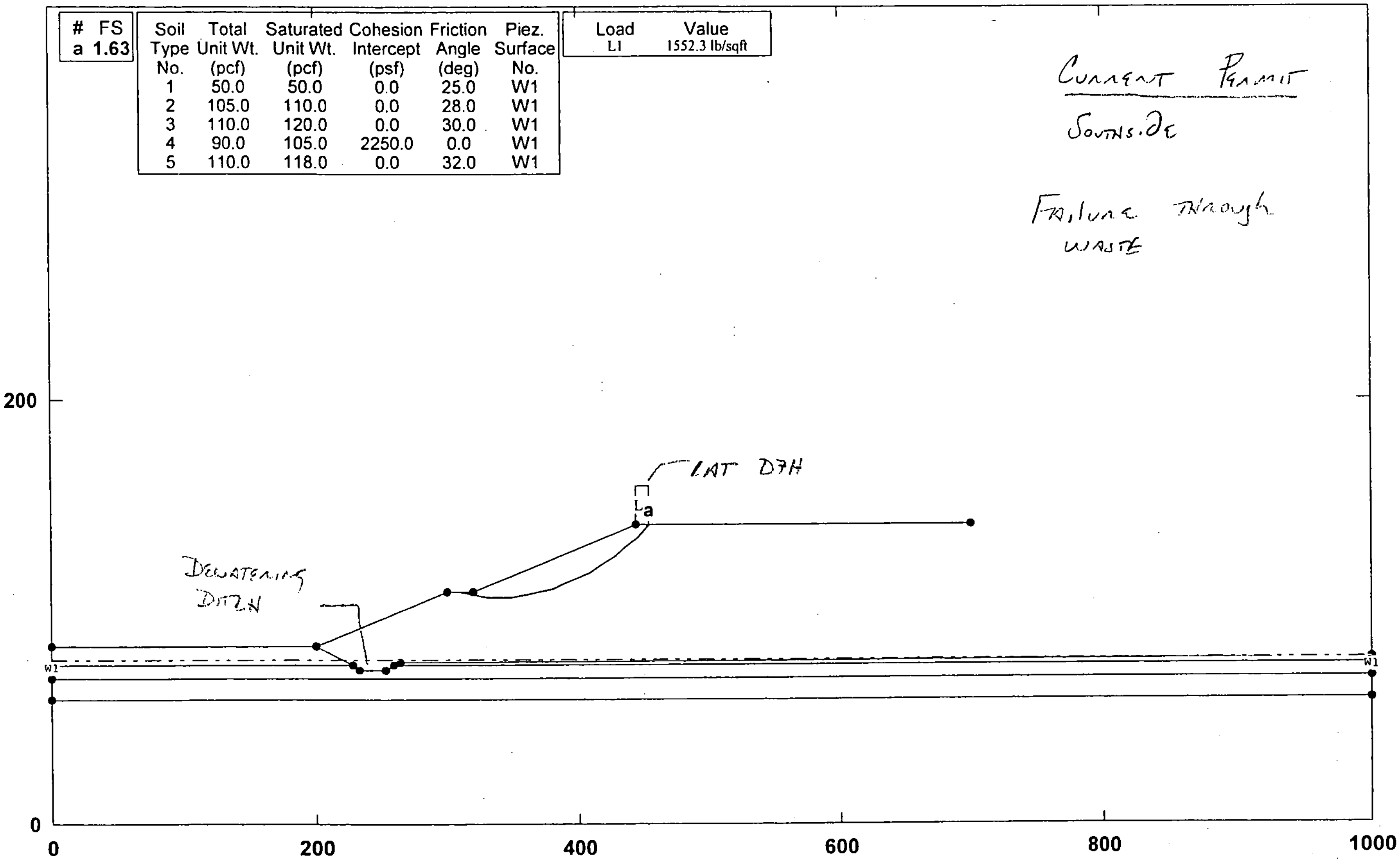
#	FS
a	1.63

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Piez. Surface No.
1	50.0	50.0	0.0	25.0	W1
2	105.0	110.0	0.0	28.0	W1
3	110.0	120.0	0.0	30.0	W1
4	90.0	105.0	2250.0	0.0	W1
5	110.0	118.0	0.0	32.0	W1

Load	Value
L1	1552.3 lb/sqft



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Safety Factors Are Calculated By The Modified Bishop Method

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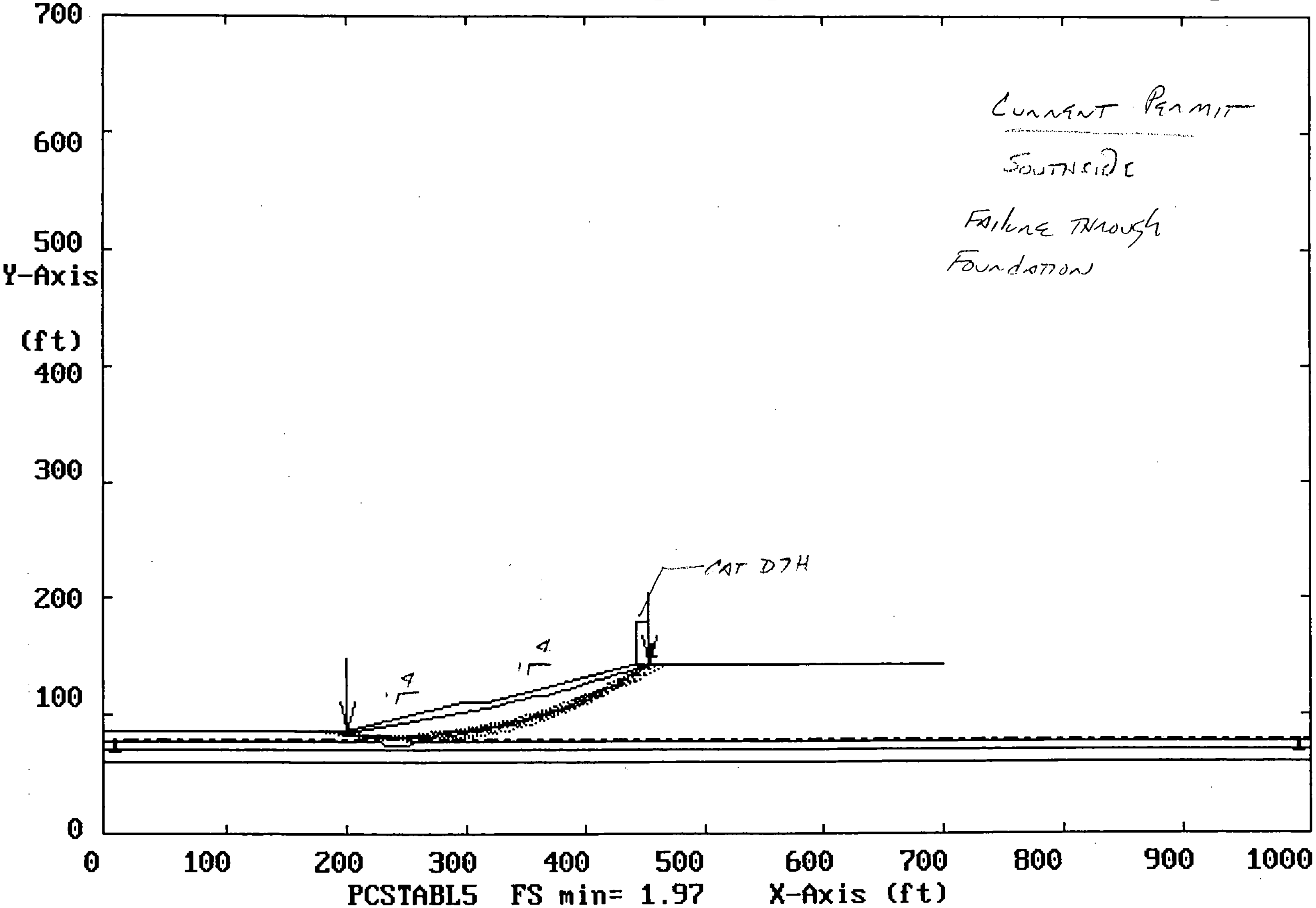
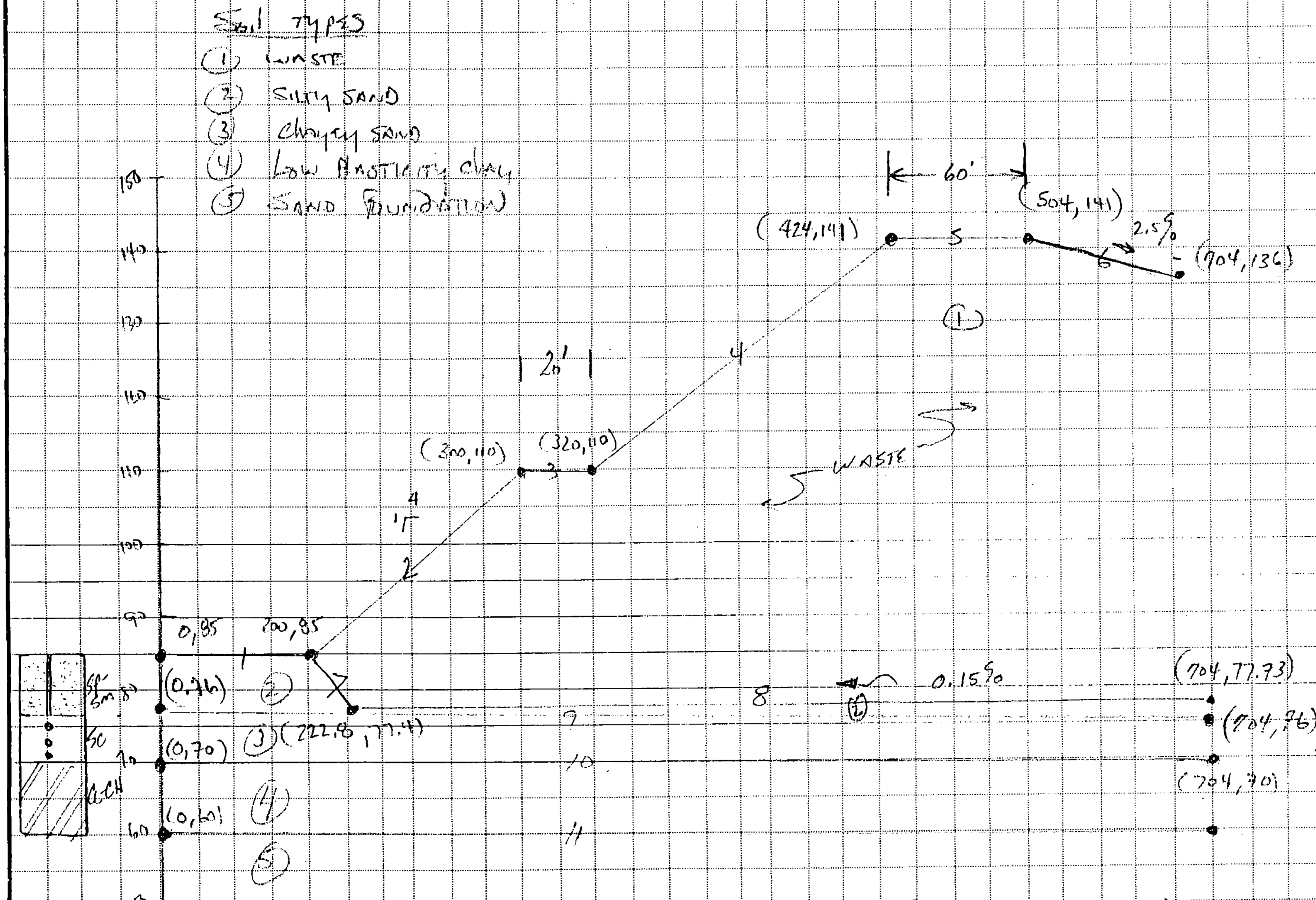
Current Permit - South side Hardee Co. Landfill   Hardee Co., FL
Ten Most Critical. C:CURNTNS.PLT By: Joseph O'Neill 04-15-01 4:49 pm



PCSTABL5 FS min= 1.97

SHEET 7



MODEL INPUTS (CURRENT PERMIT)

EAST SIDE

SCS ENGINEERS

CLIENT: Hardee County

PROJECT: Permit Modification

SUBJECT: Slope Stability — Current Permit

JOB NO.: 09199033.03

BY: JHD — DATE: April 11 2001

CHECKED: [illegible] — DATE: 5/10/01

SHEET 8 OF

SHEET 9

WITH EQUIPMENT LOADS

**** PCSTABL5 ****

by
Purdue University

--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer`s Method of Slices

Run By: Joseph O'Neill
Input Data Filename: C:CURNTEW
Output Filename: C:CURNTEW.OUT
Plotted Output Filename: C:CURNTEW.PLT

PROBLEM DESCRIPTION **Current Permit East Side**
Hardee County Landfill Hardee Co.,FL

BOUNDARY COORDINATES

6 Top Boundaries
11 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	.00	85.00	200.00	85.00	2
2	200.00	85.00	300.00	110.00	1
3	300.00	110.00	320.00	110.00	1
4	320.00	110.00	444.00	141.00	1
5	444.00	141.00	504.00	141.00	1
6	504.00	141.00	704.00	136.00	1
7	200.00	85.00	222.80	77.40	2
8	222.80	77.40	704.00	77.73	2
9	.00	76.00	704.00	76.00	3
10	.00	70.00	704.00	70.00	4
11	.00	60.00	704.00	60.00	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	62.4	62.4	.0	25.0	.00	.0	1
2	105.0	110.0	.0	28.0	.00	.0	1
3	110.0	120.0	.0	30.0	.00	.0	1
4	90.0	105.0	2250.0	.0	.00	.0	1
5	110.0	118.0	.0	32.0	.00	.0	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	.00	79.00
2	704.00	79.00

BOUNDARY LOAD(S)

1 Load(s) Specified

Load No.	X-Left (ft)	X-Right (ft)	Intensity (lb/sqft)	Deflection (deg)
1	444.00	453.50	1552.3	.0

NOTE - Intensity Is Specified As A Uniformly Distributed Force Acting On A Horizontally Projected Surface.

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

3200 Trial Surfaces Have Been Generated.

80 Surfaces Initiate From Each Of 40 Points Equally Spaced
Along The Ground Surface Between X = 300.00 ft.
and X = 320.00 ft.

Each Surface Terminates Between X = 424.00 ft.
and X = 500.00 ft.

Unless Further Limitations Were Imposed, The Minimum Elevation At Which A Surface Extends Is Y = .00 ft.

10.00 ft. Line Segments Define Each Trial Failure Surface.

SHEET 11

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 16 Coordinate Points

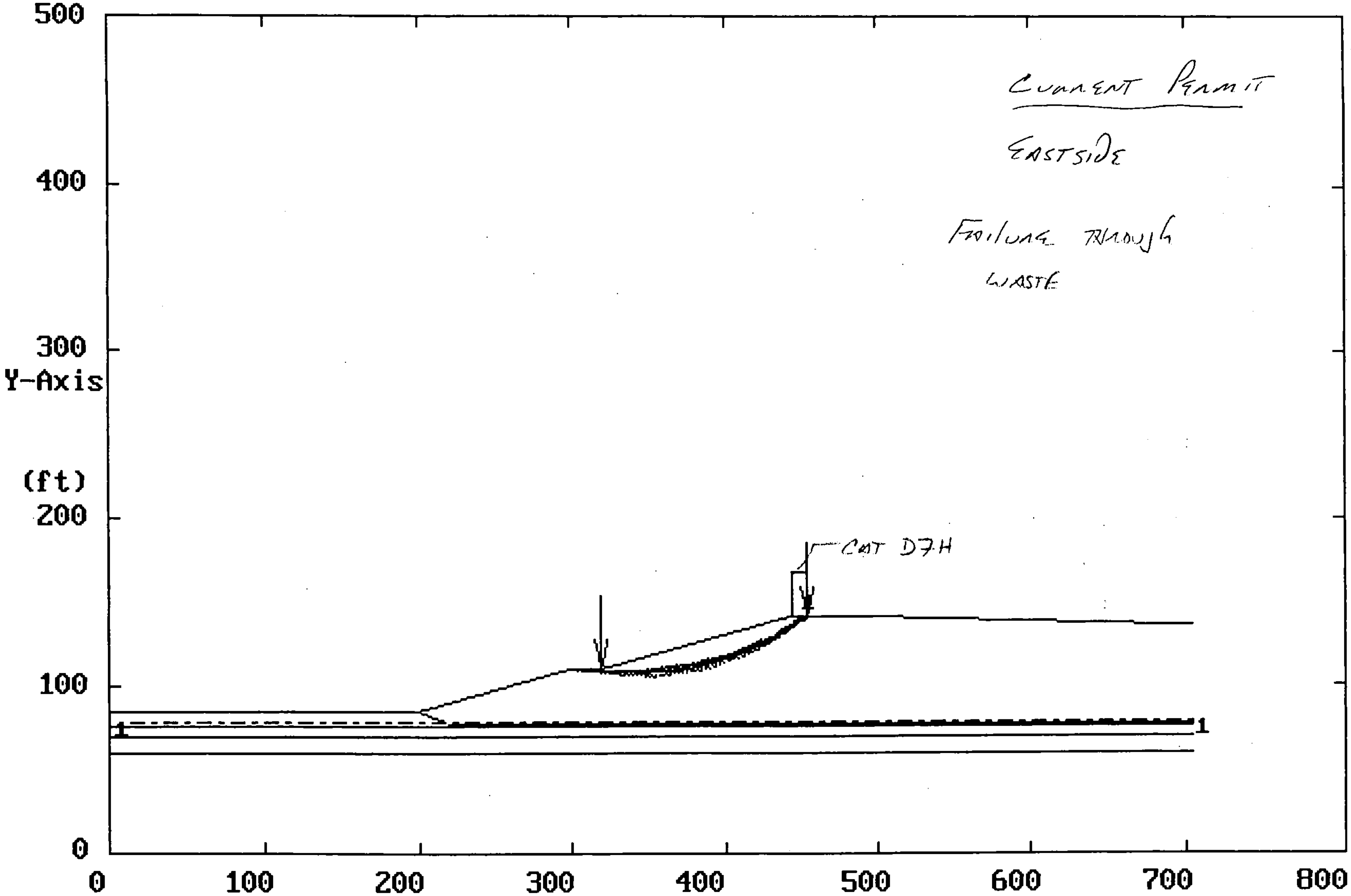
Point No.	X-Surf (ft)	Y-Surf (ft)
1	318.46	110.00
2	328.38	108.74
3	338.36	108.01
4	348.35	107.80
5	358.35	108.12
6	368.31	108.97
7	378.22	110.35
8	388.04	112.24
9	397.74	114.66
10	407.30	117.58
11	416.70	121.00
12	425.90	124.92
13	434.88	129.31
14	443.62	134.18
15	452.09	139.50
16	454.22	141.00

Circle Center At X = 347.3 ; Y = 297.0 and Radius, 189.2

FACTOR OF SAFETY = 1.683 (Failure Planes from terrace to top of landfill)

FACTOR OF SAFETY = 2.055 (Failure Planes through Waste and Foundation)

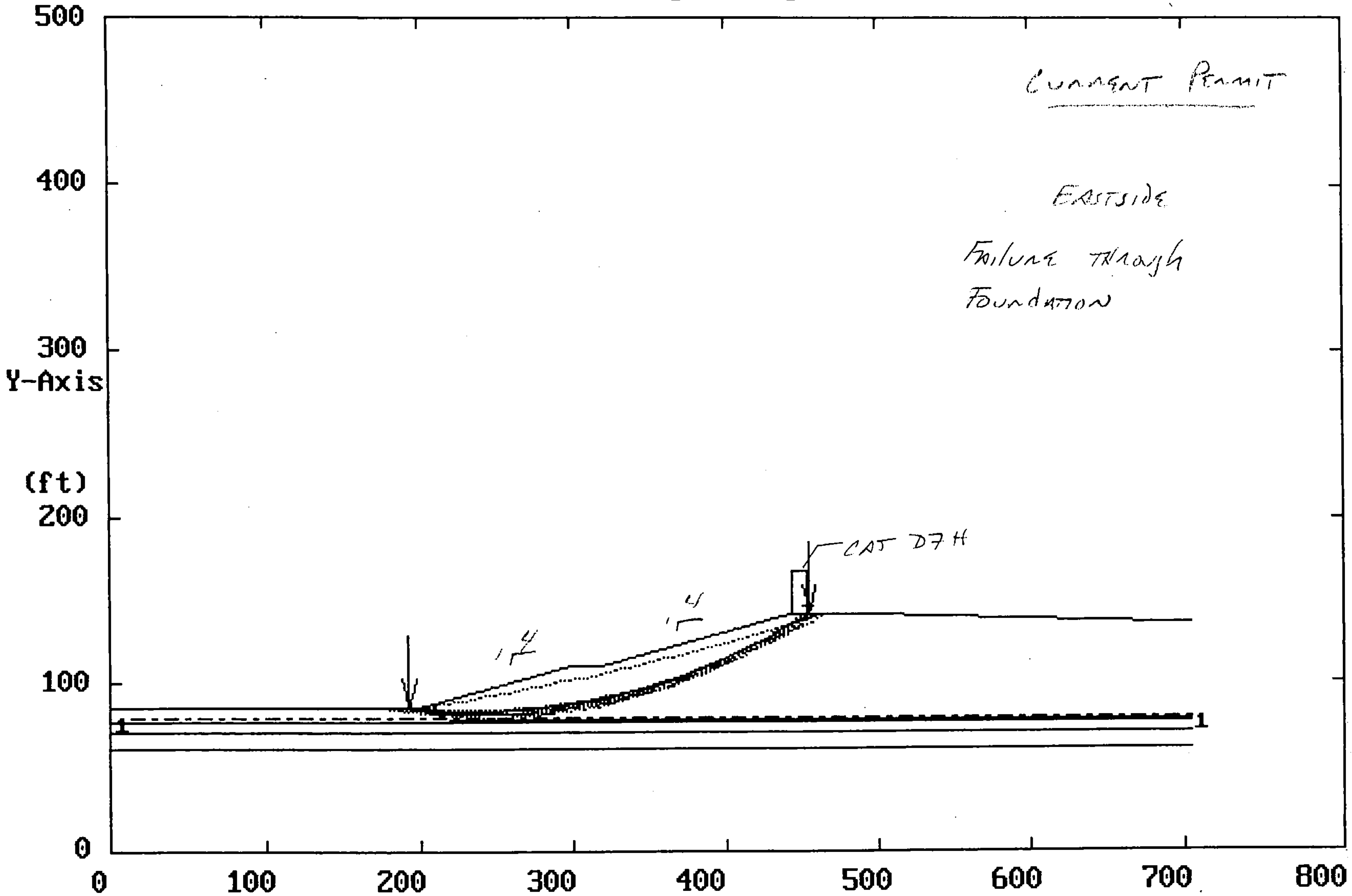
Current Permit East Side Hardee County Landfill   Hardee Co.,FL
Ten Most Critical. C:CURNTEW.PLT By: Joseph O'Neill 04-15-01 5:08 pm



PCSTABL5 FS min= 1.683   X-Axis (ft)

Sheet 12

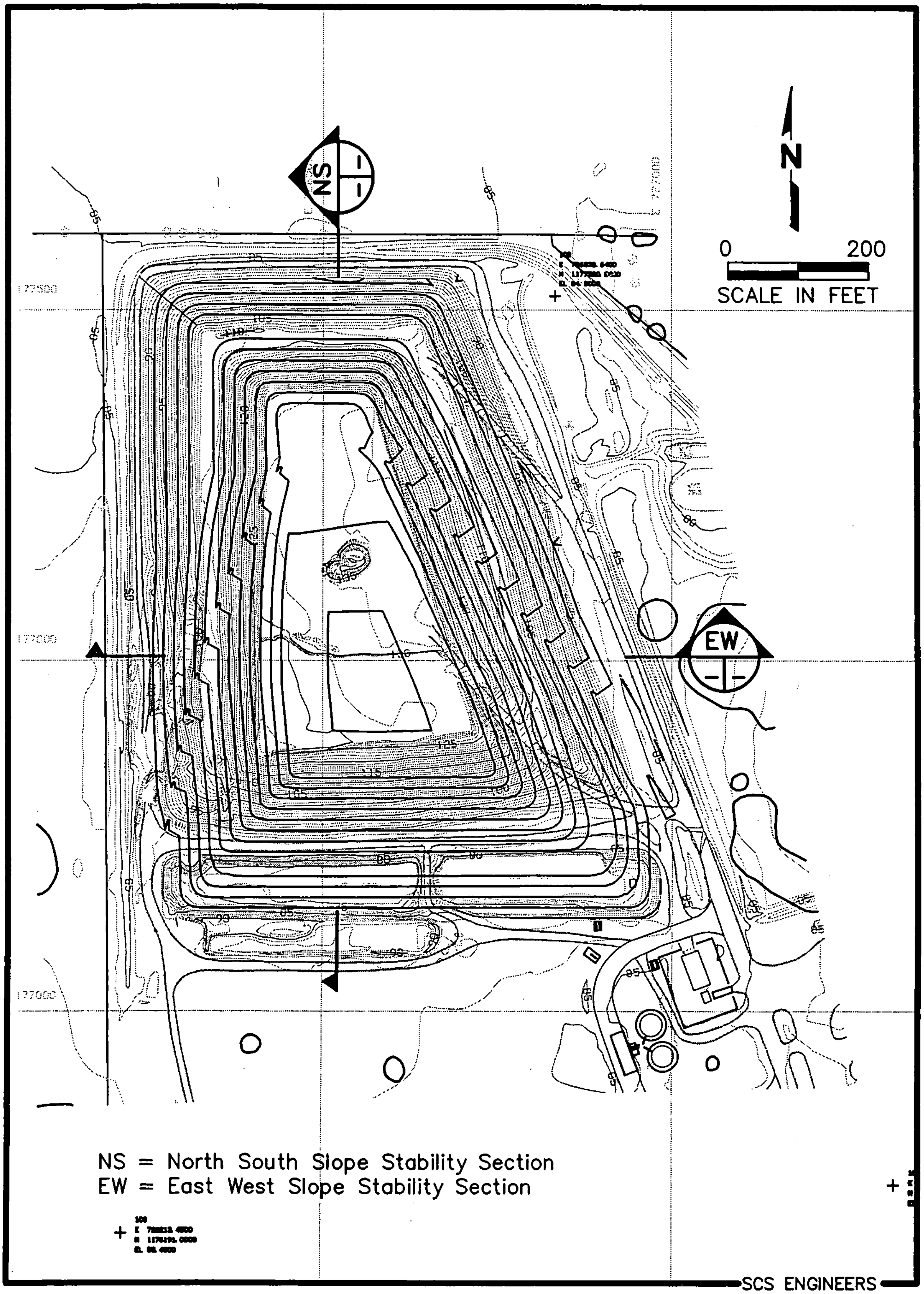
Current Permit East Side Hardee County Landfill Hardee Co.,FL
Ten Most Critical. C:CURNTEW.PLT By: Joseph O'Neill 04-15-01 5:08 pm



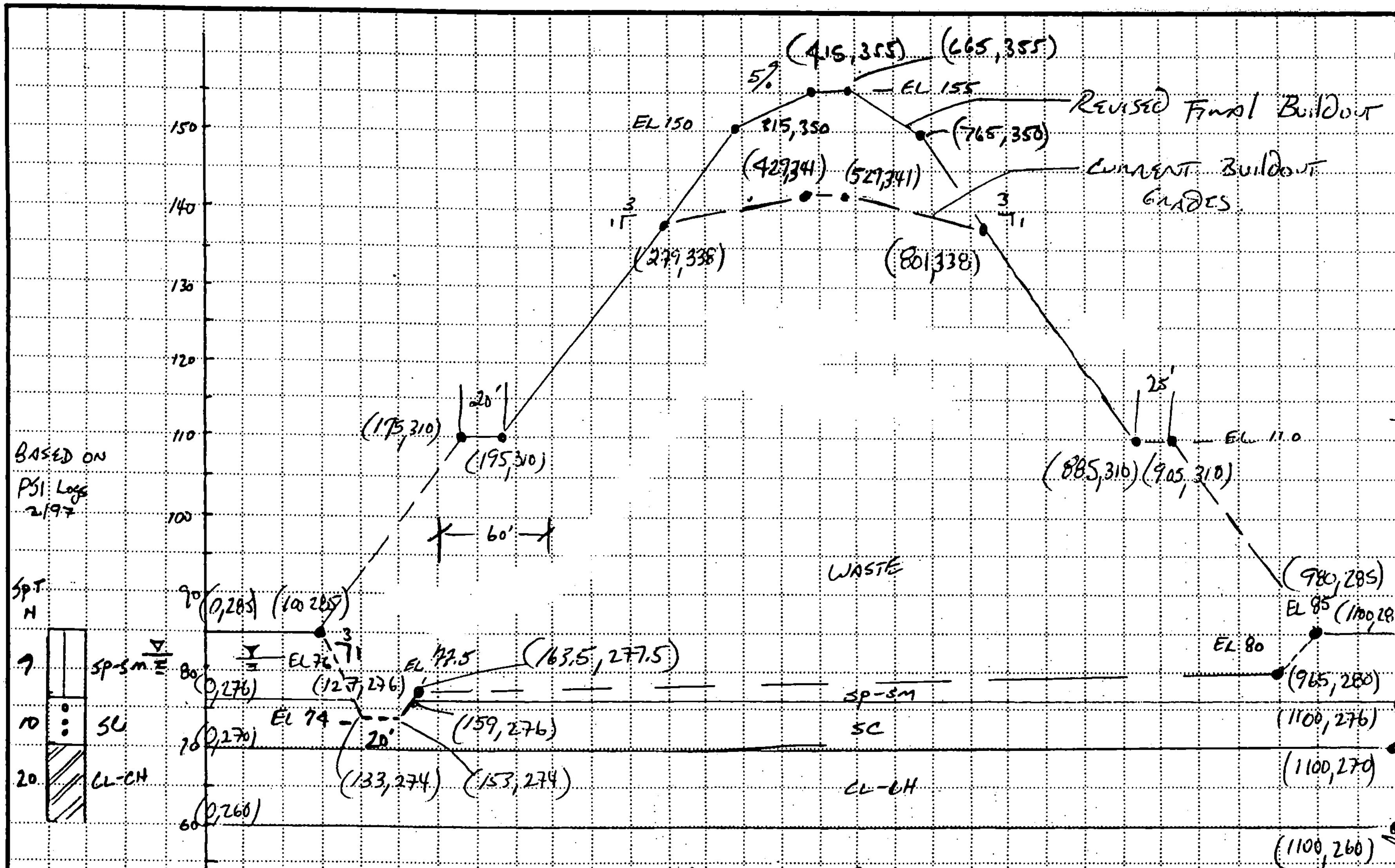
PCSTABL5 FS min= 2.055   X-Axis (ft)

SHEET 13

SHEET 14



Attachment B. Revised Slope Stability by SCS Engineers.



MODEL INPUT
North-South

NOTE: 1) Subsurface profile based on boring logs by PSI dated 2/97
2) Bottom dewatering ditch elevation based upon info by County
3) Landfill bottom based upon drawings Envisors dated 11/82 - 3/83
Monitoring well / pump station I.E. on PBSJ dated 2/96

SCS ENGINEERS

CLIENT: Hardee County
SUBJECT: Slope Stability N/S
PROJECT: Permit Modification
BY: [signature] DATE: Oct 2000
CHECKED: [signature] DATE: 11/28/00
JOB NO: 09199033.03
SHEET 15 OF

SHEET 16

WITH EQUIPMENT LOADS

** PCSTABL5 **

by
Purdue University

--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer`s Method of Slices

Run By: Joseph O'Neill
Input Data Filename: C:FINALNS2
Output Filename: C:FINALNS2.OUT
Plotted Output Filename: C:FINALNS2.PLT

PROBLEM DESCRIPTION **Final Buildout-Revised** **North/South**
Hardee County, Florida

BOUNDARY COORDINATES

11 Top Boundaries
22 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	.00	285.00	100.00	285.00	2
2	100.00	285.00	175.00	310.00	1
3	175.00	310.00	195.00	310.00	1
4	195.00	310.00	315.00	350.00	1
5	315.00	350.00	415.00	355.00	1
6	415.00	355.00	665.00	355.00	1
7	665.00	355.00	765.00	350.00	1
8	765.00	350.00	885.00	310.00	1
9	885.00	310.00	905.00	310.00	1
10	905.00	310.00	980.00	285.00	1
11	980.00	285.00	1100.00	285.00	2
12	100.00	285.00	127.00	276.00	2
13	127.00	276.00	133.00	274.00	3
14	133.00	274.00	153.00	274.00	3
15	153.00	274.00	159.00	276.00	3
16	159.00	276.00	163.50	277.50	2
17	163.50	277.50	965.00	280.00	2
18	965.00	280.00	980.00	285.00	2
19	.00	276.00	127.00	276.00	3
20	159.00	276.00	1100.00	276.00	3
21	.00	270.00	1100.00	270.00	4
22	.00	260.00	1100.00	260.00	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	50.0	50.0	.0	25.0	.00	.0	1
2	105.0	110.0	.0	28.0	.00	.0	1
3	110.0	120.0	.0	30.0	.00	.0	1
4	90.0	105.0	2250.0	.0	.00	.0	1
5	110.0	118.0	.0	32.0	.00	.0	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	.00	279.00
2	1100.00	279.00

BOUNDARY LOAD(S)

1 Load(s) Specified

Load No.	X-Left (ft)	X-Right (ft)	Intensity (lb/sqft)	Deflection (deg)
1	315.00	324.50	1552.3	.0

NOTE - Intensity Is Specified As A Uniformly Distributed
Force Acting On A Horizontally Projected Surface.

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

3200 Trial Surfaces Have Been Generated.

80 Surfaces Initiate From Each Of 40 Points Equally Spaced
Along The Ground Surface Between X = 175.00 ft.
and X = 195.00 ft.

Each Surface Terminates Between X = 315.00 ft.
and X = 665.00 ft.

Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y = .00 ft.

10.00 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 16 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	189.36	310.00
2	199.32	309.11
3	209.31	308.79
4	219.31	309.03
5	229.28	309.83
6	239.19	311.20
7	249.00	313.11
8	258.69	315.58
9	268.23	318.59
10	277.58	322.14
11	286.72	326.20
12	295.61	330.77
13	304.23	335.84
14	312.55	341.38
15	320.55	347.39
16	324.20	350.46

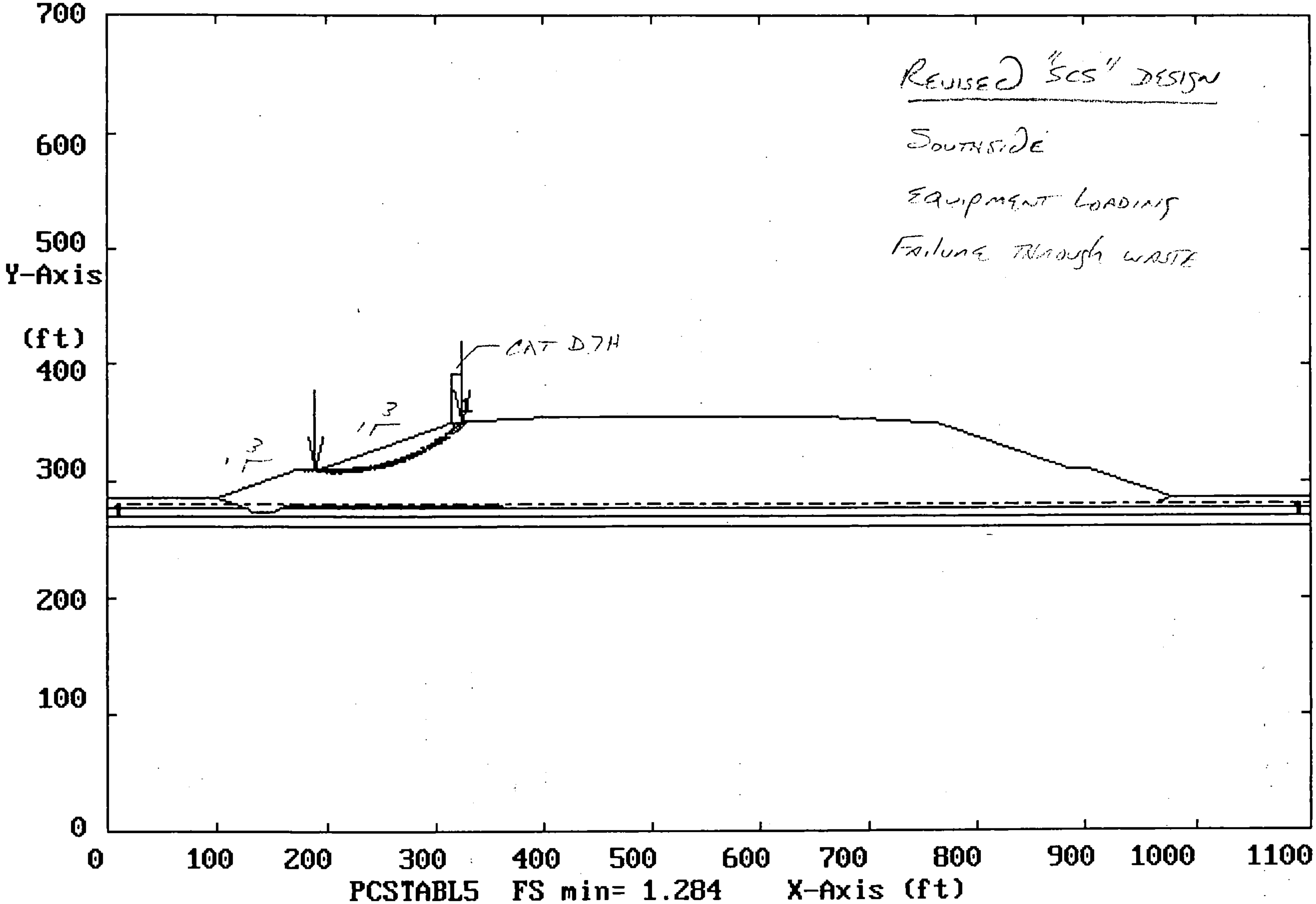
Circle Center At X = 210.1 ; Y = 486.3 and Radius, 177.5

FACTOR OF SAFETY = 1.284 (Failure Planes from terrace to top of landfill)

FACTOR OF SAFETY = 1.594 (Failure Planes through waste and foundation)

Final Buildout-Revised North/South Hardee County, Florida

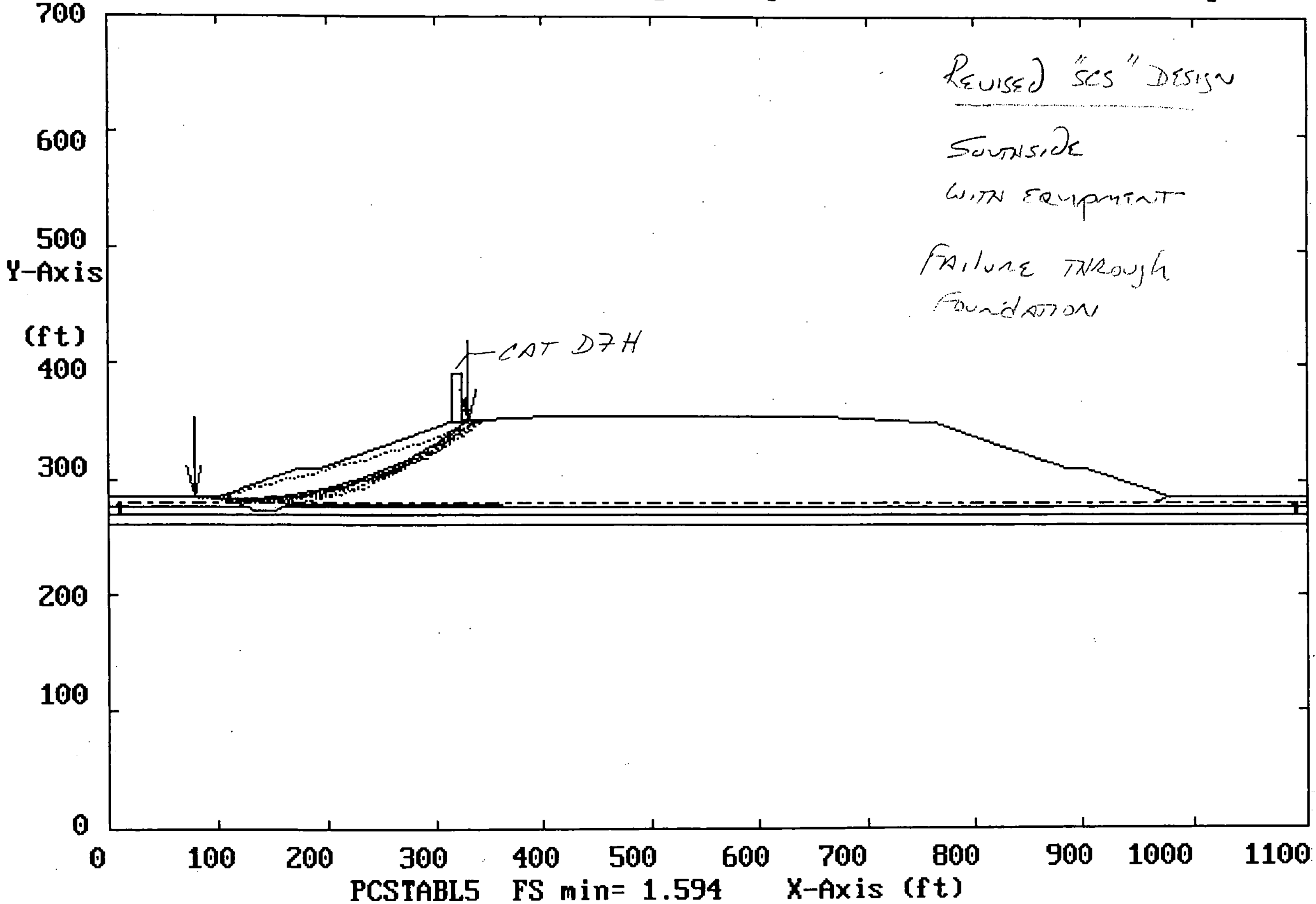
Ten Most Critical. C:FINALNS2.PLT By: Joseph O'Neill 04-15-01 6:16 pm



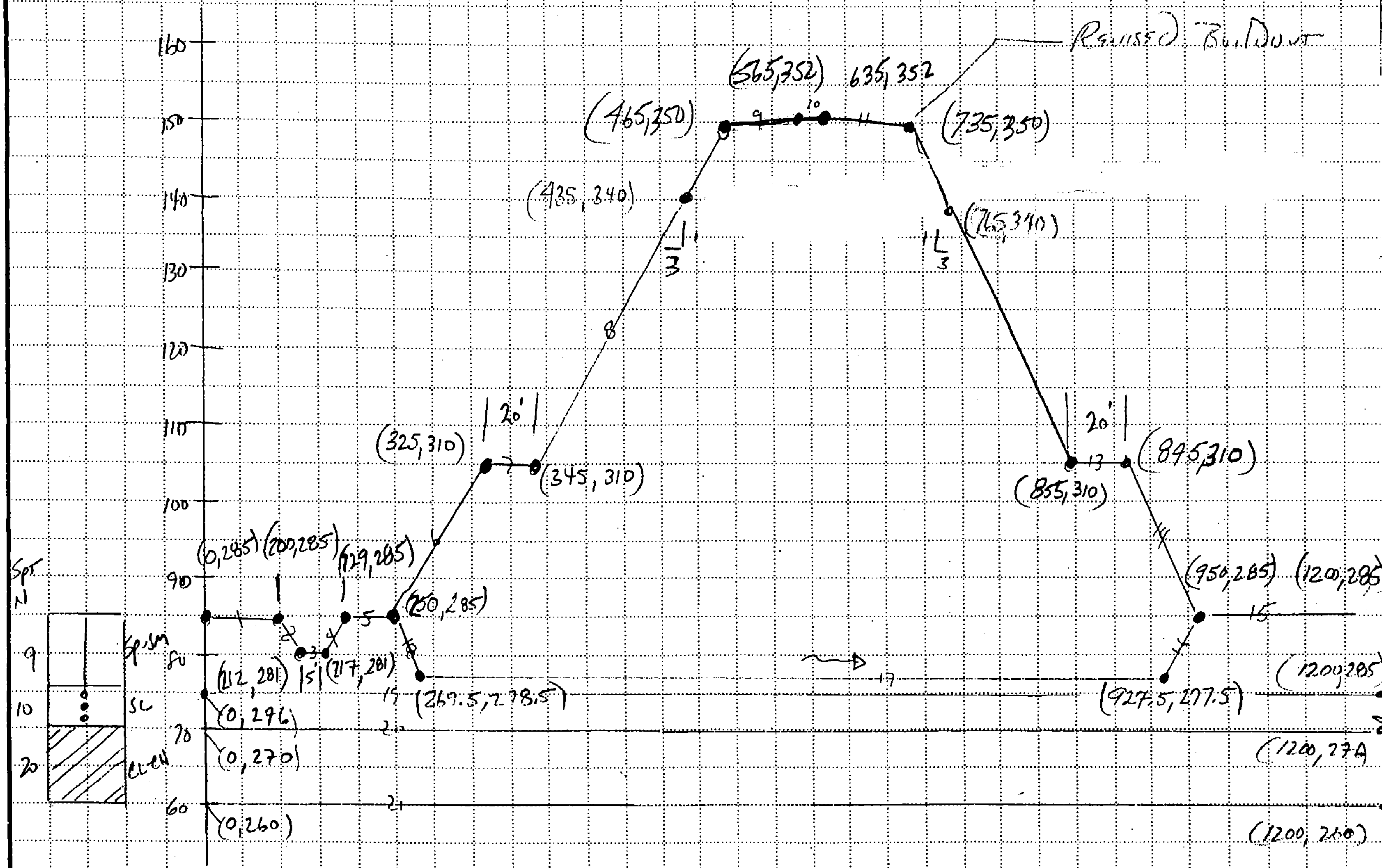
SHEET 15

Final Buildout-Revised North/South Hardee County, Florida

Ten Most Critical. C:FINALNS2.PLT By: Joseph O'Neill 04-15-01 4:46 pm



SHEET 20



MODEL INPUTS

EAST - WEST

SCS ENGINEERS

CLIENT Hardee County

SUBJECT Slope Stability E/W

PROJECT Permit Modification

BY

CHECKED

DATE 11/28/00

JOB NO.

SHEET 24 OF

SHEET 22

WITH EQUIPMENT LOADS

** PCSTABL5 **

by
Purdue University

--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer`s Method of Slices

Run By: Joseph O'Neill
Input Data Filename: C:FINALEW2
Output Filename: C:FINALEW2.OUT
Plotted Output Filename: C:FINALEW2.PLT

PROBLEM DESCRIPTION **Final Buildout-Revised** **East/West**
Hardee County, Florida

BOUNDARY COORDINATES

15 Top Boundaries
21 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	.00	285.00	200.00	285.00	2
2	200.00	285.00	212.00	281.00	2
3	212.00	281.00	217.00	281.00	2
4	217.00	281.00	229.00	285.00	2
5	229.00	285.00	250.00	285.00	2
6	250.00	285.00	325.00	310.00	1
7	325.00	310.00	345.00	310.00	1
8	345.00	310.00	465.00	350.00	1
9	465.00	350.00	565.00	352.00	1
10	565.00	352.00	635.00	352.00	1
11	635.00	352.00	735.00	350.00	1
12	735.00	350.00	855.00	310.00	1
13	855.00	310.00	875.00	310.00	1
14	875.00	310.00	950.00	285.00	1
15	950.00	285.00	1200.00	285.00	1
16	250.00	285.00	269.50	278.50	2
17	269.50	278.50	927.50	277.50	2
18	927.50	277.50	950.00	285.00	2
19	.00	276.00	1200.00	276.00	3
20	.00	270.00	1200.00	270.00	4
21	.00	260.00	1200.00	260.00	5

SIKST23

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	50.0	50.0	.0	25.0	.00	.0	1
2	105.0	110.0	.0	28.0	.00	.0	1
3	110.0	120.0	.0	30.0	.00	.0	1
4	90.0	105.0	2250.0	.0	.00	.0	1
5	110.0	118.0	.0	32.0	.00	.0	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	.00	279.00
2	1200.00	279.00

BOUNDARY LOAD(S)

1 Load(s) Specified

Load No.	X-Left (ft)	X-Right (ft)	Intensity (lb/sqft)	Deflection (deg)
1	465.00	474.50	1552.3	.0

NOTE - Intensity Is Specified As A Uniformly Distributed
Force Acting On A Horizontally Projected Surface.

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

3200 Trial Surfaces Have Been Generated.

80 Surfaces Initiate From Each Of 40 Points Equally Spaced
Along The Ground Surface Between X = 150.00 ft.
and X = 200.00 ft.

Each Surface Terminates Between X = 465.00 ft.
and X = 600.00 ft.

Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y = .00 ft.

10.00 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 33 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	185.90	285.00
2	195.72	283.10
3	205.58	281.47
4	215.49	280.10
5	225.43	279.01
6	235.39	278.19
7	245.38	277.64
8	255.38	277.36
9	265.38	277.36
10	275.37	277.63
11	285.36	278.17
12	295.32	278.98
13	305.27	280.07
14	315.17	281.42
15	325.04	283.05
16	334.86	284.94
17	344.62	287.10
18	354.32	289.53
19	363.95	292.22
20	373.51	295.17
21	382.98	298.38
22	392.36	301.85
23	401.64	305.58
24	410.82	309.55
25	419.88	313.77
26	428.83	318.24
27	437.65	322.95
28	446.34	327.91
29	454.89	333.09
30	463.29	338.51
31	471.55	344.15
32	479.65	350.02
33	480.01	350.30

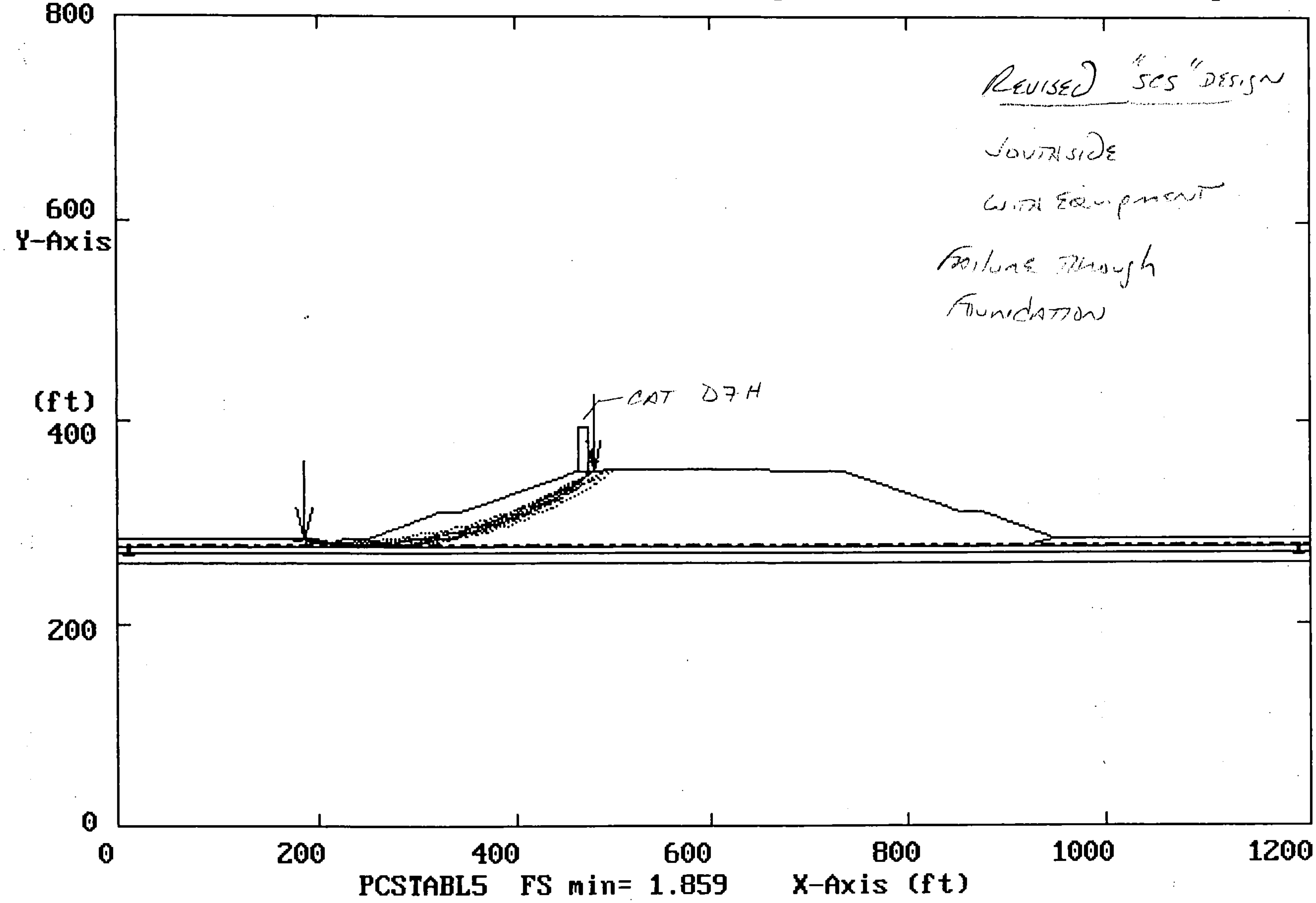
Circle Center At X = 260.5 ; Y = 644.0 and Radius, 366.6

FACTOR OF SAFETY = 1.859 (Failure Planes through waste and foundation)

FACTOR OF SAFETY = 1.296 (Failure Planes from terrace to top of landfill)

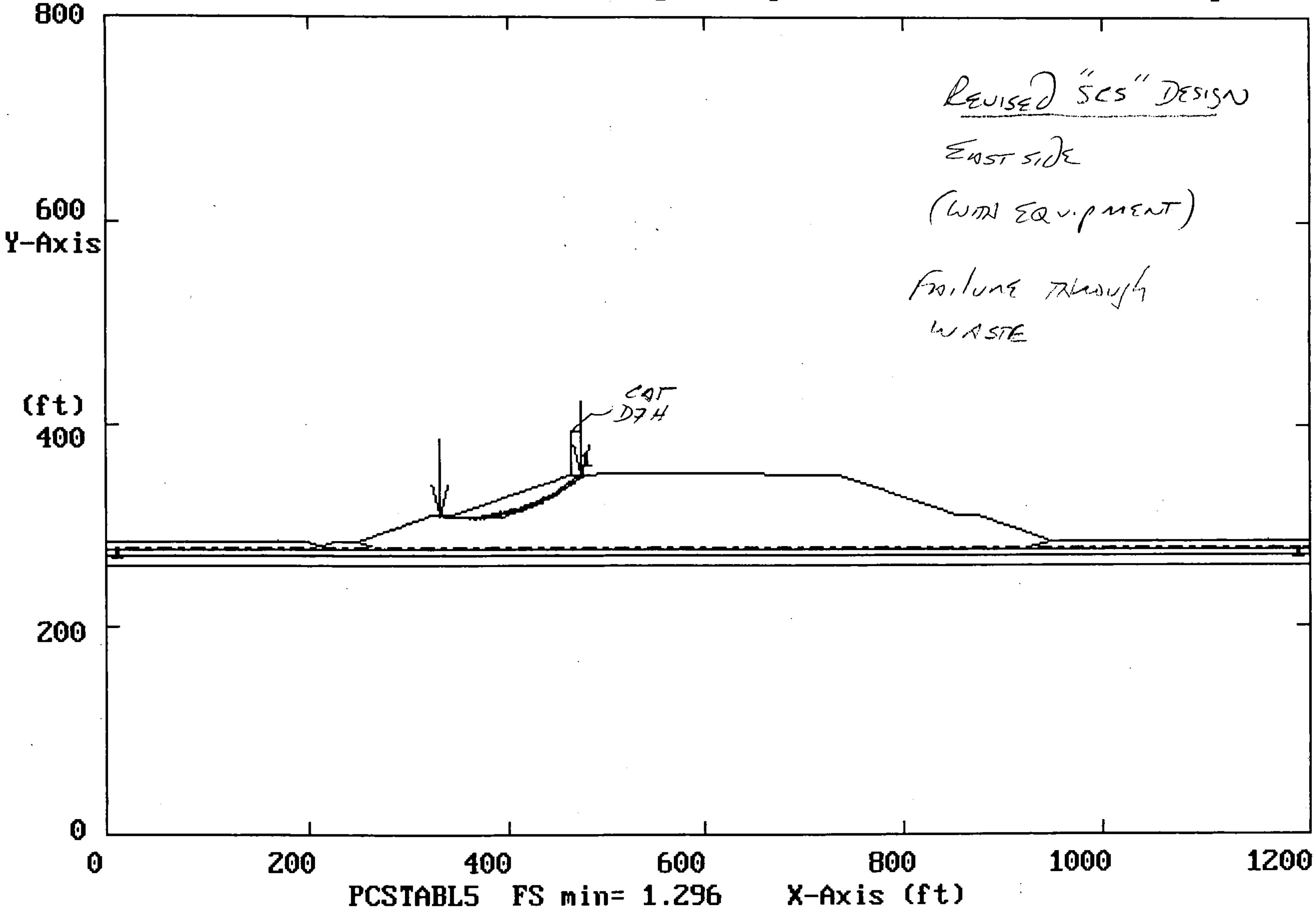
Final Buildout-Revised East/West Hardee County, Florida

Ten Most Critical. C:FINALEW2.PLT By: Joseph O'Neill 04-15-01 4:41 pm



SHEET 25

Final Buildout-Revised East/West Hardee County, Florida
Ten Most Critical. C:FINALEW2.PLT By: Joseph O'Neill 04-15-01 4:39 pm



SHEET 26

SCS ENGINEERS

CLIENT: Hardee County	PROJECT: Permit Modification	JOB NO. 09199033.03
SUBJECT: Estimate Settlement	BY: [illegible]	DATE: Oct 2000
	CHECKED: [illegible]	DATE: 11/30/00

SHEET ___ OF ___

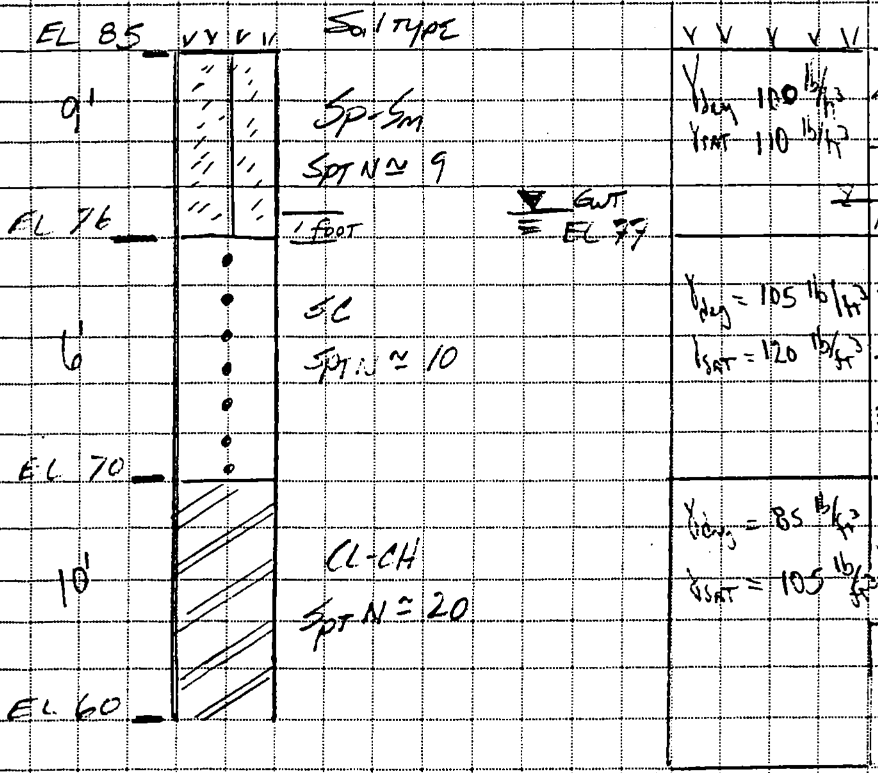
REVISED April 16 2001 [illegible initials] 5/10/01

DETERMINE CONDITIONS PRIOR TO EXCAVATION OF LANDFILL

BASED ON HARDEE COUNTY DRAWING FROM ENVISONS DATED Nov 82 THE APPROXIMATE GROUND ELEVATION WAS EL 85.0

THE APPROXIMATE GROUNDWATER ELEVATION WAS EL 77

DETERMINE INITIAL STRESSES IN EACH LAYER - ASSUME BORINGS BY PSI DATED 3/97 ARE REPRESENTATIVE.



$P_{o_1} = 4.5(100)$
$= 450\ psf$

$P_{o_2} = 4.5(100) + 3.5(100)$
$+ 1(110 - 62.4)$
$+ 3(120 - 62.4)$
$= 1020.4\ psf$

$P_{o_3} = 1020.4 +$
$3(120 - 62.4) +$
$5(105 - 62.4)$
$= 1406.2\ psf$

SHEET 28

SCS ENGINEERS

SHEET ______ OF ______

CLIENT Hardee County	PROJECT Permit Modification	JOB NO. 09199033.03
SUBJECT Estimate Settlement	BY JHD	DATE Oct 2000
	CHECKED	DATE

Revised April 16, 2001

DETERMINE CONDITIONS @ FINAL BUILDOUT (CURRENT & REVISED)

Current Buildout Plans

EL 141

61.7'

EL 79.3

1.3'

EL 78

2'

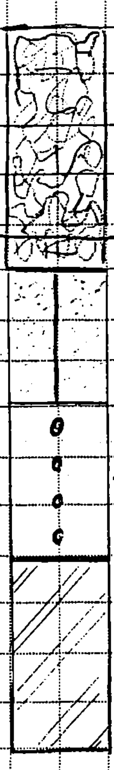
EL 76

6'

EL 70

10'

EL 60



~~$\gamma_w = 1750$ lb/cy (64.8 lb/ft³)~~ (UNIT WEIGHT ~50 lb/ft³)

$P_{F1} = 61.7(\cancel{64.8}\ 50) + 1.3(\cancel{64.8}\ 50 - 62.4) + 1.0(110 - 62.4) = \cancel{4048.9}$ 3132.6 psf

$P_{F2} = 4048.9 + 1(110 - 62.4) + 3(120 - 62.4) = \cancel{4268.3}$ psf 3353 psf

$P_{f3} = 4269.3 + 3(120 - 62.4) + 5(105 - 62.4) = \cancel{4655.1}$ psf 3738.8 psf

Revised Buildout Plans

EL 155

75.7'

EL 79.3

1.3'

EL 78

2'

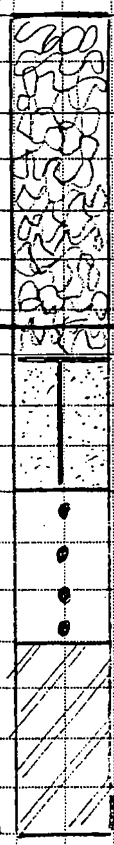
EL 76

6'

EL 70

10'

EL 60



$P_{f1} = 75.7(\cancel{64.8}\ 50) + 1.3(\cancel{64.8}\ 0 - 62.4) + 1(110 - 62.4) = \cancel{4956.1}$ psf 3832.6 psf

$P_{f2} = 4956.1 + 1(110 - 62.4) + 3(120 - 62.4) = \cancel{5176.5}$ psf 4053 psf

$P_{f3} = 5176.5 + 3(120 - 62.4) + 5(105 - 62.4) = \cancel{5562.3}$ psf 4438.8 psf

1) Groundwater approximately equal to dewatering ditch elevation on 10/99 survey ditch elevation was approx EL 79.3

2) Existing ground elevation (EL ~85) was excavated approx 7'–10' down to (EL 77–75), based upon PBSJ drawings dated ______. The average bottom elevations were estimated to be EL 78.0. The excavation depth was based upon the inverts of the perimeter manholes.

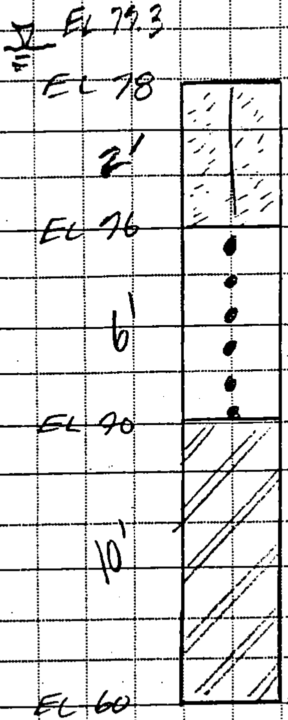
SCS ENGINEERS

SHEET ____ OF ____

CLIENT Hardee Co	PROJECT Permit Modification	JOB NO. 09199032.03
SUBJECT Estimated Settlement	BY JHO	DATE Oct 2000
	CHECKED	DATE

Revised April 16 2001

Estimate Compression Index for Soils



Sp-Sm — SPT N ~ 9 — γ_{dry} ~ 100 lb/ft³, γ_{SAT} ~ 110 lb/ft³

Assumption: $D_r \approx 30\%$

SC — SPT N ~ 10 — γ_{dry} ~ 105 lb/ft³, γ_{SAT} ~ 120 lb/ft³

Assumption: $D_r \approx 30-40\%$, Say 35%

CL-CH — SPT N ~ 20 — γ_{dry} ~ 85 lb/ft³, γ_{SAT} ~ 100 lb/ft³

PSI Lab Results:
LL ≈ 128%
PL ≈ 39%
PI ≈ 89%

Layer (1) Sp-Sm

$D_r \sim 30\%$

Void Ratio (Source: Lambe Whitman)
0.9 (e_{max}) 0.30 (e_{min})

$$D_R = \frac{e_{max} - e}{e_{max} - e_{min}} \times 100$$

$$\frac{30}{100} = \frac{0.9 - e}{(0.9 - 0.3)}$$

$$0.3(0.6) = 0.9 - e$$

$$0.9 - 0.3(0.6) = e_o$$

$$0.72 = e_o$$

SCS ENGINEERS

SHEET 1 OF

CLIENT Hardee Co	PROJECT Permit Modification	JOB NO. 09195033.02
SUBJECT Estimated Settlement	BY	DATE Oct 2000
	CHECKED	DATE

// Revised April 16, 2001

Layer (2) SC

Dr ~ 35%

Void Ratio (Lambe Whitman) Source

1.1 emax 0.4 emin

$$D_r = \frac{e_{max} - e}{e_{max} - e_{min}} \times 100$$

$$0.35 = \frac{1.1 - e}{(1.1 - 0.4)}$$

$$0.35(0.7) = 1.1 - e$$

$$0.855 = e_0$$

(0.86)

Layer (3) CL-CH

$$\gamma_{SAT} = \left(\frac{G_s + e}{1 + e}\right)\gamma_w \quad G = \text{specific gravity} = 2.65$$

$\gamma_{SAT} \sim 105 \text{ lb/ft}^3$

$\gamma_w = 62.4 \text{ lb/ft}^3$

(Source from PSI report dated 2/97)

$$\frac{\gamma_{SAT}}{\gamma_w} = \left(\frac{G_s + e}{1 + e}\right)$$

$$\frac{105}{62.4} = \left(\frac{2.65 + e}{1 + e}\right)$$

$$1.6827 = \frac{2.65 + e_0}{1 + e_0}$$

$$e_0 = 1.417 \rightarrow 1.4$$

Emax ~ 1.0

Emin ~ 0.9

(Based upon professional judgment)

SCS ENGINEERS

SHEET ____ OF ____

CLIENT Hardee County	PROJECT Permit Modification	JOB NO. 09199033.03
SUBJECT Estimated Settlement	BY [illegible]	DATE Oct 2000
	CHECKED	DATE

Revised April 16, 2001

ESTIMATED CONSOLIDATION INDEX PROPERTIES

$C_c \approx a(e_o - b)$ from B.K. Hough Reference

Layer	Description	e_o	b (e_{min})	a	C_c
1	Silty sand (SM)	0.72	0.30	0.09	0.038
2	Clayey sand (SC)	0.855	0.40	0.23	0.10
3	Low Plastic (CL) Clays	1.417	0.9	0.29	0.15

$$\Delta S \approx \frac{C_c H}{1+e_o} \log\left(\frac{p_o + \Delta P}{p_o}\right)$$

C_c - compression index
e_o - initial void ratio
p_o - initial pressure in center of layer (psf)
ΔP - change in pressure (psf)
H - layer thick (ft)

SHEET

32

Estimated Settlement

Hardee County Landfill
Permit Modification
Hardee County, Florida
f:/projects/091999033.03/geotech/settle.xls

REVISED : April 16,2001
(Waste Unit Weight)

Layers	Description	Initial Stress (psf)	Final Stress (Current Plan) (psf)	Final Stress (Revised Plan) (psf)	Change in Stress (Current Plan) (psf)	Change in Stress (Revised Plan) (psf)
1	Med. Dense SP-SM	450	3,133	3,833	2,683	3,383
2	Med. Dense SC	1,020	3,353	4,053	2,333	3,033
3	Stiff CL/CH	1,406	3,739	4,439	2,333	3,033

Notes: SP-SM - Poorly graded / Silty sand
SC - Clayey Sand
CL/CH - Low Plasticity Clay/High Plasticity Clay

Layers	Layer Height (ft)	Initial Void Ratio	Cc	Settlement @Mid (ft)	Settlement @ Mid (ft)
1	2	0.72	0.038	0.04	0.04
2	6	0.855	0.1	0.17	0.19
3	10	1.417	0.15	0.26	0.31
	Estimated Settlement (Current Plan)			0.47	
	Estimated Settlement (Revised Plan)				0.54

SHEET 33

Estimated Net Bearing Capacity

Hardee County Landfill
Permit Modification
Hardee County, Florida
f:/projects/091999033.03/geotech/bearing.xls

REVISED APRIL 16,2001
(Waste Unit Weight)

Layers	Description	Initial Stress (psf)	Final Stress @ Toe (psf)	Final Stress @ Mid (psf)	Change in Stress @ Toe (psf)	Change in Stress @ Mid (psf)
1	Med. Dense SP-SM	450	1,399	8,056	949	7,606
2	Med. Dense SC	1,020	1,619	8,276	599	7,256
3	Stiff CL/CH	1,406	2,005	8,662	599	7,256

Notes: SP-SM - Poorly graded / Silty sand
SC - Clayey Sand
CL/CH - Low Plasticity Clay/High Plasticity Clay

Layers	Layer Height (ft)	Initial Void Ratio	Cc	Settlement @Mid (ft)	Settlement @ Mid (ft)
1	2	0.72	0.038	0.02	0.06
2	6	0.855	0.1	0.06	0.29
3	10	1.417	0.15	0.10	0.49
	Estimated Settlement (@ Toe)			0.18	
	Estimated Settlement (@ Mid)				0.84

Change in Pressure @ Toe
Unit Weight Waste (pcf) = 105

Ptoe 1 = 1398.74 psf
Ptoe 2 = 1619.14 psf
Ptoe 3 = 2004.94 psf

Change in Pressure @ Toe
Unit Weight Waste (pcf) = 105

Ptoe 1 = 8055.74 psf
Ptoe 2 = 8276.14 psf
Ptoe 3 = 8661.94 psf

	Westside	Midpoint	Eastside
El =	78.4	77.9	77.41
Settlement	0.18	0.84	0.18
	78.22	77.06	77.23

Net Bearing Capacity (@center)
Waste Unit Weight 50 pcf — Pressure 3767.64 psf

Excess Unit Weight 105 pcf — Pressure 8008.14 psf

Net 4240.5 psf
(Amount of pressure above current permit levels)

ATTACHMENT C

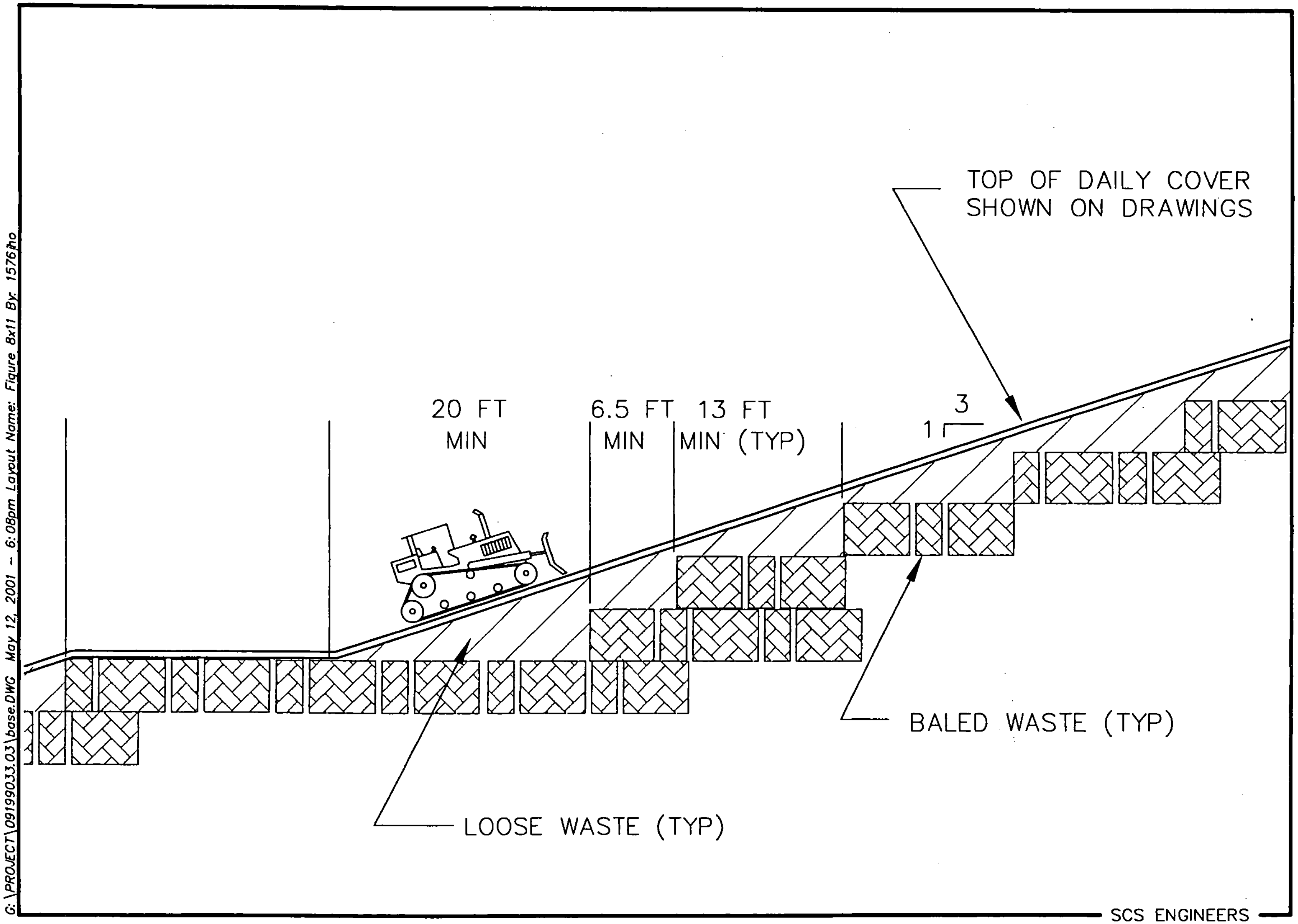


Figure – Sideslope Compaction

SHEET 1

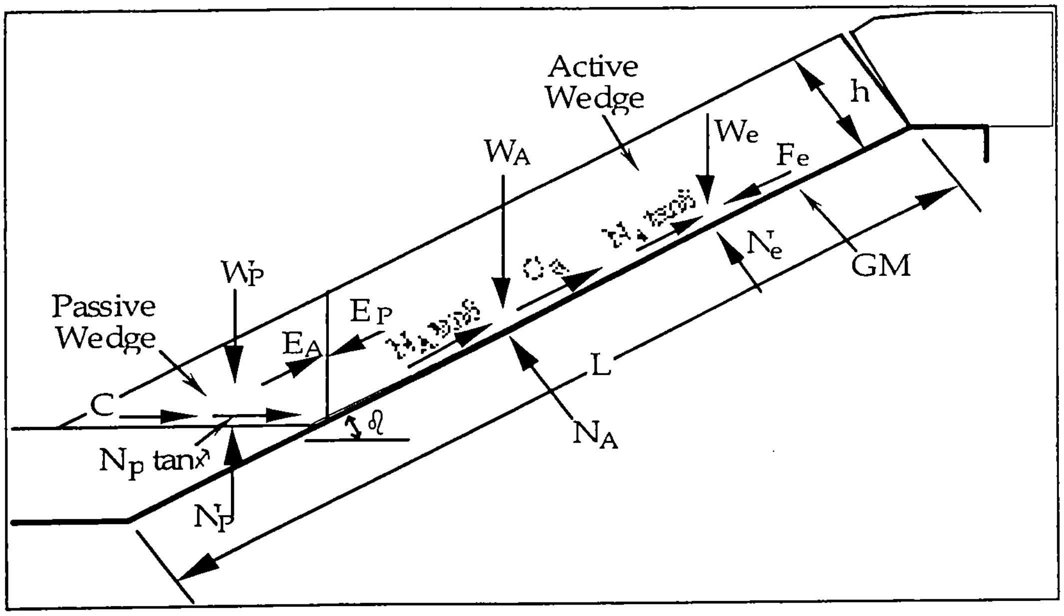
ATTACHMENT D

For GSI/GRI members only

Constructed by: Te-Yang Soong

Cover Soil Stability Worksheet for Example #2

Uniform Cover Soil Thickness with the Incorporation of Equipment Loads (Moving Up or Down Slope)



Calculation of FS

Active Wedge:

Wa= 91.3 kN

Na= 86.7 kN

Passive Wedge:

Wp= 1.3 kN

$$FS = \frac{-b + \sqrt{b^2 - 4ac}}{2a}$$

a= 167.9

b= -235

c= 32.3

FS= 1.25

thickness of cover soil = h =	0.31	m	(upper 12 in of cover)
soil slope angle beneath the geomembrane = β =	18.4	°	= 0.32 (rad.)
finished cover soil slope angle = ω =	18.4	°	= 0.32 (rad.)
length of slope measured along the geomembrane = L =	38.6	m	
unit weight of the cover soil = γ =	7.9	kN/m^3	(50 lb/ft³)
friction angle of the cover soil = φ =	25.0	°	= 0.44 (rad.)
cohesion of the cover soil = c =	0.0	kN/m^2	C= 0 kN
interface friction angle between cover soil and geomembrane = δ =	25.0	°	= 0.44 (rad.)
adhesion between cover soil and geomembrane = ca =	0.0	kN/m^2	Ca= 0 kN

thickness of cover soil = h =	0.31	m		*b/h= 1.8*
equipment ground pressure (= wt. of equipment/(2wb)) = q =	148.7	kN/m^2	(CAT D7H)	*We=q w I= 405.2*
length of each equipment track = w =	2.9	m		*Ne=Wecos β= 384.5*
width of each equipment track = b =	0.6	m		*Fe=We(a/g)= 20.3*
influence factor* at geomembrane interface = I =	0.94			
acceleration/deceleration of the bulldozer = a =	0.05	g	stop/push downhill	

*Influence Factor Default Values

Cover Soil Thickness	Equipment Track Width		
	Very Wide	Wide	Standard
²300 mm	1.00	0.97	0.94
300-1000 mm	0.97	0.92	0.70
³1000 mm	0.95	0.75	0.30

← upper 12-in (304.8 mm)

Note: numbers in boxes are input values

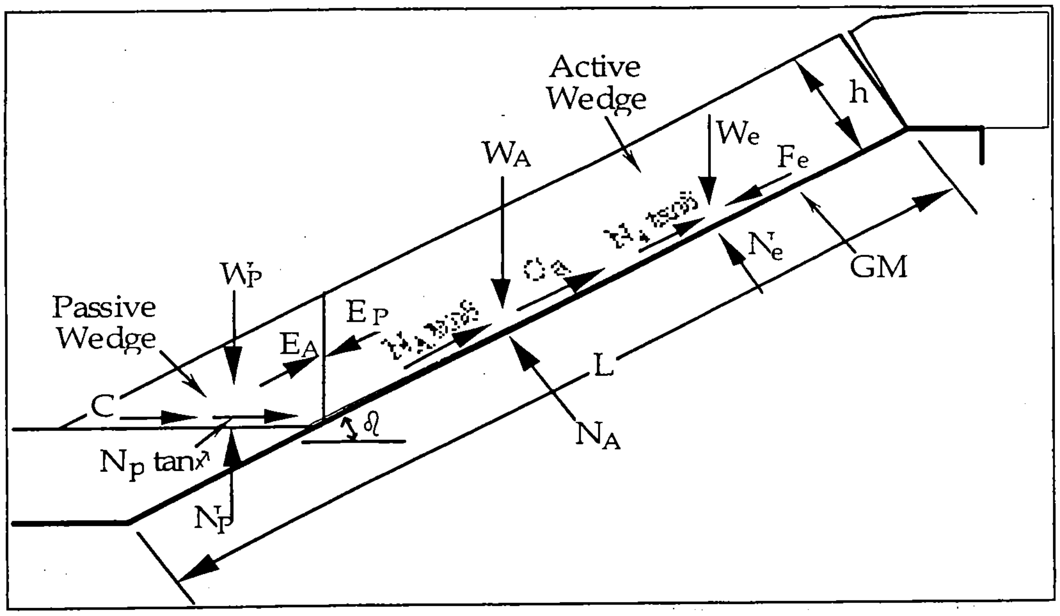
numbers in Italics are calculated values

For GSI/GRI members only

Constructed by: Te-Yang Soong

Cover Soil Stability Worksheet for Example #2

Uniform Cover Soil Thickness with the Incorporation of Equipment Loads (Moving Up or Down Slope)



Calculation of FS

Active Wedge:

Wa= 253.8 kN

Na= 240.8 kN

Passive Wedge:

Wp= 10.9 kN

$$FS = \frac{-b + \sqrt{b^2 - 4ac}}{2a}$$

a= 180.7

b= -266

c= 36.2

FS= 1.32

thickness of cover soil = h =	0.91	m	3 ft cover
soil slope angle beneath the geomembrane = β =	18.4	°	(3:1) = *0.32 (rad.)*
finished cover soil slope angle = ω =	18.4	°	(3:1) = *0.32 (rad.)*
length of slope measured along the geomembrane = L =	38.6	m	
unit weight of the cover soil = γ =	7.9	kN/m^3	(50 lb/ft³)
friction angle of the cover soil = φ =	25.0	°	= *0.44 (rad.)*
cohesion of the cover soil = c =	0.0	kN/m^2	*C= 0 kN*
interface friction angle between cover soil and geomembrane = δ =	25.0	°	= *0.44 (rad.)*
adhesion between cover soil and geomembrane = ca =	0.0	kN/m^2	*Ca= 0 kN*

thickness of cover soil = h =	0.91	m	*b/h= 0.6*
equipment ground pressure (= wt. of equipment/(2wb)) = q =	148.7	kN/m^2	(CAT D7H) *We=q w I= 301.8*
length of each equipment track = w =	2.9	m	*Ne=We cos β= 286.3*
width of each equipment track = b =	0.6	m	*Fe=We(a/g)= 15.1*
influence factor* at geomembrane interface = I =	0.70		
acceleration/deceleration of the bulldozer = a =	0.05	g	STOP/push Down Hill

*Influence Factor Default Values

Cover Soil Thickness	Equipment Track Width		
	Very Wide	Wide	Standard
≤300 mm	1.00	0.97	0.94
300-1000 mm	0.97	0.92	0.70
≥1000 mm	0.95	0.75	0.30

← 3 ft cover (914 mm)

Note: numbers in boxes are input values

numbers in Italics are calculated values

SHEET 3

Caterpillar® Performance Handbook

23rd edition

CATERPILLAR®

SHEET 4




MODEL	D7G		D7H Series II		D8N		D8L	
Flywheel Power	149 kW	200 HP	160 kW	215 HP	212 kW	285 HP	250 kW	335 HP
Operating Weight*								
(Power Shift)	20 666 kg	45,560 lb	24 195 kg	53,470 lb	36 842 kg	81,222 lb	38 114 kg	84,026 lb
(Direct Drive)	20 510 kg	45,218 lb	24 117 kg	53,298 lb	—		—	
(Power Shift Diferential Steer)	—		24 469 kg	54,073 lb	—		—	
Engine Model	3306		3306		3406		3408	
Rated Engine RPM	2000		2100		2100		1900	
No. of Cylinders	6		6		6		8	
Bore	121 mm	4.75"	121 mm	4.75"	137 mm	5.4"	137 mm	5.4"
Stroke	152 mm	6"	152 mm	6"	165 mm	6.5"	152 mm	6"
Displacement	10.5 L	638 in³	10.5 L	638 in³	14.6 L	893 in³	18 L	1099 in³
Track Rollers (Each Side)	6		7		8		8	
Width of Standard Track Shoe	508 mm	20"	560 mm	22"ES	560 mm	22"	560 mm	22"
Length of Track on Ground	2.70 m	8'11"	2.90 m	9'6"	3.21 m	*10'6"	3.22 m	10'6.5"
Ground Contact Area (W/Std. Shoe)	2.76 m²	4280 in²	3.24 m²	5016 in²	3.6 m²	5565 in²	3.59 m²	5565 in²
Track Gauge	1.98 m	6'5"	1.98 m	6'6"	2.08 m	6'10"	2.28 m	7'6"
GENERAL DIMENSIONS:								
Height (Stripped Top)**	2.27 m	7'5"	2.44 m	8'0"	2.59 m	8'6"►	2.89 m	9'6"
Height (To Top of ROPS)	3.20 m	10'6"	3.33 m	10'11"	3.43 m	11'3"►	3.87 m	12'8"
Height (To Top of Cab ROPS)	—		3.42 m	11'3"	—		—	
Overall Length (With S Blade)	5.28 m	17'4"	6.03 m	19'9"	6.24 m	20'6"	6.22 m	20'5"
(Without Blade)	4.19 m	13'9"	4.62 m	15'2"	4.93 m	16'2"	4.95 m	16'3"
Width (Over Trunnion)	—		2.86 m	9'5"	3.05 m	10'	—	
Width (W/O Trunnion — Std. Shoe)	2.55 m	8'5"	2.54 m	8'4"	2.7 m	8'10"	2.84 m	9'4"
Ground Clearance	347 mm	13.7"	406 mm	16"	528 mm	20.8"	456 mm	18"
Blade Types and Widths:								
Straight	3.66 m	12'0"	3.91 m	12'10"	—		4.17 m	13'8"
Angle	4.27 m	14'0"	—		—		—	
Angle Straight	—		4.49 m	14'9"	4.96 m	16'3"	—	
Full Angle	—		4.08 m	13'5"	—		—	
Universal	3.81 m	12'6"	3.96 m	13'1"	4.26 m	14'0"	—	
Semi-U	—		3.66 m	12'1"	3.94 m	12'11"	—	
Fuel Tank Refill Capacity	435 L	115 U.S. gal	488 L	129 U.S. gal	488 L	129 U.S. gal	753 L	199 U.S. gal

*Operating Weight includes ROPS canopy, operator, lubricants, coolant, full fuel tank, hydraulic controls and fluid, straight dozer with tilt, horn, back-up alarm, retrieval hitch and front pull hook.
— D7G includes end track guiding guards.
— D7H Series II with extended undercarriage: length of track on ground 3.07 m (10'1") ground contact area 3.43 m² (5324 in²).
— D8N equipped with track guides, 635 mm (24") MS shoes, single shank ripper and SU blade.
**Height (stripped top) — without ROPS canopy, exhaust, seat back or other easily removed encumbrances.

SCS ENGINEERS

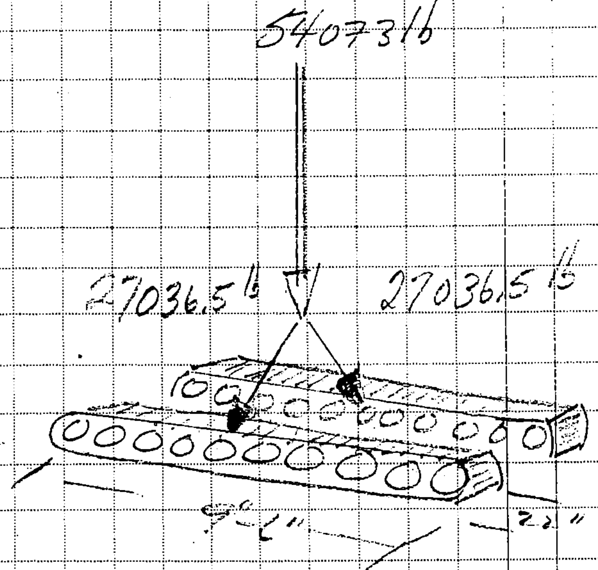
SHEET 5 OF ____

CLIENT Hardee Co	PROJECT Permit Modification	JOB NO. 09200020.11
SUBJECT Slope Stability	BY [illegible]	DATE April 10 2001
Filling Operations	CHECKED [illegible]	DATE 5/10/01

County Equipment — CAT D7H Dozer for compaction

Use operating weight = 54073 lb
from CAT Handbook
pg 1-6 23 Edition

Length of track on ground 9'-6" (2.90 m)
Width of shoe 22" (0.56 m)



Surface contact area / track

$$\left(\frac{9'-6"}{12}\right) \times \left(\frac{22"}{12}\right) = 17.42 \text{ sf}$$

Ground contact pressure per track

$$\sigma = F/A = \frac{27036.5 \text{ lb}}{17.42 \text{ sf}} = 1552.33 \text{ lb/ft}^2 \quad (74.33 \text{ kN/m}^2)$$

(2 tracks = 148.66 kN/m²)

SCS ENGINEERS

SHEET 6 OF ____

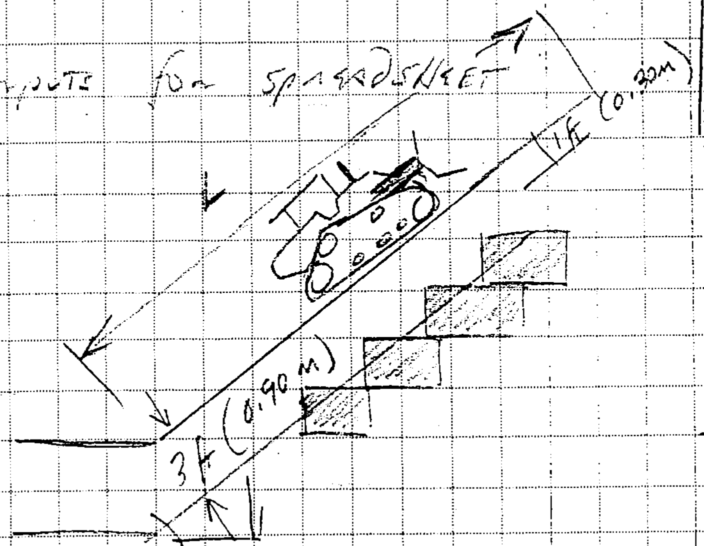
CLIENT Hardee County	PROJECT Permit Modification	JOB NO. 09200070.11
SUBJECT Slope Stability	BY JTD	DATE April 10, 01
Filling Operations	CHECKED	DATE

Wedge failure through loose fill compacted by Dozer

12-inch - simulate slippage during loose fill cover

36-inch - simulate loose fill on sideslope

Inputs for spreadsheet



Slope angle = β = 18.4°

Acceleration = 0 g (push up hill)

Acceleration = 0.05 g Down hill

See pg __ of __

STRENGTH

— Strength of loose waste (strength)

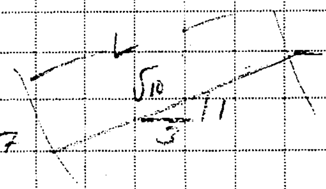
Conservatively use φ = 25° c = 0 psf

INTERFACE

No geomembrane interface thus material slippage is internal to waste

use φ = 25° c = 0 psf

Length of slope



$L = (147 - 107)\sqrt{10} = 126.49$ ft (38.56 m)

COVER THICKNESS

Assume 3 ft (0.9144 m) is equivalent to loose waste

Also check upper 1 ft (0.3048 ft) for slippage

EQUIPMENT PRESSURE / LOADS 943.8 lb/ft² (see equipment load)

45.19 KN/m² x 2 tracks = 90.38 KN/m²

SHEET 7

DREXEL
UNIVERSITY

Geosynthetic Research Institute
33rd & Lancaster Walk
Rush Building - West Wing
Philadelphia, PA 19104
TEL 215 895-2343
FAX 215 895-1437

Geotextiles Geomembranes Geogrids Geocomposites Geosynthetic Clay Liners Geopipes Geonets

FOR GSI/GRI MEMBER ORGANIZATIONS ONLY!

COVER SOIL SLOPE STABILITY INVOLVING GEOSYNTHETIC INTERFACES

by

Te-Yang Soong, Ph.D.
Research Engineer

and

Robert M. Koerner, Ph.D., PE
Director and Professor

Geosynthetic Research Institute
Drexel University
West Wing - Rush Building
Philadelphia, PA 19104

GRI Report #18

December 9, 1996

SHEET 8

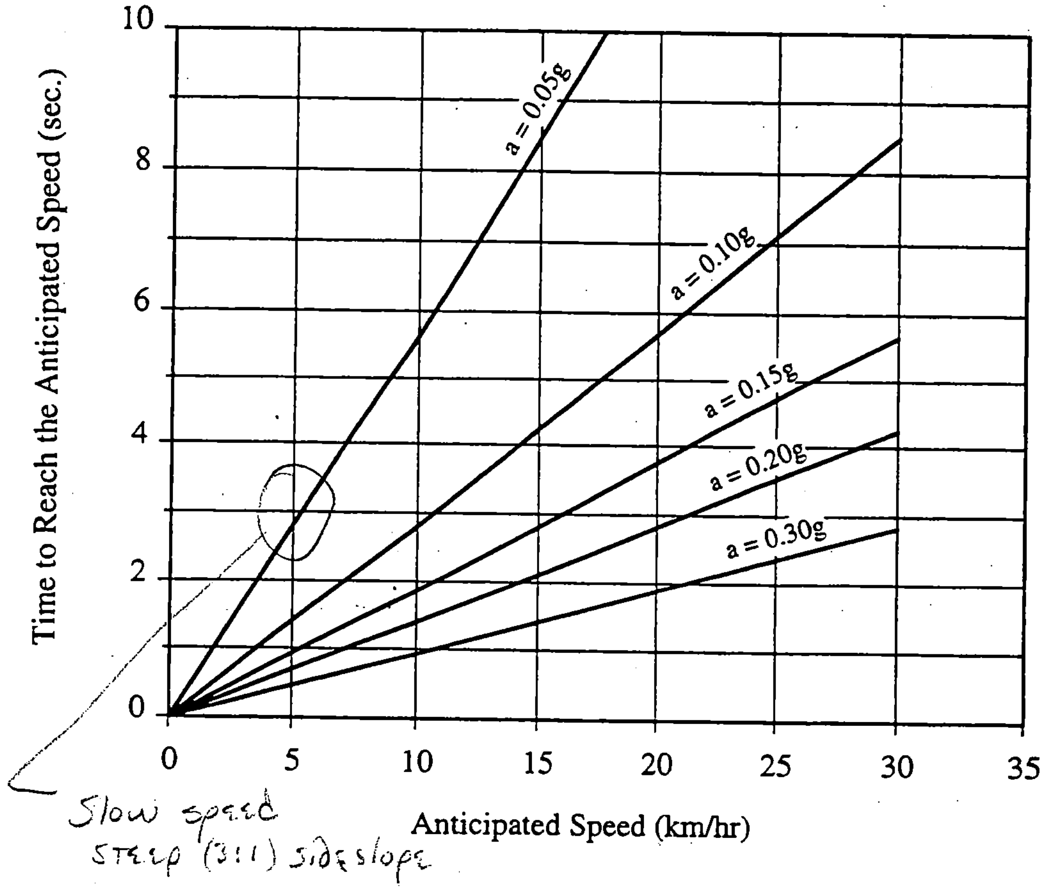


Figure 9 - Graphic relationship of construction equipment speed and rise time to obtain equipment acceleration

The acceleration of the bulldozer, coupled with an influence factor "I" (from Figure 7), results in the dynamic force per unit width at the cover soil to geomembrane interface, "F_e". The relationship is as follows:

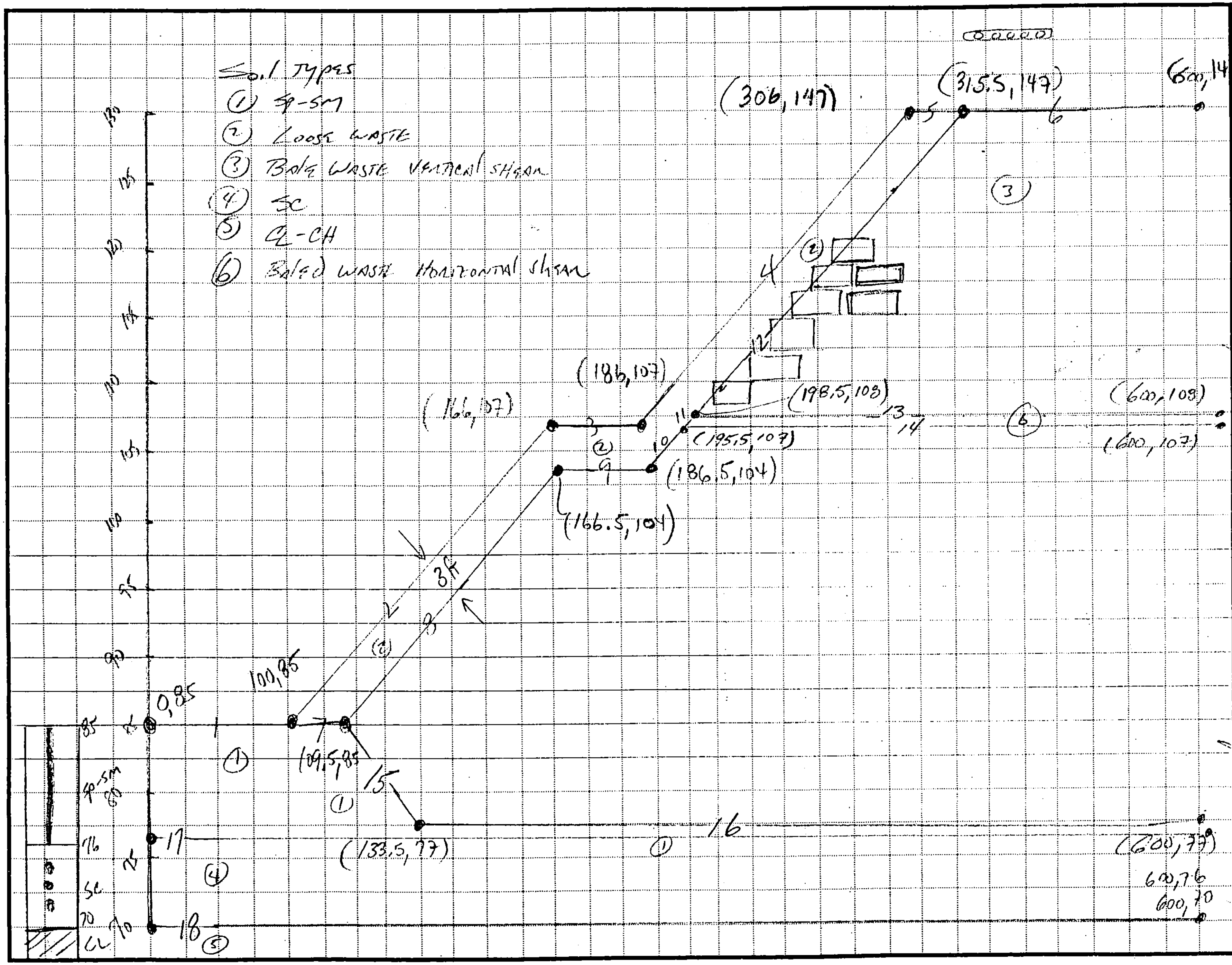
$$F_e = W_e\left(\frac{a}{g}\right)I \tag{17}$$

where

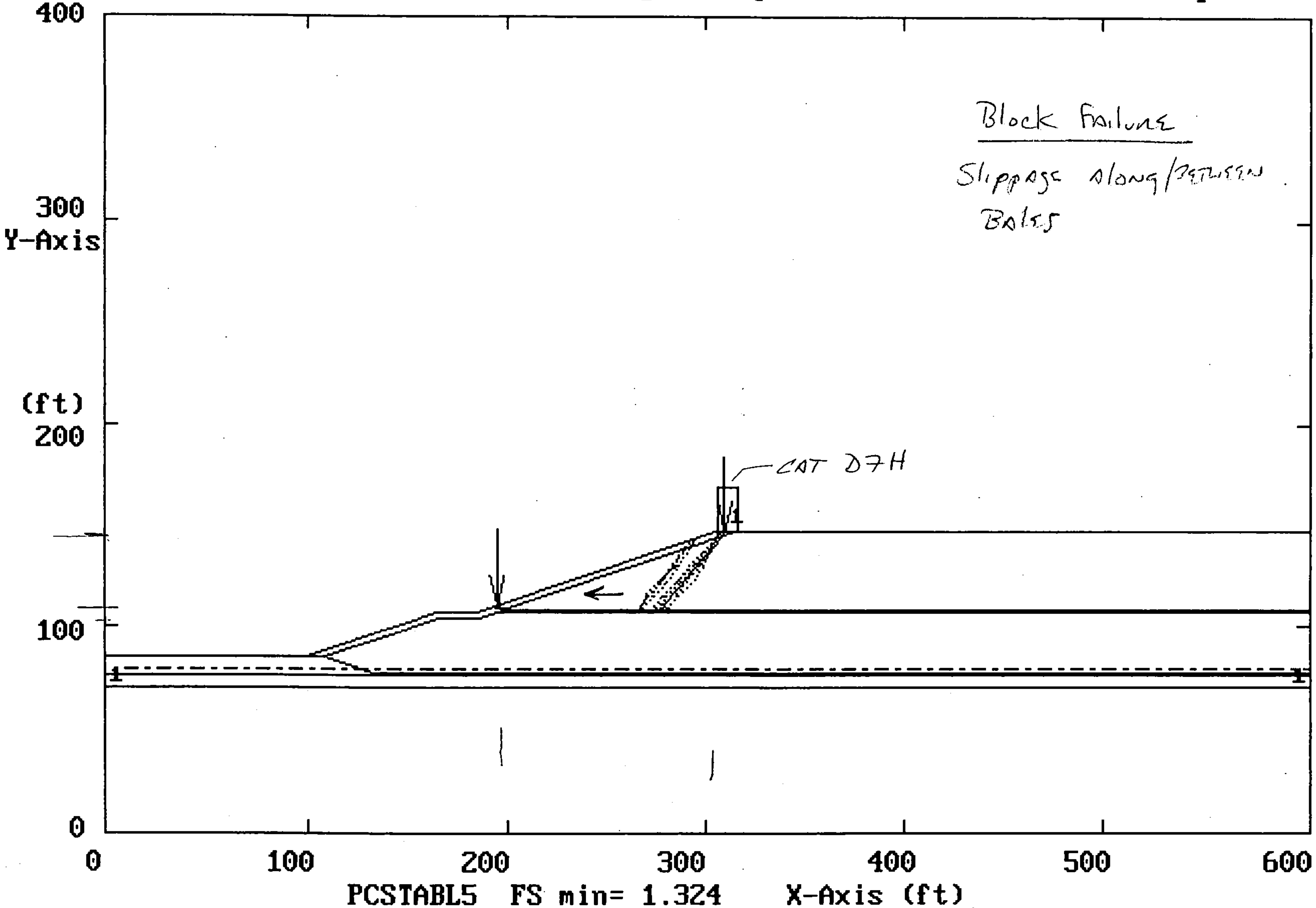
- F_e = dynamic force per unit width parallel to the slope at the geomembrane interface,
- W_e = equivalent equipment (bulldozer) force per unit width at geomembrane interface, recall Equation (16).
- β = soil slope angle beneath geomembrane
- a = acceleration of the bulldozer
- g = acceleration due to gravity
- I = influence factor at the geomembrane interface, see Figure 7

SCS ENGINEERS

CLIENT: Hardee County
PROJECT: Permit Modification
SUBJECT: Slope Stability Filling Operations
JOB NO.: 09200020.11
BY: [illegible] DATE: April 10, 01
CHECKED: [illegible] DATE: 5/10/01
SHEET 5 OF



Equipment Loading of Sideslopes Hardee County Landfill Hardee Co, FL
Ten Most Critical. C:EQUIP.PLT By: Joseph O'Neill 04-15-01 8:41 pm



Sheet 10

SHEET 11

** PCSTABL5 **

by
Purdue University

--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer`s Method of Slices

Run Date: 04-16-01
Time of Run: 8:20 am
Run By: Joseph O'Neill
Input Data Filename: C:EQUIP
Output Filename: C:EQUIP.OUT
Plotted Output Filename: C:EQUIP.PLT

PROBLEM DESCRIPTION **Equipment Loading of Sideslopes**
Hardee County Landfill Hardee Co, FL

BOUNDARY COORDINATES

6 Top Boundaries
18 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	.00	85.00	100.00	85.00	1
2	100.00	85.00	166.00	107.00	2
3	166.00	107.00	186.00	107.00	2
4	186.00	107.00	306.00	147.00	2
5	306.00	147.00	315.50	147.00	2
6	315.50	147.00	600.00	147.00	3
7	100.00	85.00	109.50	85.00	1
8	109.50	85.00	166.50	104.00	3
9	166.50	104.00	186.50	104.00	3
10	186.50	104.00	195.50	107.00	3
11	195.50	107.00	198.50	107.00	6
12	198.50	108.00	315.50	147.00	3
13	198.50	108.00	600.00	108.00	6
14	195.50	107.00	600.00	107.00	3
15	109.50	85.00	133.50	77.00	1
16	133.50	77.00	600.00	77.00	1
17	.00	76.00	600.00	76.00	4
18	.00	70.00	600.00	70.00	5

Sheet 12

ISOTROPIC SOIL PARAMETERS

6 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	105.0	110.0	.0	28.0	.00	.0	1
2	50.0	50.0	.0	25.0	.00	.0	1
3	50.0	50.0	.0	25.0	.00	.0	1
4	110.0	120.0	.0	30.0	.00	.0	1
5	90.0	105.0	2250.0	.0	.00	.0	1
6	50.0	50.0	.0	20.0	.00	.0	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	.00	79.00
2	600.00	79.00

BOUNDARY LOAD(S)

1 Load(s) Specified

Load No.	X-Left (ft)	X-Right (ft)	Intensity (lb/sqft)	Deflection (deg)
1	306.00	315.50	1552.3	.0

NOTE - Intensity Is Specified As A Uniformly Distributed Force Acting On A Horizontally Projected Surface.

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

100 Trial Surfaces Have Been Generated.

2 Boxes Specified For Generation Of Central Block Base

Length Of Line Segments For Active And Passive Portions Of Sliding Block Is 10.0

Box No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Height (ft)
1	200.00	107.50	210.00	107.50	.50
2	260.00	107.50	280.00	107.50	.50

SHEET 13

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 9 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	194.82	109.94
2	202.18	107.25
3	276.39	107.71
4	282.32	115.77
5	289.13	123.09
6	295.33	130.93
7	302.19	138.21
8	308.51	145.96
9	309.32	147.00

FACTOR OF SAFETY = 1.324 (Block Failure along Bale Interface)

SHEET 14

Geotechnics of WASTE FILLS

Theory and Practice

Landva / Knowles, editors

ASTM

STP 1070

Landva/Knowles

Geotechnics of Waste Fills
Theory and Practice

STP 1070

ASTM

Source "Same As Sheet 14"

SHEET 15

of 15 was used by Dames & Moore (20) after rejecting values larger than 50 that may represent the encounter of obstructions. Earth Tech Corporation (9) reported the results of a vane shear test and a standard penetration test. These results are shown In Figure 3.

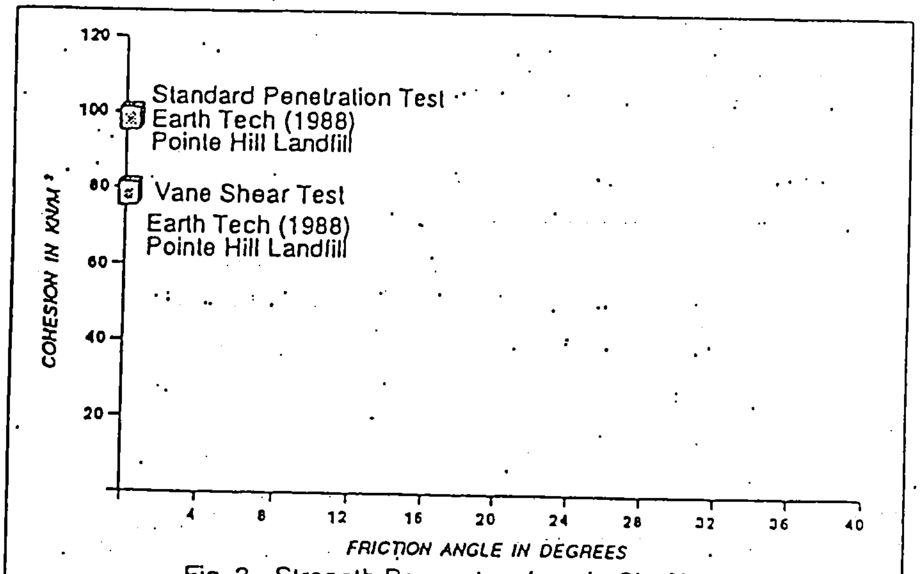


Fig. 3 - Strength Parameters from In-Situ Testing

Finally, the results of all the foregoing tests are plotted in Figure 4. Because of the scatter and scarcity of the data, it is difficult to draw any definitive conclusions on the shear strength characteristics of sanitary fill material.

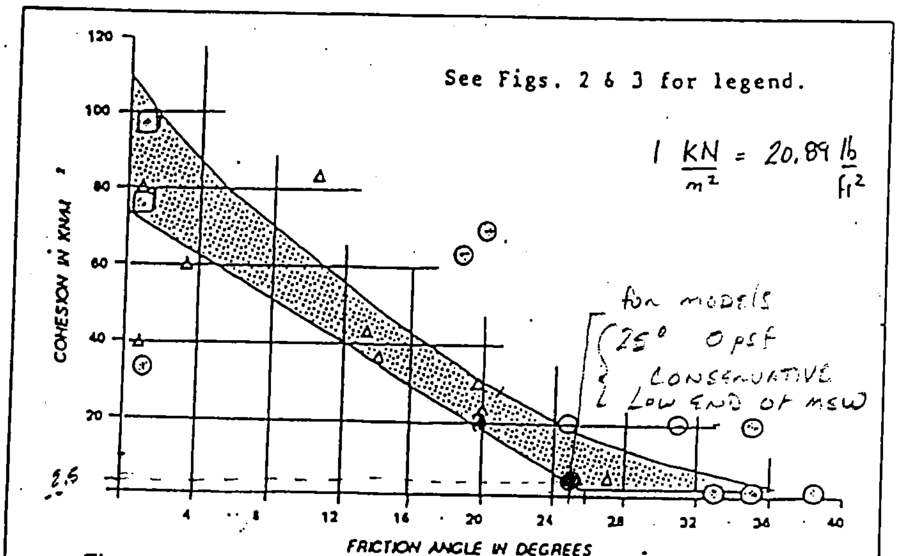
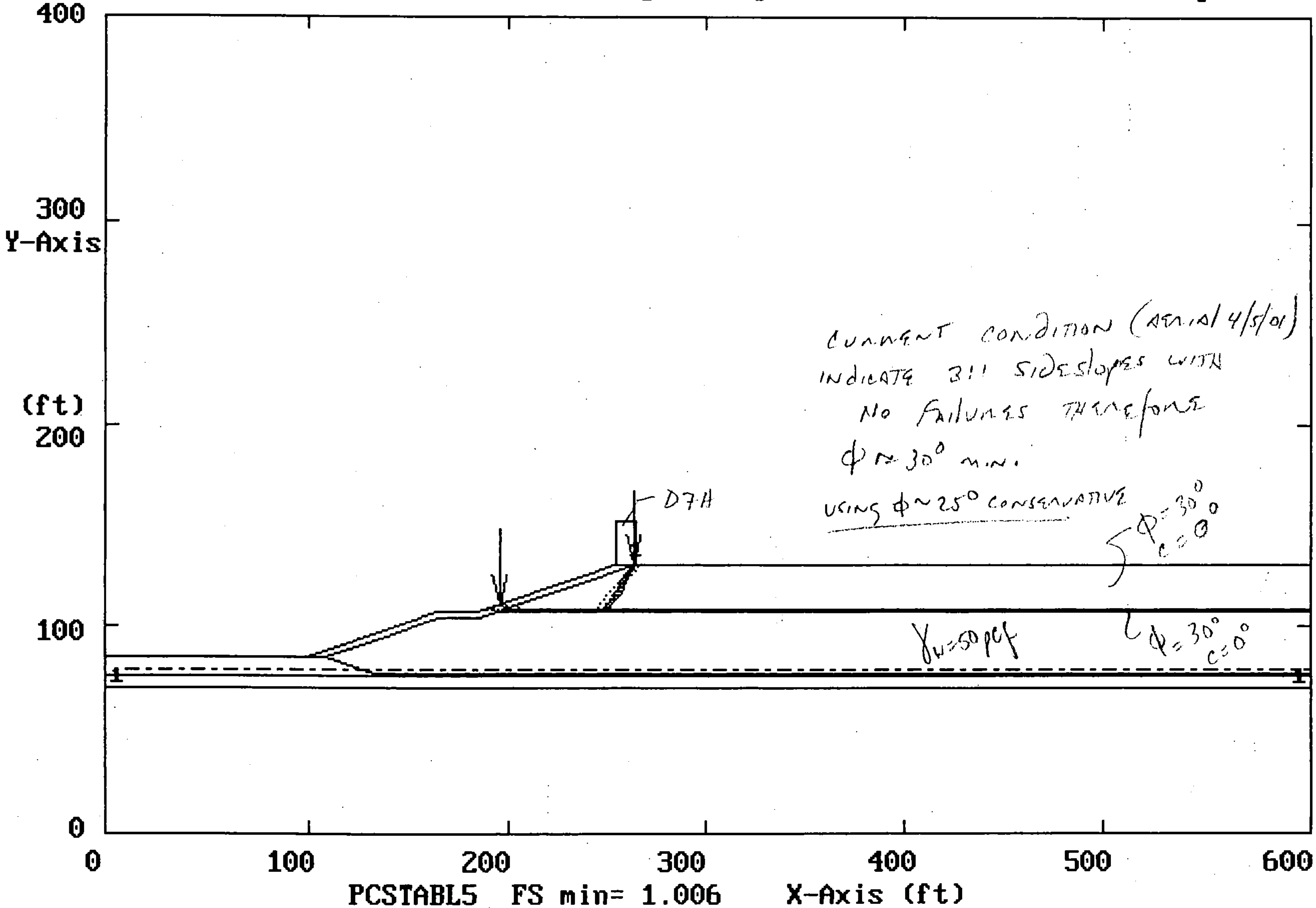


Fig. 4 - Summary Plot for All Tests with Recommended Parameters Shaded

MSW TYPICAL VALUES

Equipment Loading of Sideslopes Hardee County Landfill Hardee Co, FL
Ten Most Critical. C:EQUIP.PLT By: Joseph O'Neill 04-15-01 6:42 pm



SHEET 1/

SHEET 17

** PCSTABL5 **

by
Purdue University

--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer`s Method of Slices

Run Date:	04-15-01
Time of Run:	6:42 pm
Run By:	Joseph O'Neill
Input Data Filename:	C:EQUIP
Output Filename:	C:EQUIP.OUT
Plotted Output Filename:	C:EQUIP.PLT

PROBLEM DESCRIPTION **Equipment Loading of Sideslopes**
Hardee County Landfill Hardee Co, FL

BOUNDARY COORDINATES

6 Top Boundaries
18 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	.00	85.00	100.00	85.00	1
2	100.00	85.00	166.00	107.00	2
3	166.00	107.00	186.00	107.00	2
4	186.00	107.00	255.00	130.00	2
5	255.00	130.00	264.50	130.00	2
6	264.50	130.00	600.00	130.00	3
7	100.00	85.00	109.50	85.00	1
8	109.50	85.00	166.50	104.00	3
9	166.50	104.00	186.50	104.00	3
10	186.50	104.00	195.50	107.00	3
11	195.50	107.00	198.50	107.00	6
12	198.50	108.00	264.50	130.00	3
13	198.50	108.00	600.00	108.00	6
14	195.50	107.00	600.00	107.00	3
15	109.50	85.00	133.50	77.00	1
16	133.50	77.00	600.00	77.00	1
17	.00	76.00	600.00	76.00	4
18	.00	70.00	600.00	70.00	5

ISOTROPIC SOIL PARAMETERS

6 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	105.0	110.0	.0	28.0	.00	.0	1
2	50.0	50.0	.0	30.0	.00	.0	1
3	50.0	50.0	.0	30.0	.00	.0	1
4	110.0	120.0	.0	30.0	.00	.0	1
5	90.0	105.0	2250.0	.0	.00	.0	1
6	50.0	50.0	.0	20.0	.00	.0	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	.00	79.00
2	600.00	79.00

BOUNDARY LOAD(S)

1 Load(s) Specified

Load No.	X-Left (ft)	X-Right (ft)	Intensity (lb/sqft)	Deflection (deg)
1	255.00	264.50	1552.3	.0

NOTE - Intensity Is Specified As A Uniformly Distributed Force Acting On A Horizontally Projected Surface.

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

100 Trial Surfaces Have Been Generated.

2 Boxes Specified For Generation Of Central Block Base

Length Of Line Segments For Active And Passive Portions Of Sliding Block Is 10.0

Box No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Height (ft)
1	200.00	107.50	210.00	107.50	.50
2	240.00	107.50	250.00	107.50	.50

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 7 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	196.07	110.36
2	197.11	110.06
3	206.79	107.55
4	249.79	107.74
5	256.69	114.99
6	261.01	124.00
7	263.05	130.00

FACTOR OF SAFETY = 1.006 (Estimate of current waste strenth - existing topography indicates that the southside of the landfill has been graded to a 3(h):1(v) sideslope and there is no indication of failure. Therefore the waste internal and interface between bales must have at least a phi = 30 cohesion = 0 psf. The use of phi=25 and c=0 psf for slope stability is very conservative)

ATTACHMENT E

/

Site Volume Table: Unadjusted

Cut yards	Fill yards	Net yards	Method

Site: Final

Final operation grade approx 36" below final closure elevations

Stratum: exist vs final operations topo-040501 final operations

2985	246538	243553 (F)	Grid

Stratum: exist phase1 topo-040501 phase1_operation

4146	61507	57361 (F)	Grid

Stratum: exist phase 2 topo-040501 phase2_operations

4146	73854	69708 (F)	Grid

Stratum: exist phase 3 topo-040501 phase3_operations

4120	119705	115585 (F)	Grid

Stratum: existing phase 4 topo-040501 phase4_operations

3510	141287	137777 (F)	Grid

SCS ENGINEERS

SHEET 2 OF ____

CLIENT Hardee Co	PROJECT Permit Modification	JOB NO. 09199023.03
SUBJECT Volume Estimates	BY [illegible]	DATE April 26, 2001
	CHECKED [illegible]	DATE 5/10/01

Volume Estimates

4/5/01

(1) Volume Existing vs Final

CUT	Fill	NET
2985	246,538	243,553

(2) Volume Existing vs Phase 1

CUT	Fill	NET
4146	61507	57361 ✓

Phase (1) available airspace

(3) Volume Existing vs Phase 2

CUT	Fill	NET
4146	73854	69709

(4) Volume Existing vs Phase 3

CUT	Fill	NET
4120	119705	115585

(5) Volume Existing vs Phase 4

CUT	Fill	NET
3510	141287	137,777

INTERMEDIATE VOLUMES

Volume between Phase 1 & 2	Volume (3) − (2)	12,347 cy	Phase (2) Airspace
Volume between Phase 2 & 3	Volume (4) − (3)	45,877 cy	Phase (3) Airspace
Volume between Phase 3 & 4	Volume (5) − (4)	22,192 cy	Phase (4) Airspace
Volume between Phase 4 & Final	Volume (1) − (5)	105,776 cy	Final Airspace

SCS ENGINEERS

SHEET 3 OF ____

CLIENT Hardee Co	PROJECT Permit Modification	JOB NO. 09199033.03
SUBJECT Estimated Life	BY [initials]	DATE
Volume Estimates	CHECKED	DATE

Volume Estimates Per Phase (based upon Existing 4/5/01 vs grades shown on Permit Modification Drawings) Dated April 2001 by SCS Engineers

(1) Volume From Existing to Final

243,000 cy

(2) Volume from Existing to Phase 1

57,000 cy

(3) Volume from Phase (1) to Phase (2)

12,000 cy

(4) Volume from Phase (2) to Phase (3)

46,000 cy

(5) Volume from Phase (3) to Phase (4)

22,000 cy

(6) Volume from Phase (4) to Final

106,000 cy

SCS ENGINEERS

SHEET 4 OF ____

CLIENT Hardee Co	PROJECT Permit Modification	JOB NO. 09199077.02
SUBJECT Estimated Life	BY JHO	DATE April 2001
	CHECKED	DATE

ESTIMATED LIFE

(1) Volume from existing to final daily cover grades is approx. 243,000 cy from AutoCAD (Existing April 2001 vs Final operations grade)

Subtract intermediate cover say 5 – 10% (w/ daily) — 243,000 cy

@ 7% 17010 cy

225,990 cy airspace

(2) Assume an in-place density of 50 pcf (1350 pcy)

Therefore available tonnage

$225{,}990 \text{ cy} \left(\frac{1350 \text{ lb}}{\text{cy}}\right)\left(\frac{1 \text{ TN}}{2000 \text{ lb}}\right) = 152{,}543.25 \text{ TN}$

(3) Incoming waste

Assume $55 \frac{\text{TNS}}{\text{day}} \times \frac{6 \text{ days/week}}{7 \text{ days/week}} \times 365 \frac{\text{day}}{\text{yr}} = 17207 \frac{\text{TN}}{\text{yr}}$ (← open)

Estimated Life **8.8 yrs**

SCS ENGINEERS

SHEET 5 OF ____

CLIENT Handex Co	PROJECT Permit Modification	JOB NO. 09199023.02
SUBJECT Estimated Life	BY JHo	DATE April 2001
	CHECKED	DATE

Estimated Life

17207.143

	Daily cover @ 7%	Waste density	Disposal rate	Days/yr	Life
		0.675			

① {(243,000 cy − 17,010 cy) × (1350 lb / 2000 lb/TN)} / {(55 TNS/day)(6/7)(365)} = 8.8 yr

② {(57,000 cy − 3990) × 0.675} / 17207.143 = 2.08 yr

③ {(12,000 cy − 840 cy) × 0.675} / 17207.143 = 0.44 yr

④ {(46,000 − 3220 cy) × 0.675} / 17207.143 = 1.68 yr

⑤ {(22,000 cy − 1540 cy) × 0.675} / 17207.143 = 0.80 yr

⑥ {(106,000 cy − 7420 cy) × 0.675} / 17207.143 = 3.87 yr

Check ① vs (2+3+4+5+6)

8.8 yr vs 8.86 yr

OK

Environmental Consultants

3012 U.S. Highway 301 North
Suite 700
Tampa, FL 33619-2242

813 621-0080
FAX 813 623-6757

SCS ENGINEERS

December 13, 2000
File No. 09199033.03

D.E.P.
DEC 1 3 2000
Southwest District Tampa

Ms. Susan Pelz, P.E.
Solid Waste Engineer
Florida Department of Environmental Protection
Southwest District
3804 Coconut Palm Drive
Tampa, FL 33319

Subject: Hardee County Landfill Operations Permit Modification
Permit Number 38414-002-SO
Hardee County, Florida

Dear Susan:

On behalf of Hardee County (County) SCS Engineers (SCS) is pleased to submit the following revisions to the current operational filling sequence plans for the Hardee County landfill. The shallow top slopes of the current operations design does not allow for efficient placement of baled waste materials. The proposed revisions were designed to increase the amount of available airspace for baled and loose waste on the top of the landfill. In addition, the modifications to the plans will allow placement of both municipal solid waste and construction and demolition debris (C&D) within the current dewatering ditch. The dewatering ditch is located on the southern side of the active working area.

Based upon conversations with the Florida Department Environmental Protection (FDEP) and Hardee County (County) regarding the proposed revisions, specifically fill sequencing, geotechnical integrity of the design, and stormwater management, SCS has completed the following analysis to address these regulatory issues.

PROPOSED OPERATIONAL SEQUENCE MODIFICATIONS

SCS modified the grading plan of the landfill based upon the County's request to have two access roads leading to the upper portion of the landfill, to increase the available airspace on top of the landfill for placement of baled solid waste, and to allow placement of solid waste and C&D debris in the current dewatering ditch.

Two access road were incorporated into the modified design to allow access to the upper portion of the landfill. One access road is located on the eastern side of the landfill and will serve as the primary access road. The access road on the western side of the landfill will serve as a secondary road to be used by landfill equipment and personnel. Both roads are graded with a minimal two percent cross slope to promote drainage. Runoff from the roads is collected in ditches, which parallel the roads, and discharge at the bottom of the landfill.

To increase the efficiency of placement of baled waste on top of the landfill, the sideslopes of the landfill were graded at a three to one slope from the lower terrace, at Elevation 110, to a crest at Elevation 150. From the crest of the landfill to the peak, at Elevation 155, a minimum slope of five percent was set to promote drainage. This will make best use of available airspace on the upper portion of the landfill by increasing the height and increasing the topslope of the landfill. Due to the rectangular shape of the bales, loose unbaled material will be placed along the sideslopes to achieve the grades shown on the drawings.

The current dewatering ditch was filled with water during the October 23, 1999 aerial topogragphy mapping. SCS has developed approximate contours of the dewatering ditch based upon information supplied by the County and those contours are shown on Sheet 4 of the drawings. The bottom of the dewatering ditch was assumed to be at approximately Elevation 74. Upon removal of the water in the ditch, the silty sand that has washed in the ditch will be removed. The ditch will be filled and compacted with a mix of solid waste and C&D debris based upon availability.

SCS compared the existing topography as of October 23, 1999, versus the revised grading plan to estimate the available disposal volume. SCS incorporated the estimated volume increase due to the addition of the dewatering ditch for disposal. The estimated volume available for disposal is approximately 340,000 cubic yards. The calculations are contained in Attachment A.

GEOTECHNICAL ANALYSIS

In 1994, Professional Services Incorporated (PSI) collected boring and soil information immediately south of the active area. SCS reviewed the information contained PSI's report and used this information to complete the geotechnical analysis of the revised plans. The 1994 geotechnical report conducted by PSI is contained in Attachment B. SCS did not conduct a specific geotechnical field investigation of the landfill and used information gathered by PSI and others.

SCS has conducted a geotechnical analysis of the revised filling sequence to expressly address slope stability of the landfill, estimated settlement of the landfill foundation, and the allowable bearing capacity of the soils underlying the landfill due to the revised fill sequence plan. Geotechnical calculations were computed showing the impact due to the modifications to the current permit design. Calculations are contained in Attachment C.

Slope Stability

SCS conducted a slope stability comparison of the current design and the proposed modified grading plan. The two primary areas of interest were rotational failure of the entire landfill and rotational failure of the upper portion of the landfill due the increase in height. As shown in Table 1, no significant changes in the slope stability from the previous permit design are anticipated and the revised design provides stable conditions.

TABLE 1. SLOPE STABILITY FACTORS OF SAFETY

North/South Section		East/West Section		Comment
Current Permit	Revised Permit	Current Permit	Revised Permit	
1.67	1.61	1.74	1.61	Failure through foundation
1.43	1.42	1.42	1.49	Failure through waste material

Settlement

SCS conducted a settlement calculation of the landfill foundation and compared the current and revised estimated deflections at the center of the landfill footprint. Leachate is gathered by a collection system located on the perimeter of the landfill. Excessive deflections at the center of the landfill could possibly allow ponding of leachate and effect the efficiency of the collection system. As shown in the Table 2, no significant changes in the deflection of the foundation from the previous design were computed and the revised design settlements are not anticipated to allow ponding of leachate.

TABLE 2. ESTIMATED SETTLEMENT

Settlement in Middle of Landfill		
Current Permit	Revised Permit	Difference
0.57 ft (6.8 in)	0.64 ft (7.7 in)	0.07 ft (0.84 in)

Bearing Capacity

SCS conducted a bearing capacity estimate of the landfill foundation soils. The landfill foundation soils are a medium dense sandy clay and a stiff low plasticity soil. Based on the slope stability and settlement analysis the foundation soils have ample bearing capacity. To estimate the amount of excess capacity the foundation soils contain, SCS estimated the amount of pressure required on the foundation soils that could potentially cause excessive deflection of the center of the landfill. Based upon calculations contained in Attachment C, the estimated excess bearing capacity of the landfill foundation is approximately 3,000 pounds per square foot. Because the foundation has excess capacity, the revised design is sufficient.

STORMWATER MANAGEMENT

SCS computed the anticipated runoff quantities for use in design of stormwater control structures. The overall site stormwater management design was not analyzed by SCS and was assumed to have sufficient capacity to receive runoff from the landfill.

SCS computed estimated runoff flowrates using guidelines in the Southwest Florida Water Management District's (SWFWMD) ERP manual. A Type II, Florida Modifed, 25-year-24hour storm event was used for rainfall distribution. The 25 year-24 storm event has a rainfall amount of approximately 8.2 inches. This is consistent with the method used by PBS&J for the leachate storage tanks. SCS determined runoff subbasins for the revised buildout plans. Using SWFWMD guidelines, SCS computed stormwater runoff quantities for each subbasin. Runoff will be routed to terrace swales and downchutes. The terrace swales and downchutes during fill operations have been designed to convey the design storm. The delineation of the subbasins, runoff quantities, and calculations are contained in Attachment D.

Downchutes or drainage structures will be required in at least the three locations shown in the revised permit modification drawings. The revised permit modification drawings are contained in Attachment E. Final design of the stormwater conveyance structures will be performed as part of the final closure design and permitting.

Please contact us if you have any questions or require any additional information.

Very truly yours,

12/13/2000

Joseph H. O'Neill, P.E.
Senior Project Engineer
SCS ENGINEERS

Raymond J. Dever, P.E., D.E.E.
Vice President
SCS ENGINEERS

JHO/RJD:jho
Attachments

ATTACHMENT A

VOLUME ESTIMATE

HARDEE COUNTY LANDFILL

(Revised Permit Conditions)
Exist (as of 10/29/99) versus SCS Final Buildout (November, 2000)

Site Volume Table: Unadjusted

	Cut yards	Fill yards	Net yards	Method
Site: final buildout				
Stratum: ex-final existing final				
	1,571	345,298	343,727 (Fill)	Grid

The above amount is a total airspace. For waste disposal volume subtract intermediate and daily cover, closure cap.

ATTACHMENT B

PROFESSSIONAL SERVICES, INCORPORATED (PSI) REPORT

ATTACHMENT 6-1

GEOTECHNICAL INVESTIGATION

Report
Geotechnical Engineering Services
Hardee County Sanitary Landfill
PSI Project No. 757-75054

Environmental
Geotechnical
Construction
Consulting • Engineering • Testing

Information To Build On

psi Environmental
Geotechnical
Construction
Consulting • Engineering • Testing

March 10, 1997

Post, Buckley, Schuh & Jernigan, Inc.
1560 Orange Avenue, Suite 700
Winter Park, Florida 32789

Attention: Mr. Bob Mackey, P.E.
Project Manager

RE: Report
Geotechnical Engineering Services
Hardee County Sanitary Landfill
PSI Project No.: 757-75054

Dear Mr. Mackey:

In accordance with our proposal to you dated February 5, 1997, Professional Service Industries, Inc. (PSI) has provided geotechnical engineering services in connection with the referenced project. This report includes an overview of the field work and laboratory testing that we completed for the assignment. Also provided are preliminary recommendations for site preparation and foundation design of the leachate storage tanks.

PROJECT CONSIDERATIONS

The Hardee County Sanitary Landfill is located in northeast Hardee County, east of U.S. 17 and north of County Road 636. The property is located in Section 35, Township 33 South, Range 25 East. The landfill site is generally rectangular in shape occupying a plan area of approximately 100 acres.

At the present time, geotechnical engineering services have been directed at the northwest corner of the site, where a liner wall will be constructed as well as above ground leachate storage tanks. The liner wall will be located south of the existing dewatering ditch and will consist of installing a High Density Polyethylene (HDPE) liner in a trench. The HDPE liner will be keyed into low permeable clays at depth providing a hydraulic cut off barrier.

The leachate storage tanks are to be built near the maintenance building. They will comprise two 50,000 gallon above ground tanks. It is proposed that the tanks be supported on a shallow foundation system.

A generalized plan view of the facility and the area of interest at this time is included on Sheet 1.

SUBSOIL AND GROUNDWATER CONDITIONS

General

To evaluate subsoil and groundwater conditions in the area of interest to this assignment, we drilled/sampled six Standard Penetration Test (SPT) borings. These borings were completed in general accordance with the procedures outlined in ASTM D-1586. The borings were advanced to depths in the range 25 to 40 feet below grade. The approximate locations at which the borings were drilled are indicated on **Sheet 1.**

In the upper 10 feet, SPT samples were recovered continuously then at 5 foot centers thereafter to boring termination. Samples recovered from the borings were visually stratified in the laboratory by a geotechnical engineer, following guidelines contained in the Unified Soil Classification System (USCS). Records of the materials encountered in the borings are presented as soil profiles on **Sheet 2. Sheet 2** includes a legend describing the various materials in USCS format.

Stratigraphy

The borings disclosed reasonably consistent subsoil conditions in the area of evaluation. For the purpose of discussions, these conditions have been generalized as follows. From the ground surface to depths in the range 12 to 18 feet below grade is a varying sequence of fine sands. These sands grade from being relatively clean to slightly silty and silty/clayey in composition (i.e. SP, SP/SM, SM and SC materials). Based on the SPT blow counts, these materials are in a loose to medium dense condition.

Underlying the upper sands is clays. These clays grade from being sandy to silty in composition and from soft to extremely hard in consistency. There are clay zones that are primarily derived from weathered limestone, with SPT blow counts in excess of 50 blows for a few inches. All four of the proposed liner wall borings were terminated in clay.

Groundwater

Groundwater level measurements were made in the borings at the time of drilling. These measurements disclosed the water table at depths in the range 4.0 to 7.8 feet below grade. As a result of recharge during the rainy season, the water table will rise some 2 to 3 feet above current levels. The groundwater levels at the site will also be impacted by construction activities.

LABORATORY TESTING

As noted earlier, the laboratory testing work included the stratification of all soil samples in accordance with USCS procedures. Additionally, we carried out four laboratory permeability tests plus nominal classification tests to determine pertinent engineering characteristics/parameters. All permeability tests were performed in a triaxial cell at a confining pressure of 5 psi. Results of the laboratory tests are presented in **Table 1.** This table also includes details on boring numbers and sample depths for the test specimens.

SUMMARY OF FINDINGS AND RECOMMENDATIONS

General

The results of the borings and laboratory testing indicate low permeable soils at depth in the area of the proposed liner wall. Subsoils at the site of leachate storage tanks are considered generally suitable for grade support of these structures. In order to enhance foundation performance, the tanks should be supported on subgrade soils that have been densified by surface proof rolling. A design bearing value of 3000 pounds per square foot can be used to size foundations.

Site Preparation For Storage Tanks

At the outset of construction, the site should be stripped of the existing vegetation cover and topsoils. Next, the subgrade soils should be compacted in-situ by surface rolling with a large self propelled vibratory roller. The roller should be capable of imparting a dynamic drum force of at least 36,000 pounds. The tank subgrade soils should be uniformly compacted with the roller to attain a degree of densification that is at least 95 percent of the materials ASTM D-1557 maximum dry density for a depth of 2 feet.

Proof rolling operations should be observed by a representative of this office. Observations would be made as to the general stability of the subgrade in response to rolling. In the event that yielding/pumping soils are encountered during vibratory compaction, such materials should be removed and replaced with clean granular fill. The replacement fill should also be thoroughly compacted to provide a stable subgrade.

Fill required to raise site grades should comprise clean sand with less than 12 percent by dry weight passing the U.S. Standard Number 200 sieve. The fill should be placed in one foot lifts and be compacted to 95 percent or more of the materials ASTM D-1557 maximum dry density.

Foundation Support

Results of our evaluations indicate that the subsurface materials have adequate shear strength to support fully loaded tanks. We estimate that foundations designed for a bearing pressure of 3000 psf will have a factor of safety against a bearing capacity failure in excess of three. This value is based on the assumption that the structures will be founded on thoroughly compacted native soils and/or engineered fill. The outside foundations/edges of the tank should be adequately protected by soil as to prevent undermining.

Based on our current understanding of the general loading conditions for the tanks, we anticipate settlement performance being within tolerable structural limits. We would be pleased to address settlement matters more fully when actual design loads are known.

PSI appreciates the opportunity to be of service to you on this assignment and we trust that the foregoing and accompanying attachments are of assistance to you at this time. In the event that you have any questions on the report or if you require additional information, please call.

Very truly yours,

PROFESSIONAL SERVICE INDUSTRIES, INC.

Ian Kinnear, P. E.
Senior Geotechnical Engineer
FL Registration No. 32614

IK:cd
IK\757750S4.311

Attachments
- Table 1
- Sheets 1 and 2

TABLE 1

SUMMARY OF LABORATORY TEST RESULTS
HARDEE COUNTY SANITARY LANDFILL

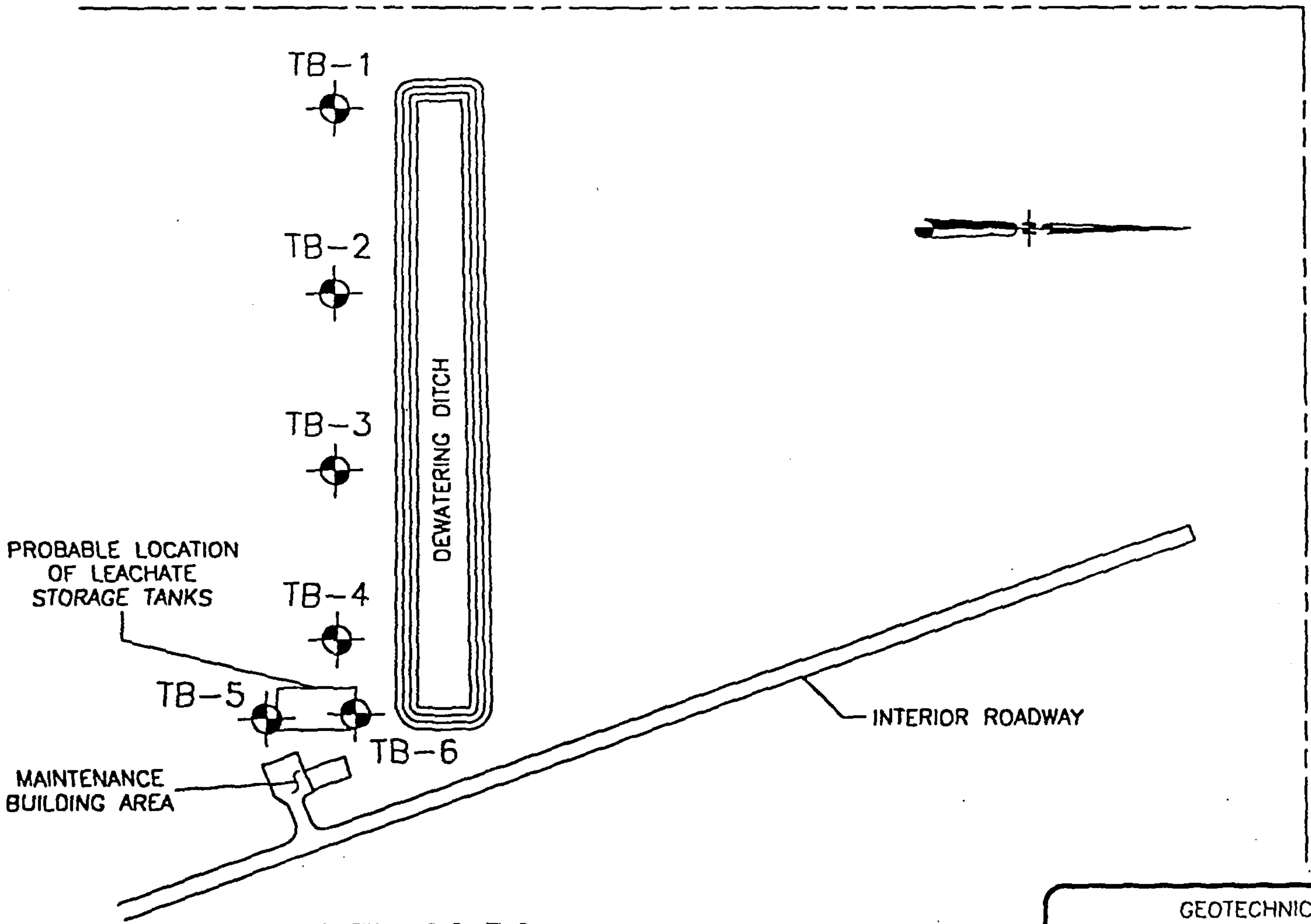
Permeability Test Results		
Boring TB-1 at 15 Feet		
Permeability	=	3.3×10^{-7} cm/sec
Wet Density	=	104.4 pcf
Moisture Content	=	56.4 %
Confining Pressure	=	5 psi
Boring TB-2 at 25 Feet		
Permeability	=	7.7×10^{-8} cm/sec
Wet Density	=	89.0 pcf
Moisture Content	=	112.7 %
Confining Pressure	=	5 psi
Boring TB-3 at 25 Feet		
Permeability	=	4.3×10^{-7} cm/sec
Wet Density	=	93.5 pcf
Moisture Content	=	80.7 %
Confining Pressure	=	5 psi
Boring TB-4 at 17 Feet		
Permeability	=	6.1×10^{-8} cm/sec
Wet Density	=	118.9 pcf
Moisture Content	=	30.8 %
Confining Pressure	=	5 psi

TABLE 1 - Continued

SUMMARY OF LABORATORY TEST RESULTS
HARDEE COUNTY SANITARY LANDFILL

Atterberg Limits		
Boring TB-3 at 25 Feet		
LL	=	128 %
PL	=	39 %
PI	=	89 %
-200	=	75 %
Boring TB-5 at 24 Feet		
LL	=	110 %
PL	=	35 %
PI	=	75 %
-200	=	54 %

Moisture Content and No. 200 Wash Sieves		
Boring TB-1 at 15 Feet		
Moisture Content	=	56.4 %
-200	=	53 %
Boring TB-2 at 20 Feet		
Moisture Content	=	105.9 %
-200	=	86 %
Boring TB-2 at 25 Feet		
Moisture Content	=	112.7 %
-200	=	97 %



SITE LOCATION

SCALE: 1"=200'

APPROXIMATE LOCATION OF STANDARD PENETRATION TEST BORING

GEOTECHNICAL ENGINEERING SERVICES

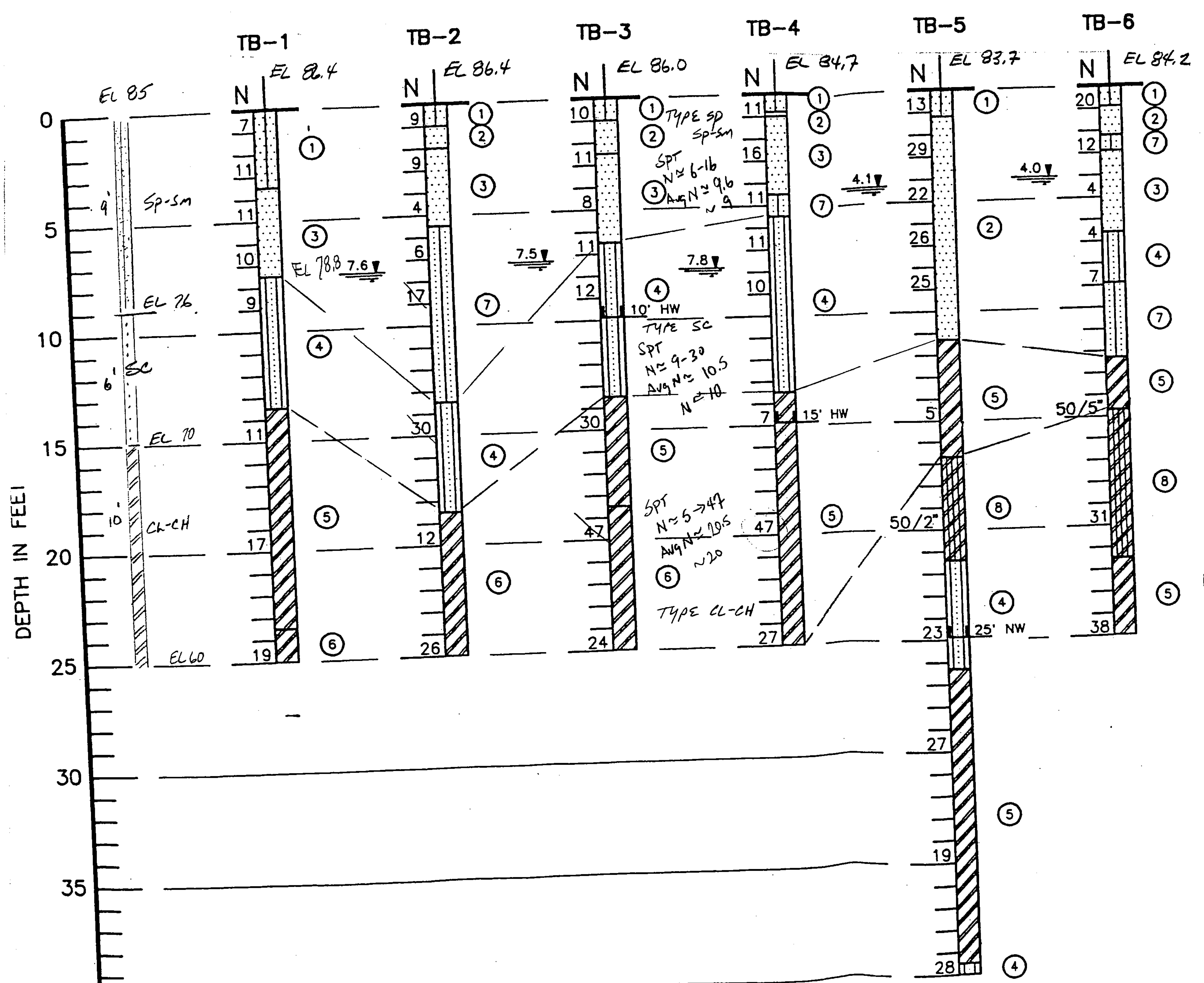
HARDEE COUNTY LANDFILL

WACHULA, FLORIDA

psi Environmental Geotechnical Construction

Consulting • Engineering • Testing

DRAWN: DCB	SCALE: NOTED	PROJ. NO: 757-75054
CHKD: IK	DATE: 2-21-97	SHEET: 1



LEGEND

①	GRAY TO BROWN FINE SAND TO SLIGHTLY SILTY FINE SAND TRACE ROOTS, (SP), (SP-SM)
②	LIGHT GRAY FINE SAND, (SP)
③	LIGHT BROWN FINE SAND, (SP)
④	GRAY TO BROWN SILTY FINE SAND TO CLAYEY FINE SAND, (SM), (SC)
⑤	GREEN TO GRAY CLAY WITH SAND SEAMS OCCASIONAL PHOSPHATES, (CL)
⑥	GREEN CLAY, (CH)
⑦	LIGHT TO DARK RED-BROWN SLIGHTLY SILTY TO SILTY FINE SAND, OCCASIONAL WEAKLY CEMENTED FINE SAND, (SP-SM), (SM)
⑧	LIGHT GRAY BROWN INDURATED CLAY/SILT TO WEATHERED LIMESTONE
(SP)	UNIFIED SOIL CLASSIFICATION GROUP SYMBOL
7.6 ▼	DEPTH TO GROUNDWATER LEVEL IN FEET: 2/13/97 TO 2/17/97
N	STANDARD PENETRATION RESISTANCE IN BLOWS PER FOOT
50/5"	NUMBERS OF BLOWS REQUIRED (50) TO DRIVE SAMPLING SPOON 5 INCHES
10' NW/HW	DEPTH TO WHICH NW/HW CASING WAS DRIVEN IN FEET, (NOTE: 3" CASING/4" CASING RESPECTIVELY)

GEOTECHNICAL ENGINEER

HARDEE COUNTY

WACHULA, FLOR

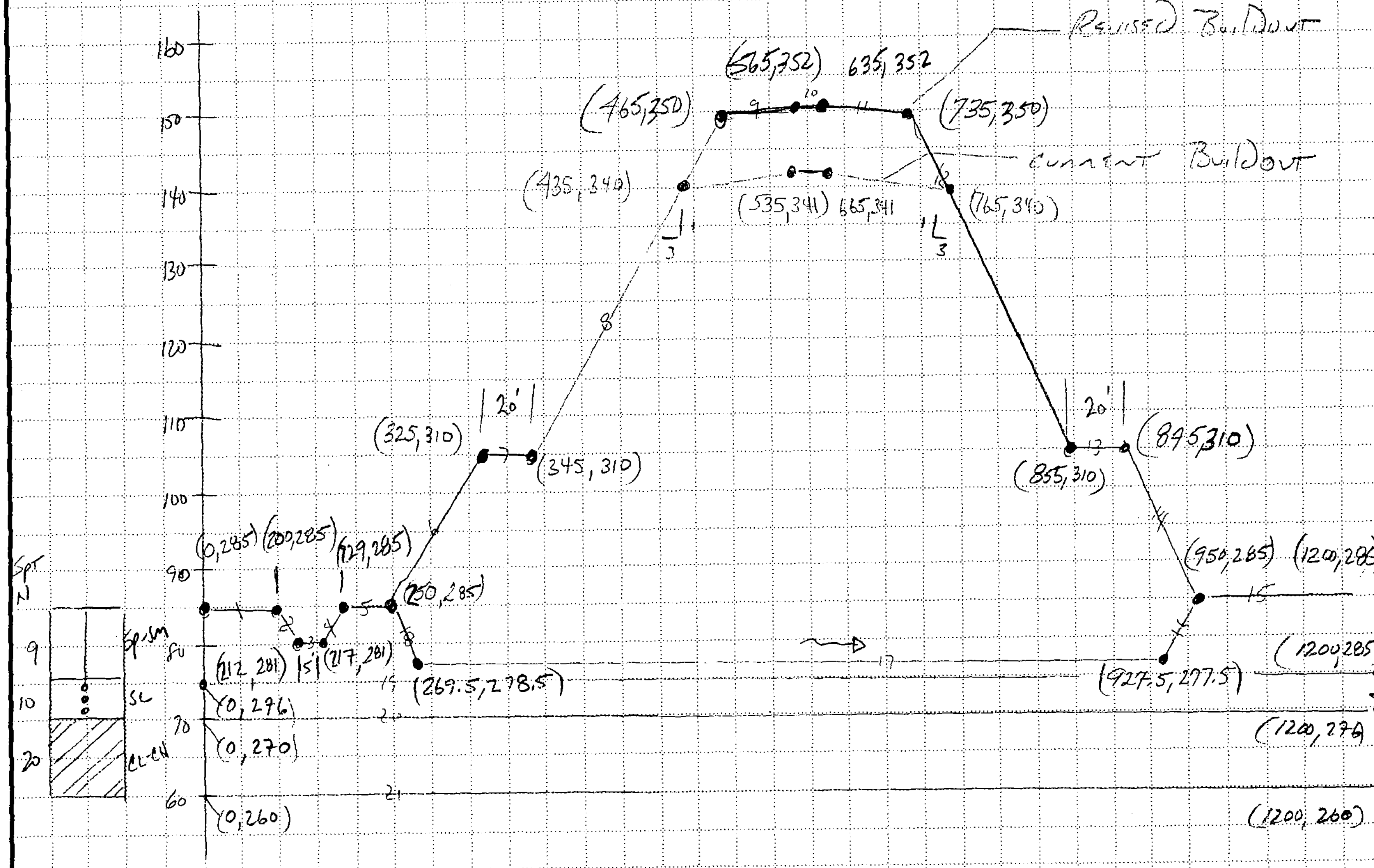
PSI Envi Geo Cons

Consulting • Engineeri

DRAWN: DCB | SCALE: NOTED

ATTACHMENT C

GEOTECHNICAL ANALYSIS



MODEL INPUT

EAST – WEST

GCS ENGINEERS

CLIENT Hardee County

PROJECT Permit Modification

SUBJECT Slope Stability E/W

BY [illegible] DATE Nov 2000

CHECKED [illegible] DATE 11/28/00

JOB NO. 04.40033.07

SHEET 1 OF 11

Sheet 2 of 11
E/W Slope Stability
Current Buildout

** PCSTABL5 **
by
Purdue University

--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer`s Method of Slices

Input Data Filename: D:FINALEW
Output Filename: D:FINALEW.OUT
Plotted Output Filename: D:FINALEW.PLT

PROBLEM DESCRIPTION Final Buildout-Current East/West
Hardee County, Florida

BOUNDARY COORDINATES

15 Top Boundaries
21 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	.00	285.00	200.00	285.00	2
2	200.00	285.00	212.00	281.00	2
3	212.00	281.00	217.00	281.00	2
4	217.00	281.00	229.00	285.00	2
5	229.00	285.00	250.00	285.00	2
6	250.00	285.00	325.00	310.00	1
7	325.00	310.00	345.00	310.00	1
8	345.00	310.00	435.00	340.00	1
9	435.00	340.00	535.00	341.00	1
10	535.00	341.00	665.00	341.00	1
11	665.00	341.00	765.00	340.00	1
12	765.00	340.00	855.00	310.00	1
13	855.00	310.00	875.00	310.00	1
14	875.00	310.00	950.00	285.00	1
15	950.00	285.00	1200.00	285.00	1
16	250.00	285.00	269.50	278.50	2
17	269.50	278.50	927.50	277.50	2
18	927.50	277.50	950.00	285.00	2
19	.00	276.00	1200.00	276.00	3
20	.00	270.00	1200.00	270.00	4
21	.00	260.00	1200.00	260.00	5

max El 141

Landfill Profile

Add +200 feet to exist. elevations for modeling purpose

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	64.8	64.8	.0	25.0	.00	.0	1	— WASTE (1750 lb/cy) 64.8 pcf)
2	105.0	110.0	.0	28.0	.00	.0	1	— SILTY SAND
3	110.0	120.0	.0	30.0	.00	.0	1	— CLAYEY SAND
4	90.0	105.0	2250.0	.0	.00	.0	1	— LOW PLASTICITY CLAY
5	110.0	118.0	.0	32.0	.00	.0	1	— SAND

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	.00	279.00
2	1200.00	279.00

} GROUND WATER ELEVATION

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

1200 Trial Surfaces Have Been Generated.

30 Surfaces Initiate From Each Of 40 Points Equally Spaced
Along The Ground Surface Between X = 325.00 ft.
and X = 345.00 ft.

Each Surface Terminates Between X = 435.00 ft.
and X = 600.00 ft.

Failure Search
① Failure through upper terrace
② Failure through foundation

Unless Further Limitations Were Imposed, The Minimum Elevation At Which A Surface Extends Is Y = .00 ft.

10.00 ft. Line Segments Define Each Trial Failure Surface.

SHEET 4 of 11
E/W slope stability

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 11 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	345.00	310.00
2	354.78	312.11
3	364.50	314.43
4	374.18	316.96
5	383.79	319.71
6	393.34	322.68
7	402.82	325.85
8	412.23	329.23
9	421.57	332.83
10	430.82	336.62
11	438.63	340.04

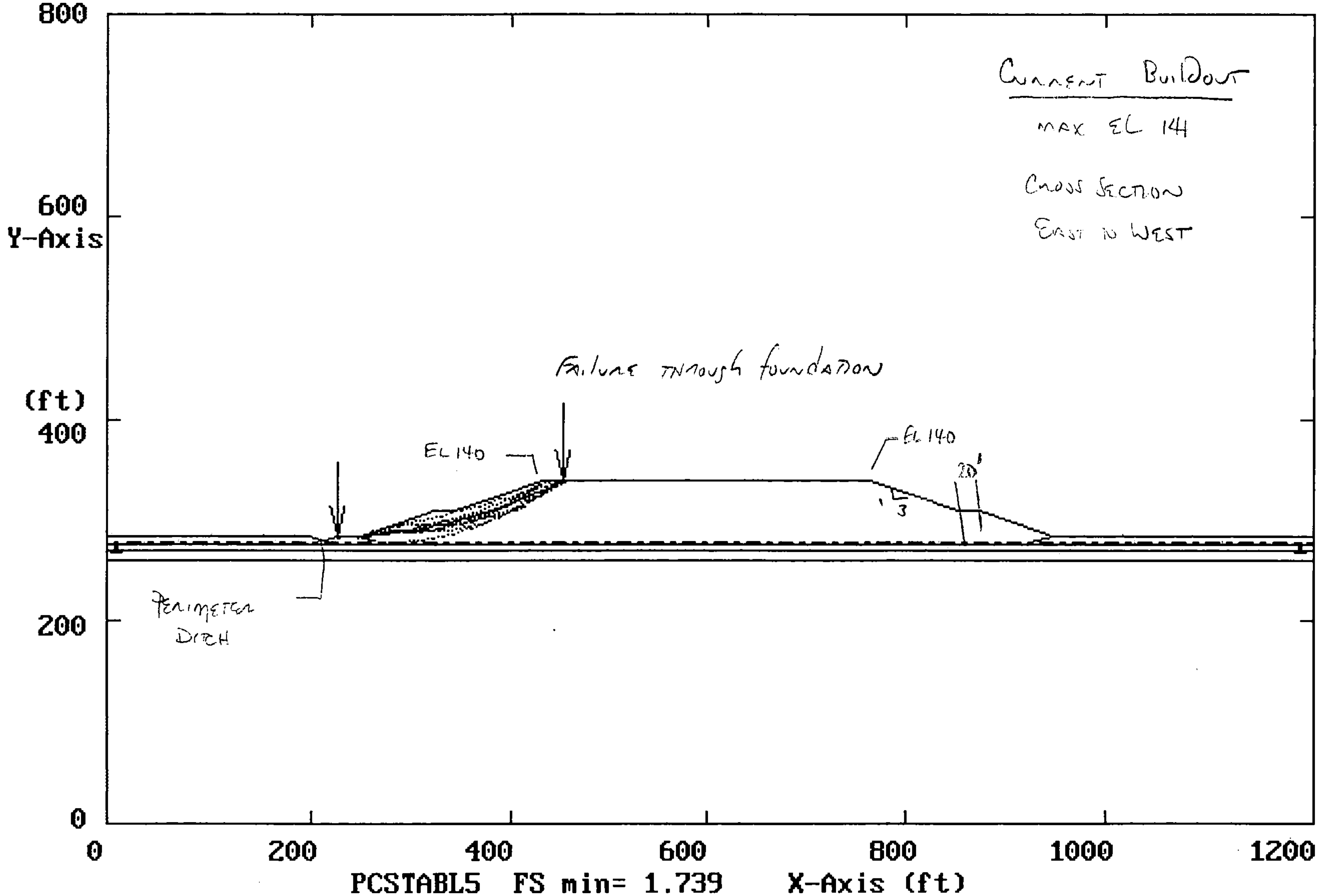
Circle Center At X = 255.0 ; Y = 751.7 and Radius, 450.8

FACTOR OF SAFETY = 1.739 (Failures Planes through the waste material & Foundation)

FACTOR OF SAFETY = 1.424 (Failures Planes from the terrace to the top of the landfill)
EL 110 to EL 141

Final Buildout-Current East/West Hardee County, Florida

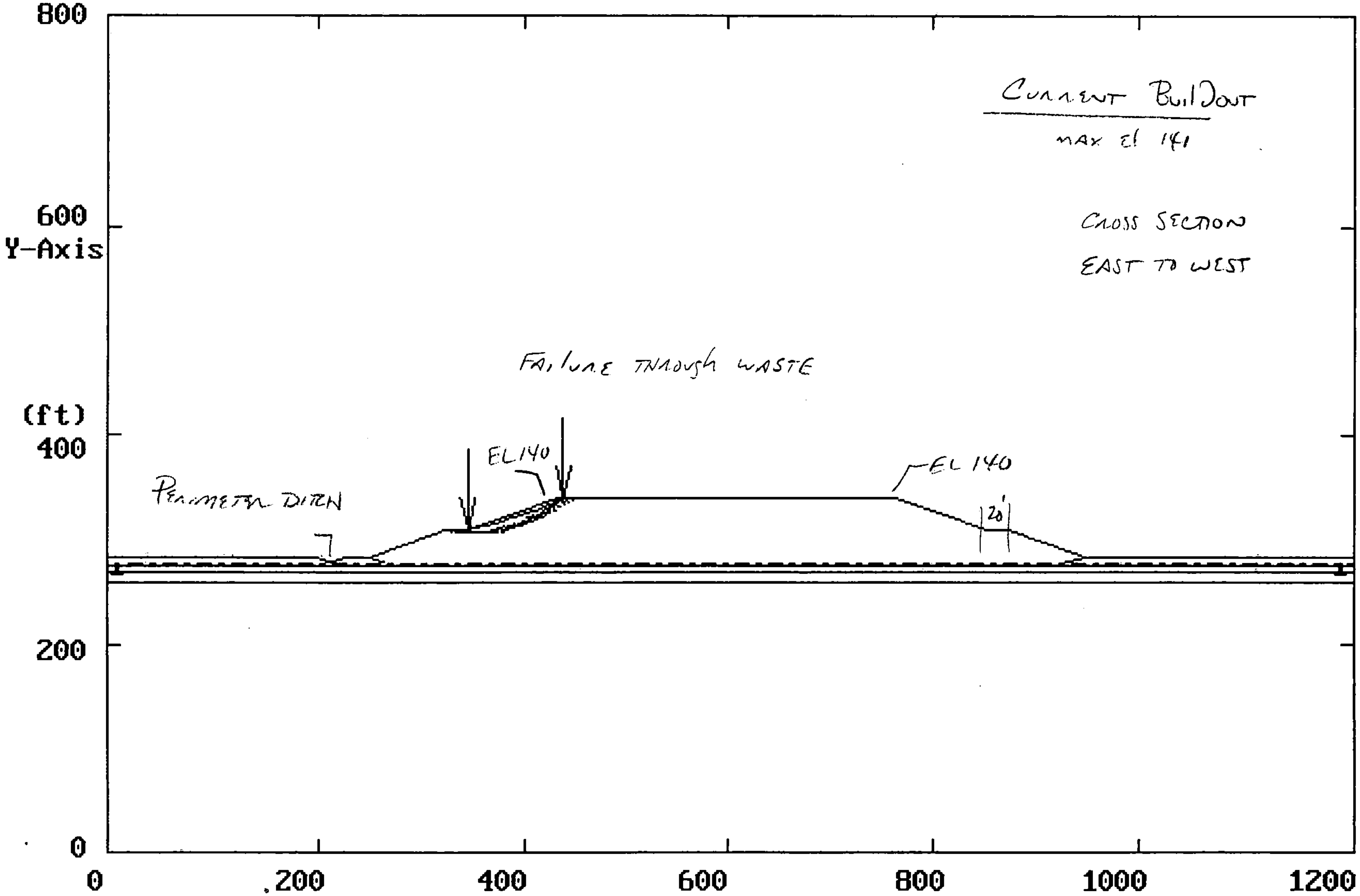
Ten Most Critical. D:FINALEW.PLT By: Joseph O'Neill 11-03-00 6:12 pm



Sheet 5 of 11
E/W slope stability

Final Buildout-Current   East/West Hardee County, Florida

Ten Most Critical. D:FINALEW.PLT By: Joseph O'Neill 11-03-00 6:38 pm



PCSTABL5 FS min= 1.424   X-Axis (ft)

Sheet 6 of 11
E/W slope stability

Sheet 7 of 11
E/W slope stability

Revised Buildout

** PCSTABL5 **
by
Purdue University

--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer's Method of Slices

Input Data Filename: D:FINALEW2
Output Filename: D:FINALEW2.OUT
Plotted Output Filename: D:FINALEW2.PLT

PROBLEM DESCRIPTION Final Buildout-Revised East/West
Hardee County, Florida

BOUNDARY COORDINATES

15 Top Boundaries
21 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	.00	285.00	200.00	285.00	2
2	200.00	285.00	212.00	281.00	2
3	212.00	281.00	217.00	281.00	2
4	217.00	281.00	229.00	285.00	2
5	229.00	285.00	250.00	285.00	2
6	250.00	285.00	325.00	310.00	1
7	325.00	310.00	345.00	310.00	1
8	345.00	310.00	465.00	350.00	1
9	465.00	350.00	565.00	352.00	1
10	565.00	352.00	635.00	352.00	1
11	635.00	352.00	735.00	350.00	1
12	735.00	350.00	855.00	310.00	1
13	855.00	310.00	875.00	310.00	1
14	875.00	310.00	950.00	285.00	1
15	950.00	285.00	1200.00	285.00	1
16	250.00	285.00	269.50	278.50	2
17	269.50	278.50	927.50	277.50	2
18	927.50	277.50	950.00	285.00	2
19	.00	276.00	1200.00	276.00	3
20	.00	270.00	1200.00	270.00	4
21	.00	260.00	1200.00	260.00	5

max elevation in southern side

Landfill profile

SHEET 8 of 11
E/W Slope Stability

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	80.0	80.0	.0	25.0	.00	.0	1 — waste @ 80 pcf (64.8 pcf)
2	105.0	110.0	.0	28.0	.00	.0	1 — silty sand
3	110.0	120.0	.0	30.0	.00	.0	1 — clayey sand
4	90.0	105.0	2250.0	.0	.00	.0	1 — low plasticity clay
5	110.0	118.0	.0	32.0	.00	.0	1 — sand

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	.00	279.00
2	1200.00	279.00

} Groundwater elevations

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

1200 Trial Surfaces Have Been Generated.

30 Surfaces Initiate From Each Of 40 Points Equally Spaced Along The Ground Surface Between X = 325.00 ft. and X = 345.00 ft.

Each Surface Terminates Between X = 450.00 ft. and X = 635.00 ft.

} Failure search regions
① failure through upper terrace
② failure through waste & foundation

Unless Further Limitations Were Imposed, The Minimum Elevation At Which A Surface Extends Is Y = .00 ft.

10.00 ft. Line Segments Define Each Trial Failure Surface.

Sheet 9 of 11
T/W slope stability

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 15 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	345.00	310.00
2	354.99	310.45
3	364.95	311.30
4	374.88	312.54
5	384.74	314.18
6	394.53	316.22
7	404.23	318.64
8	413.83	321.45
9	423.31	324.64
10	432.65	328.21
11	441.84	332.15
12	450.87	336.45
13	459.72	341.11
14	468.37	346.12
15	474.81	350.20

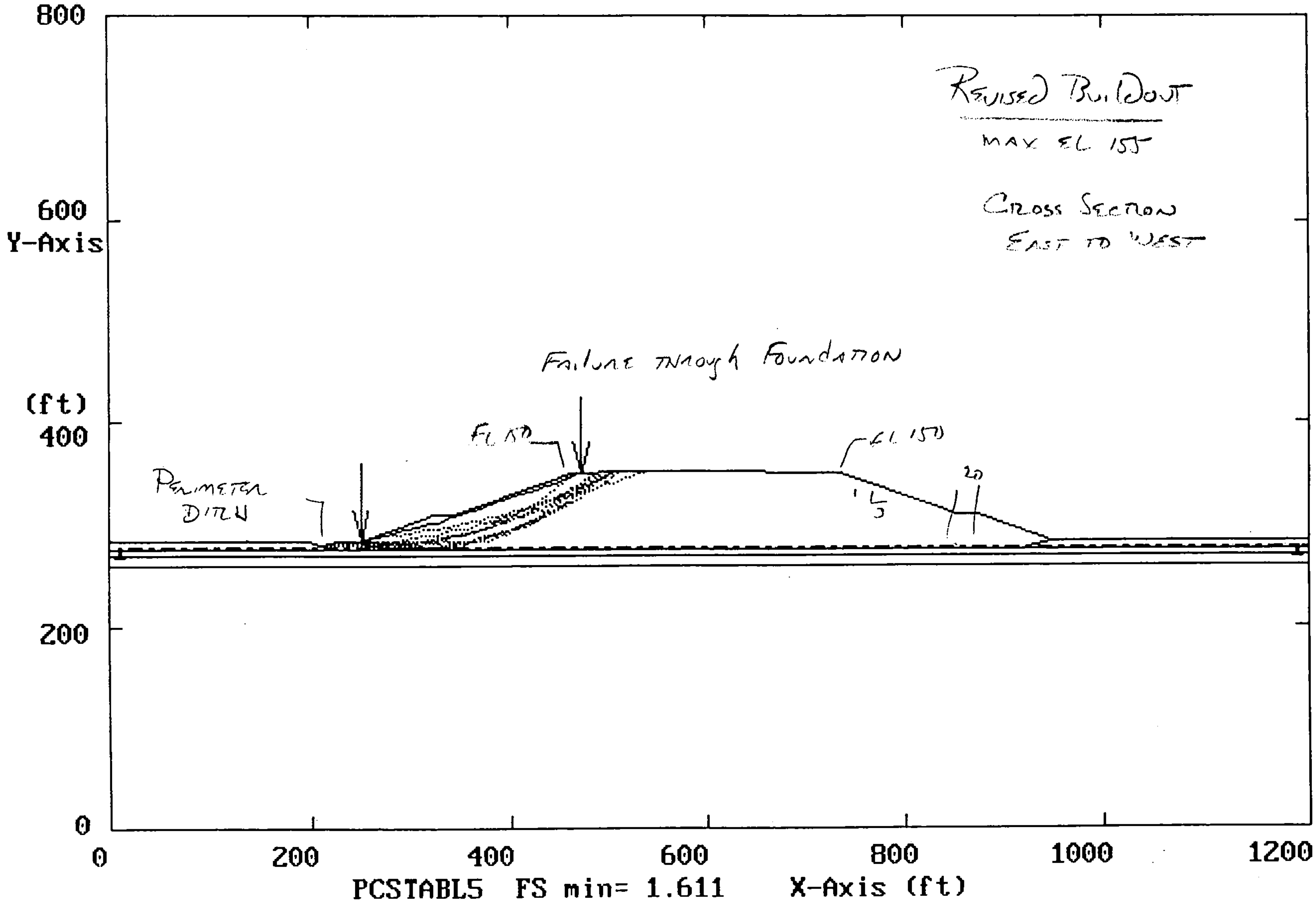
Circle Center At X = 338.8 ; Y = 560.0 and Radius, 250.1

FACTOR OF SAFETY = 1.489 (Failure Planes through the waste material & Foundation)

FACTOR OF SAFETY = 1.611 (Failure Planes from Terrace to top of landfill)
EL 110 to EL 155

Final Buildout-Revised   East/West Hardee County, Florida

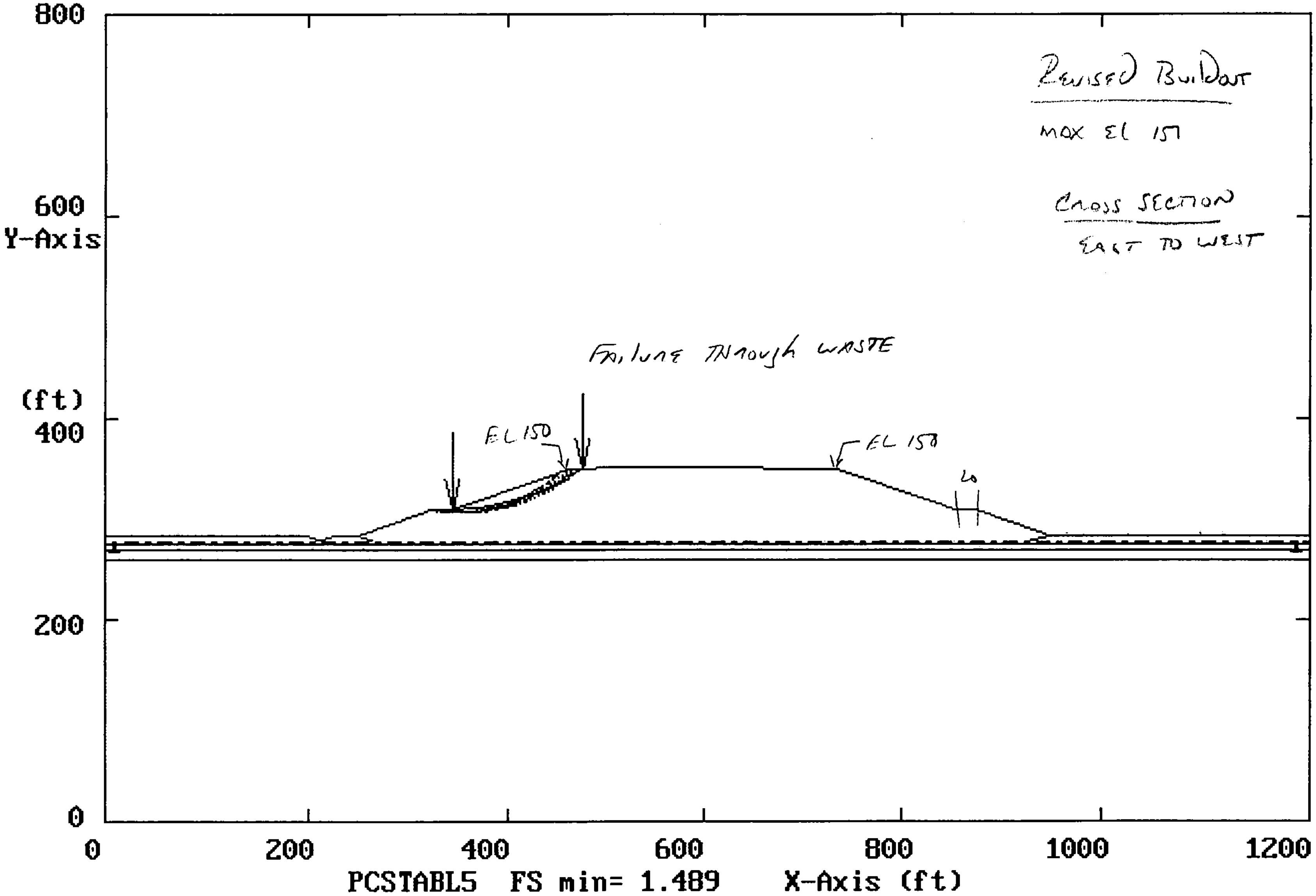
Ten Most Critical. C:FINALEW2.PLT By: Joseph O'Neill 11-02-00 10:01 pm m



Sheet 10 of 11
E/W Slope Stability

Final Buildout-Revised   East/West Hardee County, Florida

Ten Most Critical. D:FINALEW2.PLT By: Joseph O'Neill 11-03-00 6:50 pm

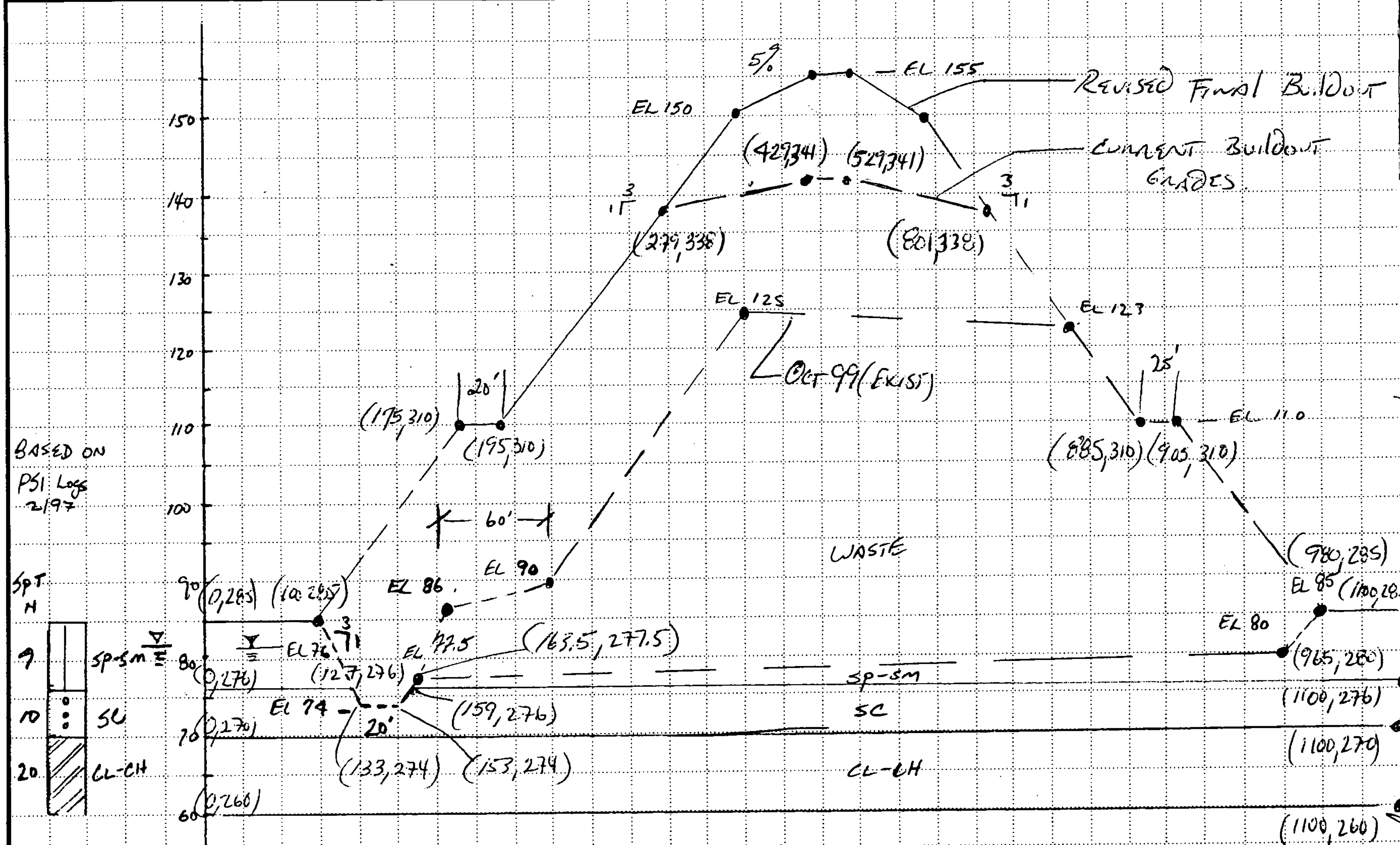


SHEET 11 of 11

E/W Slope Stability

SCS ENGINEERS

CLIENT: Hardee County
PROJECT: Permit Modification
SUBJECT: Slope Stability N/S



MODEL INPUTS

NORTH-SOUTH

NOTE: 1) SUBSURFACE PROFILE BASED ON BORING LOGS BY PSI DATED 2/97
2) BOTTOM DEWATERING DITCH ELEVATION BASED UPON INFO BY COUNTY
3) LANDFILL BOTTOM BASED UPON DRAWINGS ENVISORS DATED 11/82 - 3/83
MONITORING WELL / PUMP STATION I.E. ON PBSJ DATED 2/96

BY: [signature] DATE: OCT 2000
CHECKED: [signature] DATE: 11/28/00
JOB NO: 09199033.02

SHEET 1 OF 11

SHEET 2 of 11
N/S Slope Stability
Current Buildout

**** PCSTABL5 ****
by
Purdue University

--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer`s Method of Slices

Input Data Filename: C:FINALNS
Output Filename: C:FINALNS.OUT
Plotted Output Filename: C:FINALNS.PLT

PROBLEM DESCRIPTION **Final Buildout-Current North/South**
Hardee County, Florida

BOUNDARY COORDINATES

11 Top Boundaries
22 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	.00	285.00	100.00	285.00	2
2	100.00	285.00	175.00	310.00	1
3	175.00	310.00	195.00	310.00	1
4	195.00	310.00	279.00	338.00	1
5	279.00	338.00	429.00	341.00	1
6	429.00	341.00	529.00	341.00	1
7	529.00	341.00	801.00	338.00	1
8	801.00	338.00	885.00	310.00	1
9	885.00	310.00	905.00	310.00	1
10	905.00	310.00	980.00	285.00	1
11	980.00	285.00	1100.00	285.00	2
12	100.00	285.00	127.00	276.00	2
13	127.00	276.00	133.00	274.00	3
14	133.00	274.00	153.00	274.00	3
15	153.00	274.00	159.00	276.00	3
16	159.00	276.00	163.50	277.50	2
17	163.50	277.50	965.00	280.00	2
18	965.00	280.00	980.00	285.00	2
19	.00	276.00	127.00	276.00	3
20	159.00	276.00	1100.00	276.00	3
21	.00	270.00	1100.00	270.00	4
22	.00	260.00	1100.00	260.00	5

max el fill

Landfill Profile

add + 200 feet to exist. elevations for modeling purposes

SHEET 3 of 11
N/S slope stability

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	64.8	64.8	.0	25.0	.00	.0	1	— WASTE 1750 pcy (64.8 pcf
2	105.0	110.0	.0	28.0	.00	.0	1	— SILTY SAND
3	110.0	120.0	.0	30.0	.00	.0	1	— CLAYEY SAND
4	90.0	105.0	2250.0	.0	.00	.0	1	— LOW PLASTIC CLAY
5	110.0	118.0	.0	32.0	.00	.0	1	— SAND

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	.00	279.00
2	1100.00	279.00

} ESTIMATED WATER LEVEL CONSERVATIVE SET EQUAL TO WATER LEVEL IN DEWATERING DITCH 10/99 EL: 79.3

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

1200 Trial Surfaces Have Been Generated.

30 Surfaces Initiate From Each Of 40 Points Equally Spaced Along The Ground Surface Between X = .00 ft.
and X = 100.00 ft.

Each Surface Terminates Between X = 279.00 ft.
and X = 550.00 ft.

} Failure search region (1) Failure through upper terrace (2) Failure through foundation

Unless Further Limitations Were Imposed, The Minimum Elevation At Which A Surface Extends Is Y = .00 ft.

10.00 ft. Line Segments Define Each Trial Failure Surface.

SHEET 4 of 11
H/s slope stability

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 21 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	100.00	285.00
2	109.78	287.11
3	119.54	289.28
4	129.28	291.53
5	139.01	293.86
6	148.71	296.25
7	158.41	298.72
8	168.08	301.26
9	177.73	303.88
10	187.36	306.56
11	196.97	309.32
12	206.57	312.15
13	216.14	315.05
14	225.68	318.02
15	235.21	321.06
16	244.71	324.18
17	254.19	327.36
18	263.65	330.62
19	273.08	333.95
20	282.48	337.34
21	284.56	338.11

Circle Center At X = -176.8 ; Y = 1594.2 and Radius, 1338.1

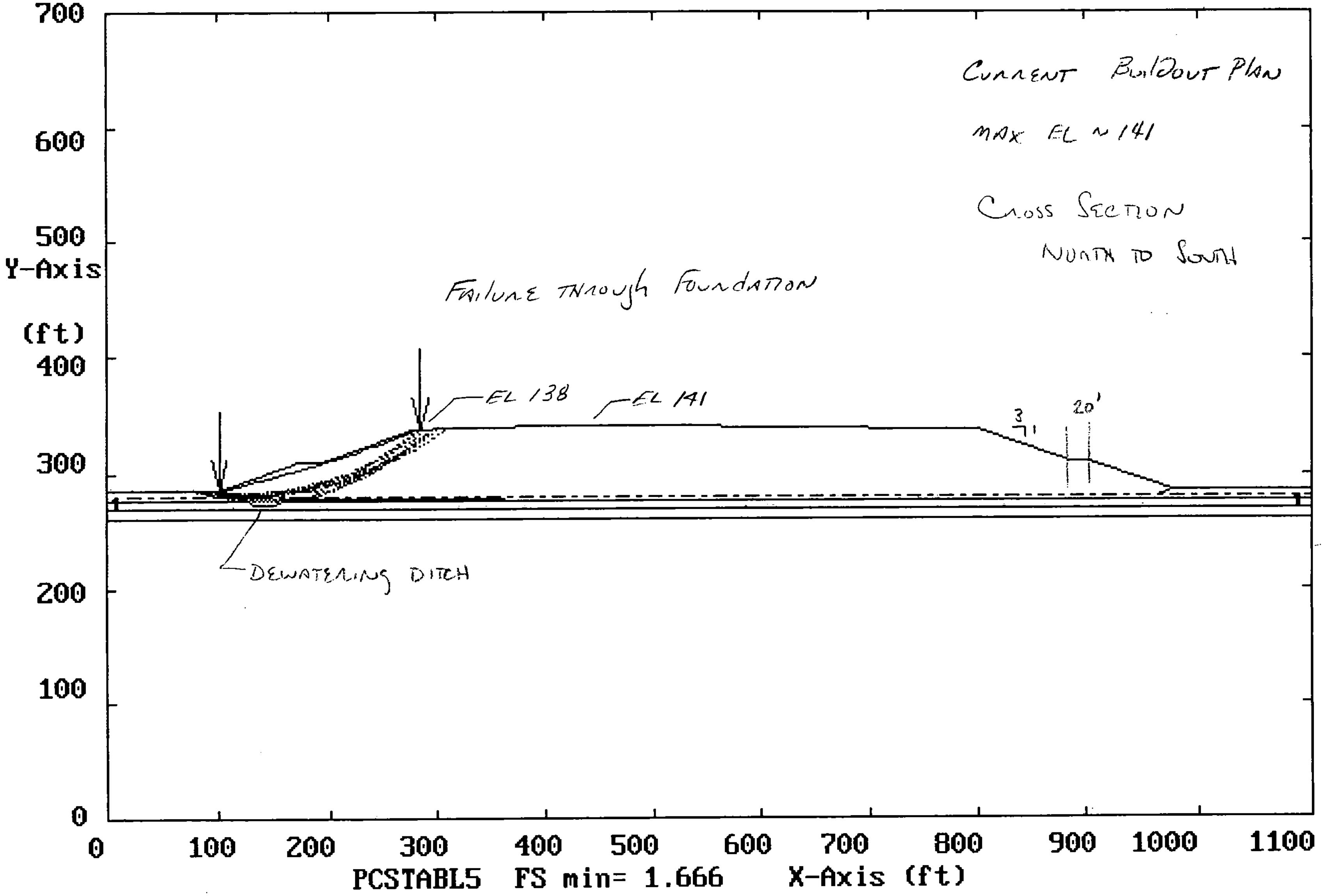
FACTOR OF SAFETY = 1.666 (Failure Planes through the waste material & Foundation)

FACTOR OF SAFETY = 1.425 (Failure Planes through from terrace to top of landfill)
El 110 to El 141

Factor of Safety

Final Buildout-Current North/South Hardee County, Florida

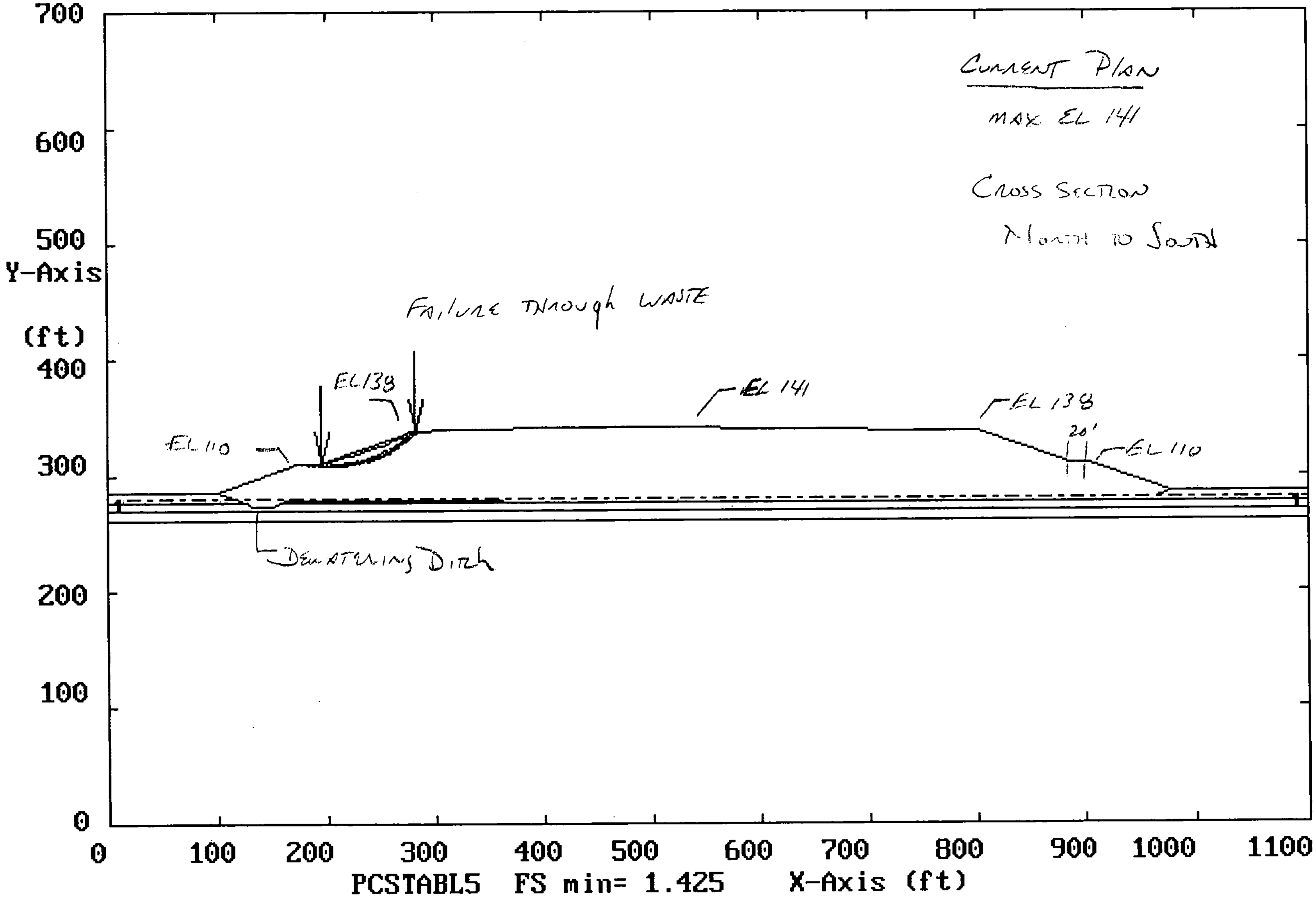
Ten Most Critical. D:FINALNS.PLT By: Joseph O'Neill 10-19-00 11:22 am



Sheet 5 of 11

N/S Slope Stability

Final Buildout-Current North/South Hardee County, Florida
Ten Most Critical. C:FINALNS.PLT By: Joseph O'Neill 11-02-00 8:25 pm



SHEET 6 of 11
N/S SLOPE STABILITY

SHEET 7 of 11
N/S slope stability
Revised Buildout

** PCSTABL5 **
by
Purdue University

--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer`s Method of Slices

Input Data Filename: D:FINALNS2
Output Filename: D:FINALNS2.OUT
Plotted Output Filename: D:FINALNS2.PLT

PROBLEM DESCRIPTION Final Buildout-Revised North/South
Hardee County, Florida

BOUNDARY COORDINATES

11 Top Boundaries
22 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	.00	285.00	100.00	285.00	2
2	100.00	285.00	175.00	310.00	1
3	175.00	310.00	195.00	310.00	1
4	195.00	310.00	315.00	350.00	1
5	315.00	350.00	415.00	355.00	1
6	415.00	355.00	665.00	355.00	1
7	665.00	355.00	765.00	350.00	1
8	765.00	350.00	885.00	310.00	1
9	885.00	310.00	905.00	310.00	1
10	905.00	310.00	980.00	285.00	1
11	980.00	285.00	1100.00	285.00	2
12	100.00	285.00	127.00	276.00	2
13	127.00	276.00	133.00	274.00	3
14	133.00	274.00	153.00	274.00	3
15	153.00	274.00	159.00	276.00	3
16	159.00	276.00	163.50	277.50	2
17	163.50	277.50	965.00	280.00	2
18	965.00	280.00	980.00	285.00	2
19	.00	276.00	127.00	276.00	3
20	159.00	276.00	1100.00	276.00	3
21	.00	270.00	1100.00	270.00	4
22	.00	260.00	1100.00	260.00	5

MAX EL 155
Landfill Profile

Add +200 feet to exist. elevations for modeling purpose

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	64.8	64.8	.0	25.0	.00	.0	1	— WASTE 1750pcy (64.8pcf)
2	105.0	110.0	.0	28.0	.00	.0	1	— Silty SAND
3	110.0	120.0	.0	30.0	.00	.0	1	— Clayey SAND
4	90.0	105.0	2250.0	0.0	.00	.0	1	— Low Plasticity Clay
5	110.0	118.0	.0	32.0	.00	.0	1	— SAND

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	.00	279.00
2	1100.00	279.00

— Groundwater elevation

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

1200 Trial Surfaces Have Been Generated.

30 Surfaces Initiate From Each Of 40 Points Equally Spaced Along The Ground Surface Between X = .00 ft. and X = 100.00 ft.

Each Surface Terminates Between X = 315.00 ft. and X = 665.00 ft.

Failure Search Region (1) failure through upper Terrace (2) failure through foundation

Unless Further Limitations Were Imposed, The Minimum Elevation At Which A Surface Extends Is Y = .00 ft.

10.00 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 25 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	100.00	285.00
2	109.78	287.11
3	119.54	289.27
4	129.29	291.51
5	139.02	293.81
6	148.73	296.17
7	158.44	298.60
8	168.12	301.09
9	177.79	303.65
10	187.44	306.27
11	197.07	308.95
12	206.69	311.70
13	216.28	314.51
14	225.86	317.39
15	235.42	320.33
16	244.96	323.33
17	254.48	326.40
18	263.97	329.52
19	273.45	332.72
20	282.91	335.97
21	292.34	339.29
22	301.75	342.67
23	311.14	346.11
24	320.51	349.61
25	322.51	350.38

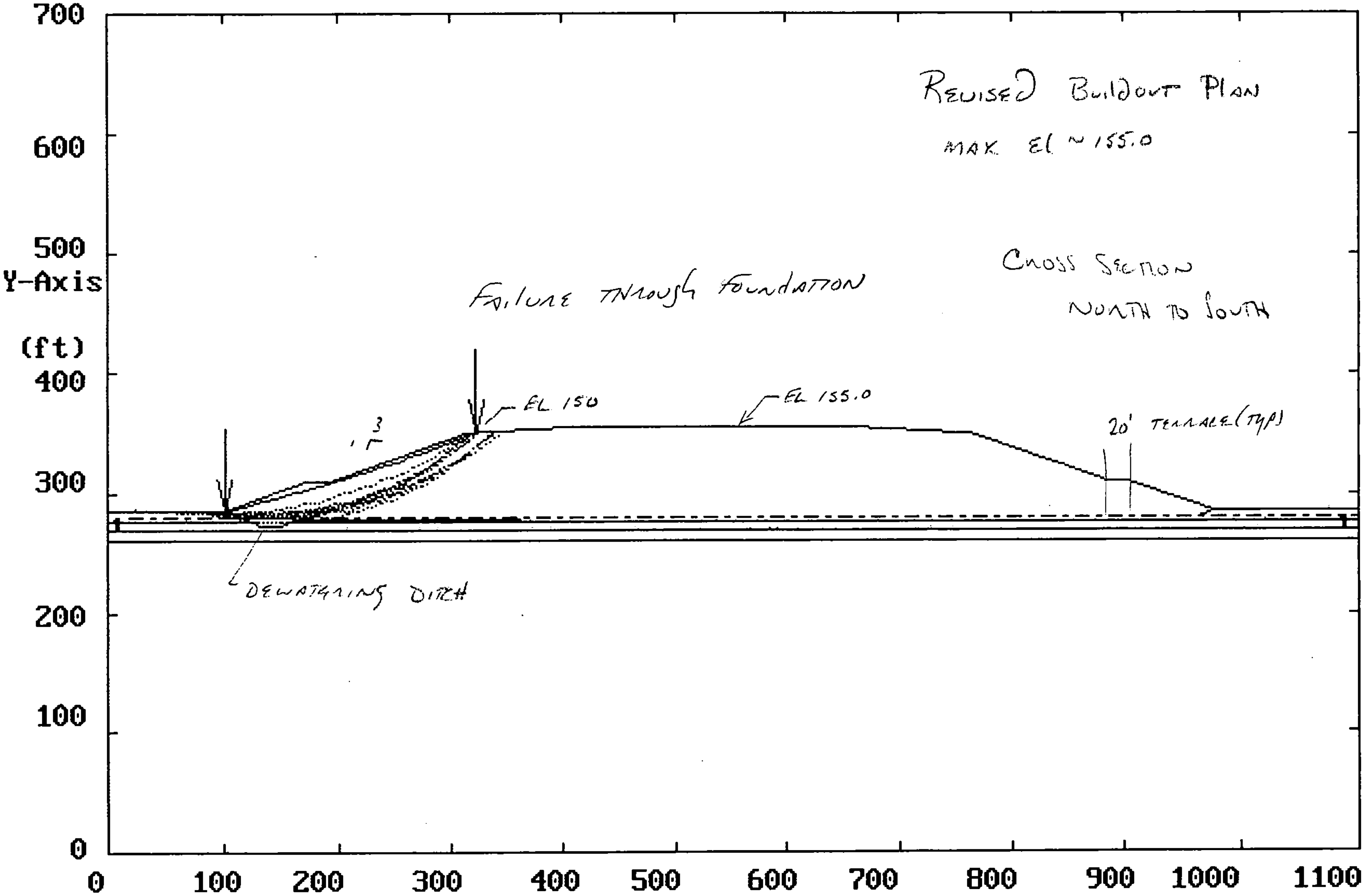
Circle Center At X = -212.5 ; Y = 1760.1 and Radius, 1507.8

FACTOR OF SAFETY = 1.611 (Failure planes through the waste materials & Foundation)

FACTOR OF SAFETY = 1.424 (Failure planes through terrace to top of landfill)
EL 110.0 to EL 155.0

Final Buildout North/South Hardee County, Florida

Ten Most Critical. D:FINALNS2.PLT By: Joseph O'Neill 10-19-00 10:42 am m

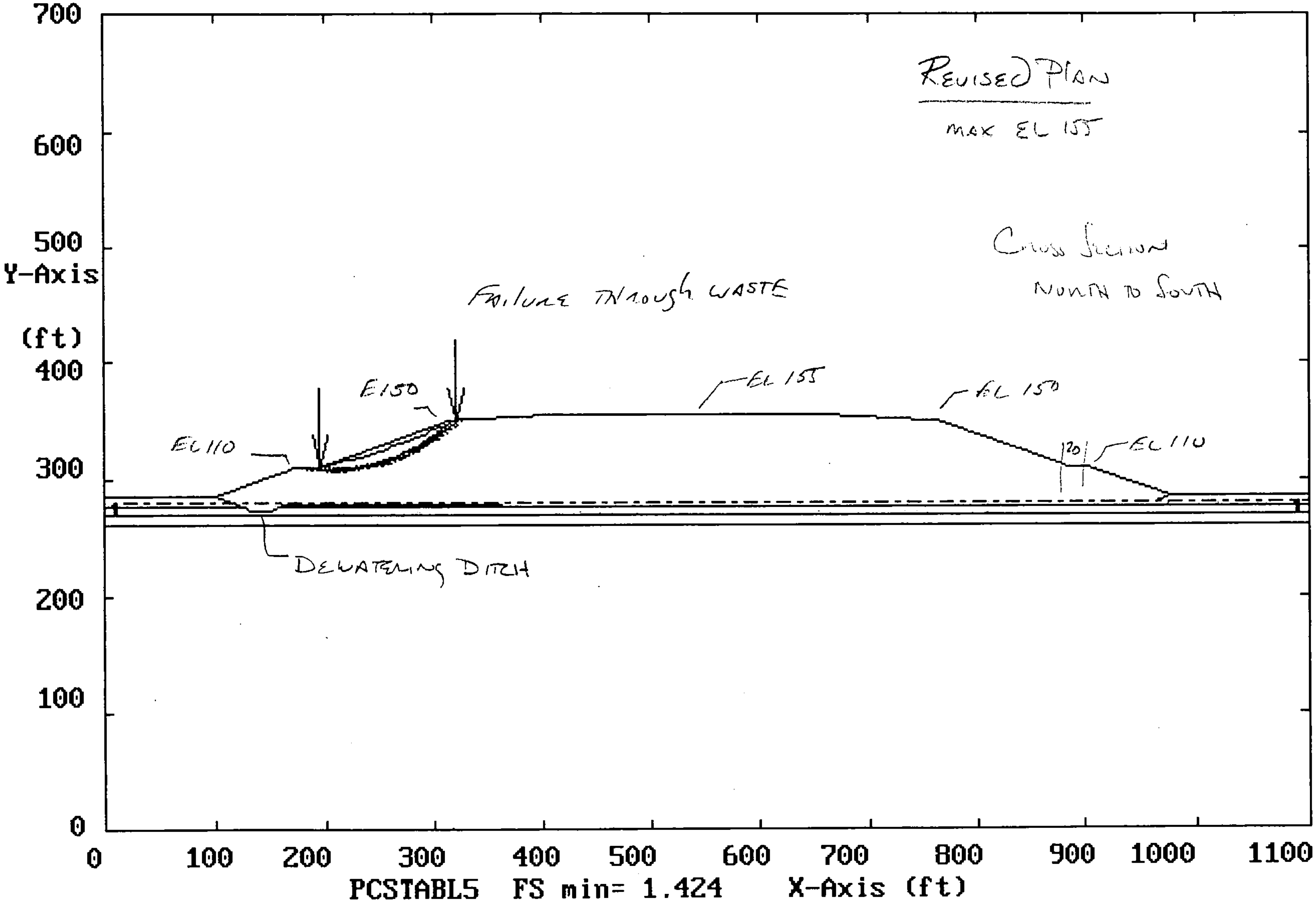


PCSTABL5 FS min= 1.611 X-Axis (ft)

SHEET 10 of 11
N/S Slope stability

Final Buildout-Revised North/South Hardee County, Florida

Ten Most Critical. C:FINALNS2.PLT By: Joseph O'Neill 11-02-00 8:19 pm



Sheet 11 of 11

N/S slope stability

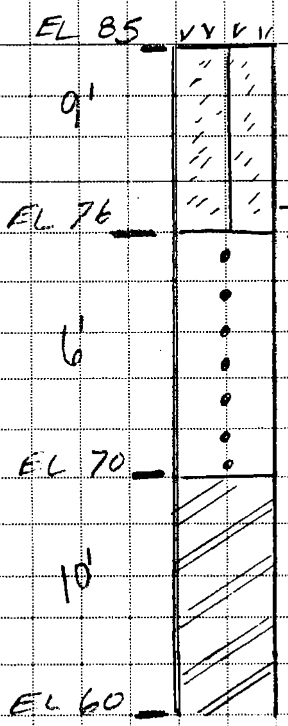
CLIENT: Hardee County	PROJECT: Permit Modification	JOB NO. 09199033.03
SUBJECT: Estimate Settlement	BY: [initials]	DATE: Oct 2000
	CHECKED: [initials]	DATE: 11/28/00

DETERMINE CONDITIONS PRIOR TO EXCAVATION OF LANDFILL

BASED ON HARDEE COUNTY DRAWING FROM ENVISORS DATED Nov 82 THE APPROXIMATE GROUND ELEVATION WAS EL 85.0

THE APPROXIMATE GROUNDWATER ELEVATION WAS EL 77

DETERMINE INITIAL STRESSES IN EACH LAYER - ASSUME BORINGS BY PSI DATED 3/97 ARE REPRESENTATIVE.



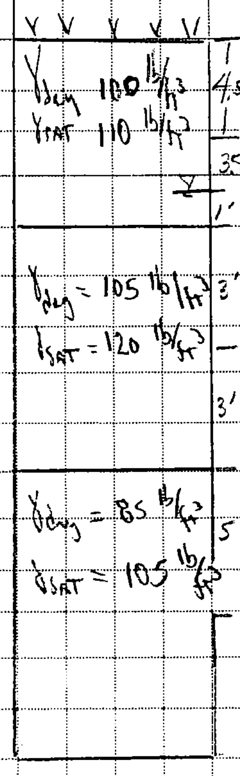
Soil type

SP-SM
SPT N ≃ 9
1 foot

GWT EL 77

SC
SPT N ≃ 10

CL-CH
SPT N ≃ 20



$P_{o_1} = 4.5(100) = 450$ psf

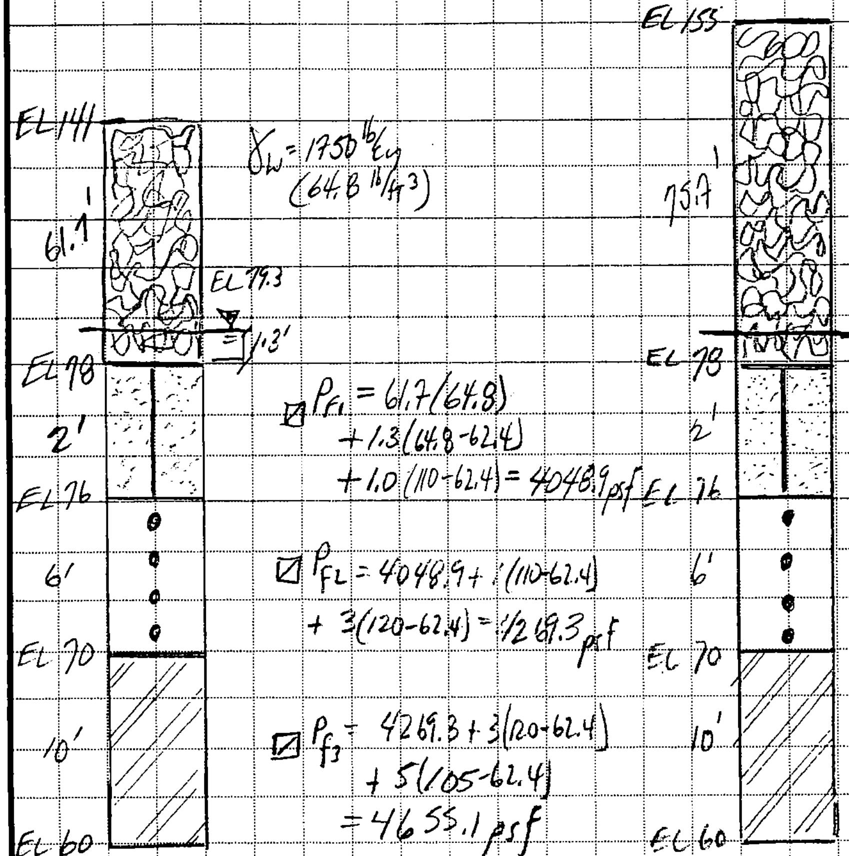
$P_{o_2} = 4.5(100) + 3.5(100) + 1(110-62.4) + 3(120-62.4) = 1020.4$ psf

$P_{o_3} = 1020.4 + 3(120-62.4) + 5(105-62.4) = 1406.2$ psf

CLIENT Hardee County	PROJECT Permit Modification	JOB NO. 09199033.03
SUBJECT Estimate Settlement	BY [initials]	DATE Oct 2000
	CHECKED	DATE

DETERMINE CONDITION @ FINAL BUILDOUT (CURRENT & REVISED)

CURRENT BUILDOUT PLANS | REVISED BUILDOUT PLANS



$\gamma_w = 1750\ lb/cy$ $(64.8\ lb/ft^3)$

Current:

☑ $P_{f1} = 61.7(64.8) + 1.3(64.8-62.4) + 1.0(110-62.4) = 4048.9\ psf$

☑ $P_{f2} = 4048.9 + 1(110-62.4) + 3(120-62.4) = 4269.3\ psf$

☑ $P_{f3} = 4269.3 + 3(120-62.4) + 5(105-62.4) = 4655.1\ psf$

Revised:

☑ $P_{f1} = 75.7(64.8) + 1.3(64.8-62.4) + 1(110-62.4) = 4956.1\ psf$

☑ $P_{f2} = 4956.1 + 1(110-62.4) + 3(120-62.4) = 5176.5\ psf$

☑ $P_{f3} = 5176.5 + 3(120-62.4) + 5(105-62.4) = 5562.3\ psf$

1) Groundwater approximately equal to dewatering ditch elevation on 10/99 survey ditch elevation was approx EL 79.3

2) Existing ground elevation (EL ~85) was excavated approx 7'-10' down to (EL 77-75), based upon PBSJ drawings dated ______. The average bottom elevations were estimated to be EL 78.0. The excavation depth was based upon the inverts of the perimeter manholes.

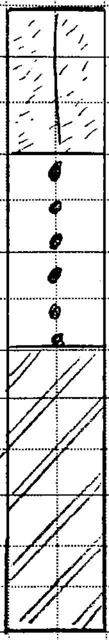
SCS ENGINEERS

SHEET 3 OF 6

CLIENT Hardee Co	PROJECT Permit Modification		JOB NO. 09199033.03
SUBJECT Estimated Settlement		BY JHO	DATE Oct 2000
		CHECKED	DATE

Estimate Compression Index for Soils

EL 79.3 (water table)



Elevation / Thickness	Soil	Unit Weight	Notes
EL 78 – EL 76 (2')	SP-SM, SPT N ~ 9	γ_{dry} ~ 100 lb/ft³; γ_{SAT} ~ 110 lb/ft³	Assumption: D_r ≈ 30%
EL 76 – EL 70 (6')	SC, SPT N ~ 10	γ_{dry} ~ 105 lb/ft³; γ_{SAT} ~ 120 lb/ft³	Assumption: D_r ≈ 30–40%, Say 35%
EL 70 – EL 60 (10')	CL-CH, SPT N ~ 20	γ_{dry} ~ 85 lb/ft³; γ_{SAT} ~ 100 lb/ft³	PSI Lab Results: LL ≈ 128%, PL ≈ 39%, PI ≈ 89%

Layer ① SP-SM

Void Ratio (Source: Lambe Whitman)

D_r ~ 30% 0.9 e_{max} 0.30 e_{min}

$$D_R = \frac{e_{max} - e}{e_{max} - e_{min}} \times 100$$

$$\frac{30}{100} = \frac{0.9 - e}{(0.9 - 0.3)}$$

$$0.3(0.6) = 0.9 - e$$

$$0.9 - 0.3(0.6) = e_o$$

$$\boxed{0.72} = e_o$$

CLIENT Hardee Co	PROJECT Permit Modification	JOB NO. 09199033.03
SUBJECT Estimated Settlement	BY [illegible]	DATE Oct 2000
	CHECKED	DATE

Layer (2) SC

$D_r \sim 35\%$

Void Ratio (Source Lambe Whitman)

1.1 e_{max} 0.4 e_{min}

$$D_r = \frac{e_{max} - e}{e_{max} - e_{min}} \times 100$$

$$0.35 = \frac{1.1 - e}{(1.1 - 0.4)}$$

$$0.35(0.7) = 1.1 - e$$

$$0.855 = e_0$$

(0.86)

Layer (3) CL-CH

$\gamma_{SAT} = \left(\frac{G_s + e}{1 + e}\right)\gamma_w$ G = specific gravity = 2.65

$\gamma_{SAT} \approx 105$ lb/ft³

$\gamma_w = 62.4$ lb/ft³

(Source from TSI report dated 2/97)

$$\frac{\gamma_{SAT}}{\gamma_w} = \left(\frac{G_s + e}{1 + e}\right)$$

$$\frac{105}{62.4} = \left(\frac{2.65 + e}{1 + e}\right)$$

$$1.6827 = \frac{2.65 + e_0}{1 + e_0}$$

$e_{max} \approx 1.0$

$e_{min} \sim 0.9$

(Based upon Professional Judgement)

$e_0 \approx 1.417 \rightarrow$ (1.4)

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SHEET 5 OF 6

CLIENT Hardee County	PROJECT Permit Modification	JOB NO. 09199083303
SUBJECT Estimated Settlement	BY [illegible]	DATE Oct 2000
	CHECKED	DATE

ESTIMATED CONSOLIDATION INDEX PROPERTIES

$C_c \approx a(e_0 - b)$ from B.K. Hough Reference

LAYER	DESCRIPTION	e_0	b (e_{min})	a	C_c
1	Silty sand (SM)	0.72	0.30	0.09	0.038
2	Clayey sand (SC)	0.855	0.40	0.23	0.10
3	Low Plastic (CL) Clays	1.417	0.9	0.29	0.15

$$\Delta S \approx \frac{C_c H}{1+e_0} \log\left(\frac{p_0 + \Delta P}{p_0}\right)$$

C_c - Compression Index
e_0 - Initial void ratio
p_0 - Initial pressure in center of layer (psf)
ΔP - Change in pressure (psf)
H - Layer thick (ft)

Estimated Settlement

Hardee County Landfill
Permit Modification
Hardee County, Florida
f:/projects/091999033.03/geotech/settle.xls

Layers	Description	Initial Stress (psf)	Final Stress (Current Plan) (psf)	Final Stress (Revised Plan) (psf)	Change in Stress (Current Plan) (psf)	Change in Stress (Revised Plan) (psf)
1	Med. Dense SP-SM	450	4,090	4,956	3,640	4,506
2	Med. Dense SC	1,020	4,269	5,177	3,249	4,156
3	Stiff CL/CH	1,406	4,655	5,562	3,249	4,156

Notes: SP-SM - Poorly graded / Silty sand
SC - Clayey Sand
CL/CH - Low Plasticity Clay/High Plasticity Clay

Layers	Layer Height (ft)	Initial Void Ratio	Cc	Settlement @Mid (ft)	Settlement @ Mid (ft)
1	2	0.72	0.038	0.04	0.05
2	6	0.855	0.1	0.20	0.23
3	10	1.417	0.15	0.32	0.37
Estimated Settlement (Current Plan)				0.57	
Estimated Settlement (Revised Plan)					0.64

B. K. Hough, formerly Professor of Civil Engineering at Cornell University and Lehigh University, is presently a consulting engineer with his own consulting firm in Ithaca, N. Y. He has also taught at Massachusetts Institute of Technology. He received his undergraduate and graduate degrees from Massachusetts Institute of Technology. A former student of Professor Terzaghi at M. I. T., he has worked chiefly in soil mechanics ever since, and now has a record of forty years of extensive and varied experience in professional practice, teaching, and research.

BASIC SOILS ENGINEERING

B. K. HOUGH

SECOND EDITION

References for Settlement

THE RONALD PRESS COMPANY • NEW YORK

ditions, the slope of the recompression diagram gives a more realistic indication of the compressibility of the formation than the slope of the virgin curve. One would then represent in the diagram the anticipated load increment Δp and establish the prospective change in void ratio as the difference between the values of e_1 and e_2. For these conditions, the change in thickness of a compressible soil layer would be calculated by substitution of these values in Eq. (5–4).

5–14. LIMITATIONS OF COMPRESSION TESTING

In order to evaluate the compression index of soil in the manner described above, suitable specimens must be obtained or prepared and one or more laboratory compression tests must be conducted. In most cases, undisturbed specimens are considered necessary. Because of the limitations of present-day sampling equipment, however, especially the equipment in the hands of most contract drillers, it is for all practical purposes impossible to obtain undisturbed samples except in stone-free clay and silt formations. Testing equipment is at present also similarly limited to use with these particular soil types. Thus there remains the problem of establishing the compression index or some similar parameter for mixed soils containing significant amounts of gravel or stone fragments as well as clay or silt, and for cohesionless formations in general. There has been some tendency in the past to dismiss this problem with the assertion that the last-mentioned soil types are relatively incompressible. While this is true in certain cases (as with hardpan or dense sand and gravel formations), there are many occasions when the problem cannot be thus dismissed. The fact is that *all* particulate materials are compressible to some degree. Some fine-grained cohesionless soil formations, especially those containing significant amounts of mica or organic matter, for example, are considerably more compressible than certain clays while many others are at least equally compressible. Furthermore, with unusual combinations of loading and settlement limitations,[12] the compressibility of even the most compact sand and gravel formation or compacted fill may become a matter of practical importance.

Perhaps the most important consideration, however, is that what is known as the *allowable bearing capacity* of soil formations for support of spread foundations is directly related to soil compressibility. Evaluation of bearing capacity, which is an essential preliminary step in the design of spread foundations (footings in particular), cannot be accomplished except by the most empirical procedures, unless the compressibility of the bearing materials is known at least approximately; this is true whether the soil happens to be stoney or stone-free.

[12] See *Jour. Soil Mech. & Fdns. Div.*, ASCE, April 1960, discussion by Lev Zetlin of paper by B. K. Hough, "Compressibility as the Basis for Soil Bearing Value."

An alternative to use of data from conventional compression tests for evaluating the compression index is therefore an evident necessity in many cases. Even with stone-free, cohesive materials, some alternative is often desirable since there are many occasions when preliminary settlement estimates or bearing capacity evaluations must be made before laboratory testing programs can be completed or even initiated. The following section deals with one such alternative.

Compression Index as a Function of Initial Density

5–15. SUPPORTING EVIDENCE AND DEVELOPMENT OF RELATIONSHIP

Virgin compression curves and typical C_c values for specimens of many different types of soil are presented in Fig. 5–11. Some of the specimens were undisturbed (U); some remolded (R). Examination of the converging pattern of these curves clearly indicates that, in a general way, compressibility varies with initial void ratio; the looser the specimen initially, the more compressible it is over any given loading range, and vice versa.

The nature of the relationship between the compression index, C_c, and no-load void ratio, e_0, for certain types of material can be established by conducting tests on remolded specimens prepared at densities which vary over a significant range. It is then possible to plot C_c as a function of e_0. In Fig. 5–12, curves plotted on this basis for remolded specimens of four different types of sand are presented. For each individual type and within the range of densities characteristic of the type, the relationship appears to be approximately linear. When this is true, the relationship may be expressed by the equation

$$C_c = a(e_0 - b) \tag{5-7}$$

In Eq. (5–7), the terms C_c and e_0 are the dependent variables, the terms a and b constants for a particular soil type. From presently available information it appears that the term a, which represents the slope of a given diagram, is dependent chiefly on particle shape, size, and gradation. The term b, the value of the intercept on the X-axis, is apparently a close approximation of the minimum void ratio of the material. Values of a and b for the sand specimens represented in Fig. 5–12 are given in the figure and values for other materials are given in a later section.

Similar soils.

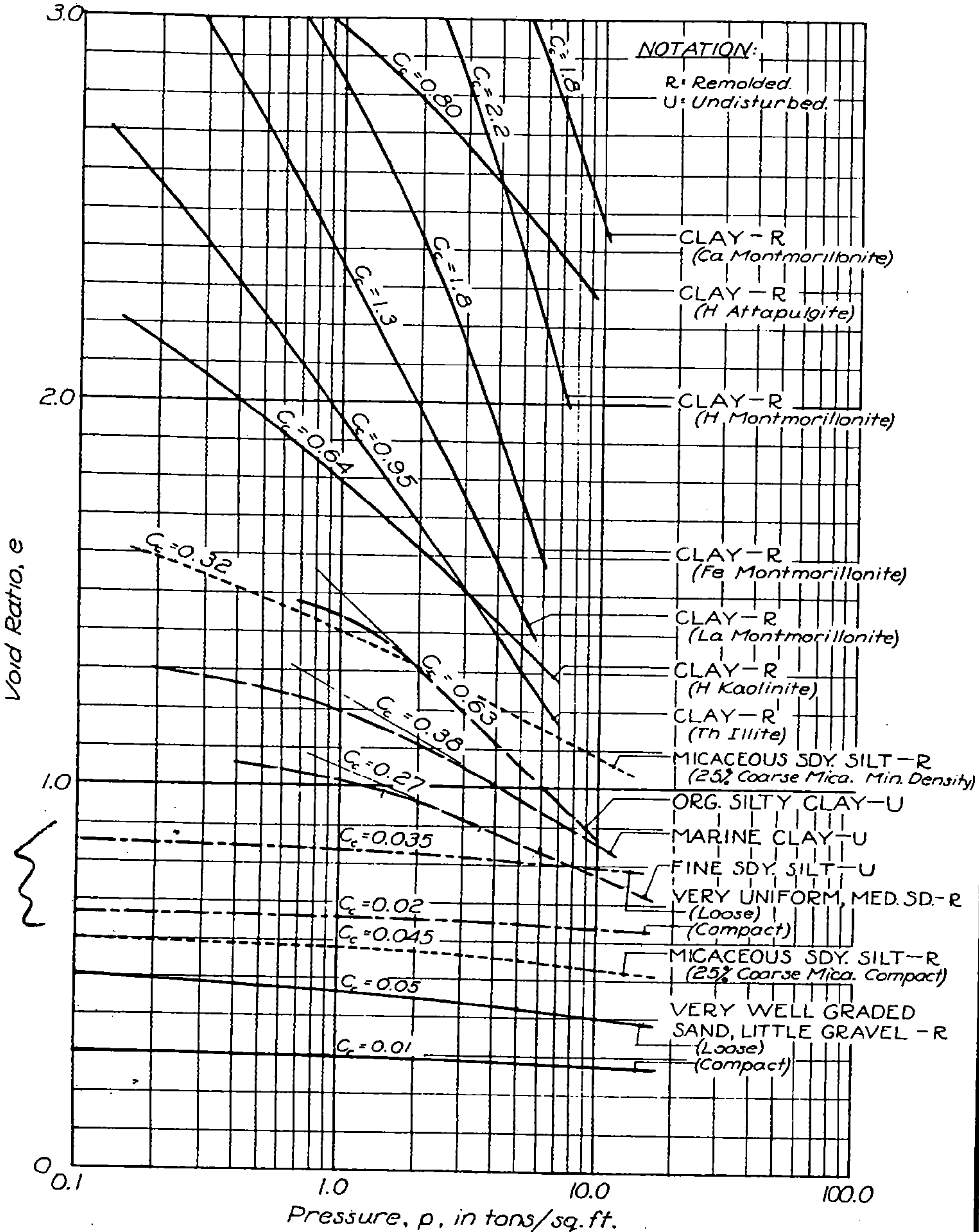

Fig. 5–11. Variation in slope of *p-e* curves with initial void ratio.

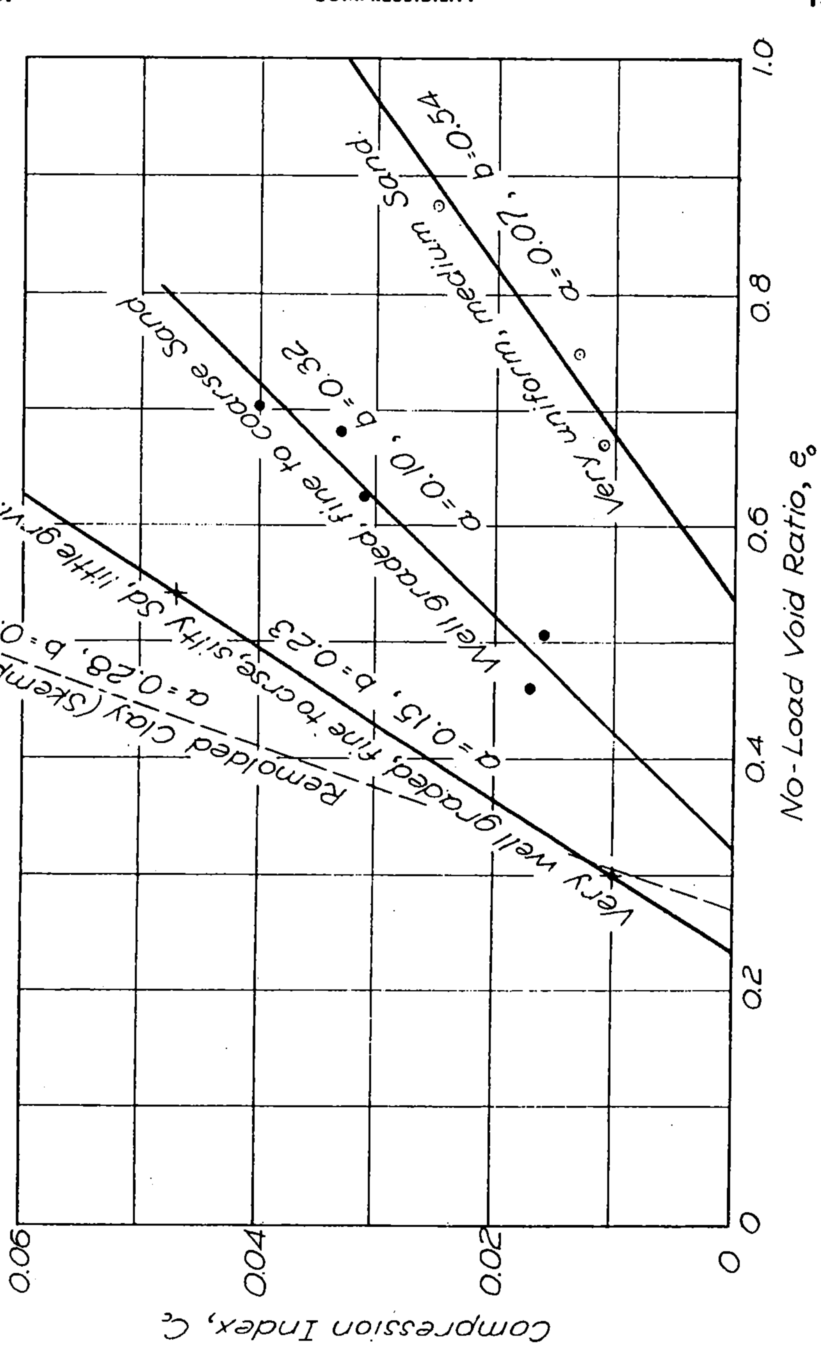

Fig. 5–12. Variation of C_c with no-load void ratio, e_0.

values 0.285 and 0.270, respectively; a curve plotted on this basis is included in Fig. 5-12 for comparative purposes.

Values of the constants a and b of Eq. (5-7) obtained from tests on laboratory prepared specimens of many different soil types, including those described above, are summarized in Table 5-1. The values given

TABLE 5-1

Values of the Constants of Equation (5-7) for Typical Materials

Type of Soil	Value of Constant a	Value of Constant b*
Uniform cohesionless material ($C_u \leq 2$)		
Clean gravel	0.05	0.50
Coarse sand	0.06	0.50
Medium sand	0.07	0.50
Fine sand	0.08	0.50
Inorganic silt	0.10	0.50
Well-graded, cohesionless soil		
Silty sand and gravel	0.09	0.20
Clean, coarse to fine sand	0.12	0.35
Coarse to fine silty sand	0.15	0.25
Sandy silt (inorganic)	0.18	0.25
Inorganic, cohesive soil		
Silt, some clay; silty clay; clay	0.29	0.27
Organic, fine-grained soil		
Organic silt, little clay	0.35	0.50

* The value of the constant b should be taken as e_{min} whenever the latter is known or can conveniently be determined. Otherwise, use tabulated values as a rough approximation.

for materials such as sand and gravel, which are too coarse for testing in consolidometers of conventional size, represent assumptions based on study of available settlement records.

5-16. GENERALIZATIONS AS TO COMPRESSIBILITY

Before describing procedures for utilizing Eq. (5-7) for evaluation of the compression index in practical applications, it may be instructive to consider certain general aspects of compressibility which are evident from the discussion which has thus far been presented. These generalities may be stated in the following manner.

At a given void ratio, a (confined) *uniform* material is less compressible than one which is well graded.

Considering (confined) uniform materials at a given void ratio, the finer the particle size, the more compressible is the material.

Soils in general with bulky, angular, or rounded particles are less compressible than those with flat particles.

Clays with needle-shaped particles, such as attapulgite (and to a lesser degree, halloysite), are less compressible than those with plate-shaped particles, montmorillonite (plate-shaped particles plus expanding lattice) in particular.

Materials of any given type which include significant amounts of mica and/or organic matter are more (sometimes considerably more) compressible than those of the same type which do not.

As an overall generalization, the greater its void ratio prior to loading, the greater is the compressibility of any given soil type; and vice versa.[15]

5-17. INITIAL DENSITY OF SOIL FORMATIONS

It is evident that information on the original, "no-load" void ratio of a formation must be available if the C_c, e_0 relationship is to be used directly for estimating soil compressibility. A rather general impression apparently exists to the effect that sedimentary formations, at least, are laid down initially in a condition approximating their maximum void ratio. Skempton's work suggests that this is true in the case of fine-grained sedimentary formations, clay in particular. Coupled with this belief is the assumption that the present, in-place condition of such formations is entirely the result of loading subsequent to deposition. If these assumptions could be completely accepted, the value e_{max} could be substituted for e_0 in Eq. (5-7) and application of the equation would be greatly simplified.

Unfortunately, there are many reasons for doubting the general applicability of such assumptions as the above. For example, in a texturally uniform deposit of fine-grained sand or silt, if these assumptions were valid, the void ratio of the material would steadily decrease with depth and at any given depth would have the same value at points which laterally are some distance apart. The finding of such a condition in a natural formation, however, is very much more the exception than the rule. In many cases, void ratio varies quite unpredictably both laterally and with depth. Most surprising to the layman, perhaps, is the finding that void ratio often *increases* with depth, loose sand layers being found beneath more compact surface layers and soft clay intervals underlying stiff clay.

The construction of compression diagrams based on use of the C_c, e_0 relationship in the manner described in the next section is often helpful

[15] This, of course, is the justification for the expenditure of considerable sums of money to compact both earth fills and natural soil formations prior to loading.

tions and in many cases will provide a means of estimating the compression index without recourse to undisturbed sampling and laboratory testing.

Field Compression Diagrams

5–18. DEFINITION

As the term is used in this book, a field compression diagram is a pressure-void ratio curve originating at or passing through a point which represents the in-place density of an element in a natural soil formation or earth fill and the existing overburden pressure.

5–19. CONSTRUCTION AND UTILIZATION

The recommended construction should be performed on semilog paper with pressure and void ratio scales appropriate to the conditions of the problem. The void ratio scale should cover the range from e_{max} to e_{min} for the material in question. For the pressure scale, it is usually sufficient to make provision for two logarithmic cycles ranging from 0.1 to 1.0 and from 1.0 to 10.0 tons per sq. ft., respectively.

A pressure-void ratio curve originating at $e = e_{max}$ and $p = 0.1$ ton per sq. ft. is then constructed as shown in Fig. 5–14, by utilization of the relationship,

$$C_c = a(e_{max} - b)$$

For clay soils, e_{max} can be taken as the void ratio at the liquid limit. For other soil types, an indication of e_{max} can be obtained by reference to Table 2–3 or by test on representative material. Although of less practical importance, it may be of interest to draw a second diagram, originating at e_{min}. The latter may be assumed to be a horizontal line.

The two diagrams described above establish limits on the area within which a point representing the in-place condition of the soil will fall except in a very few cases, which are mentioned later. Points A, B, and C in Fig. 5–14 represent examples of in-place condition points for ordinary situations.

If a plotting of the in-place void ratio and overburden pressure for a soil element of any type results in a point such as point A, close to the uppermost limiting diagram, it may reasonably be assumed that the material was laid down in an approximation of its loosest condition and that the subsequent reduction in void ratio was due entirely to weight of present overburden. If the soil is a cohesive type it would

Either Eq. (5–10), or Eq. (5–7) substituting $e_{max} = e_0$, can be used obtain an approximation of the compression index for this mater

If the soil is a clay which is in such a condition that the in-place void ratio and pressure plot at point B, it should be presumed, initially at least, that it is precompressed and that the field compression diagram

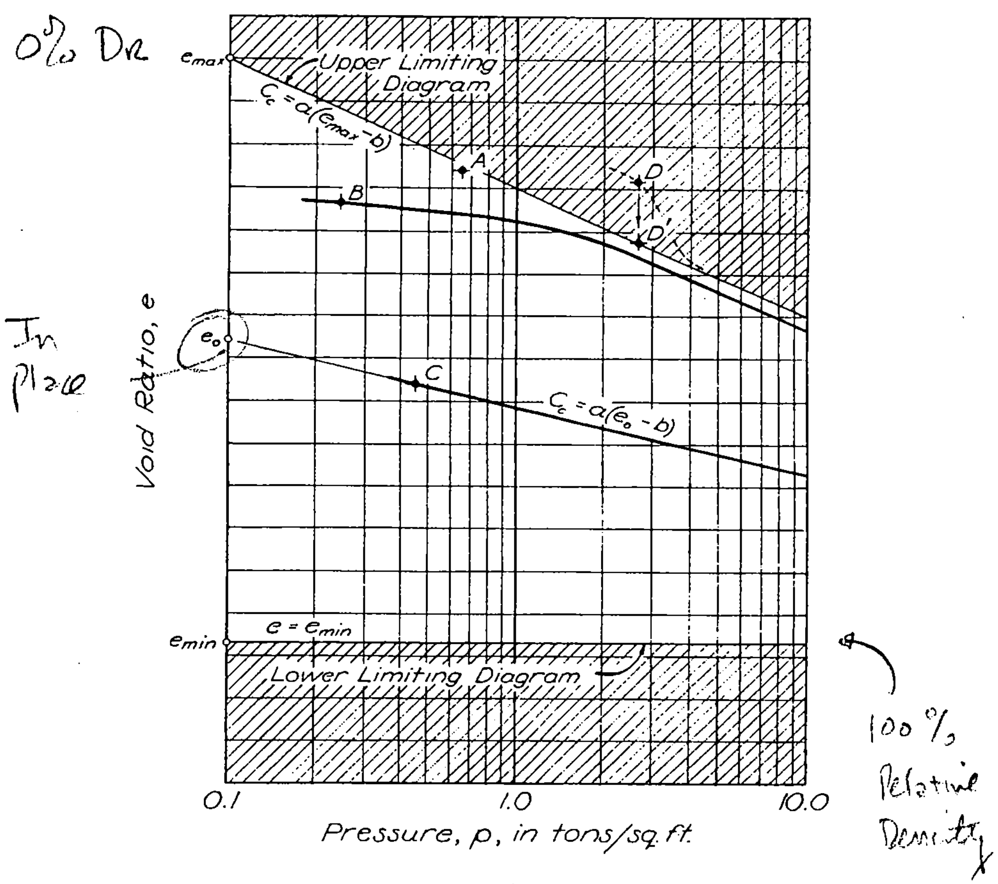

Fig. 5–14. Illustration of procedure for constructing field compression diagrams.

will resemble that shown by the full line diagram through B in Fig. 5–14. This plotting provides a reasonable basis for recommending a program of undisturbed sampling and laboratory testing even though greater than ordinary expense may be involved.

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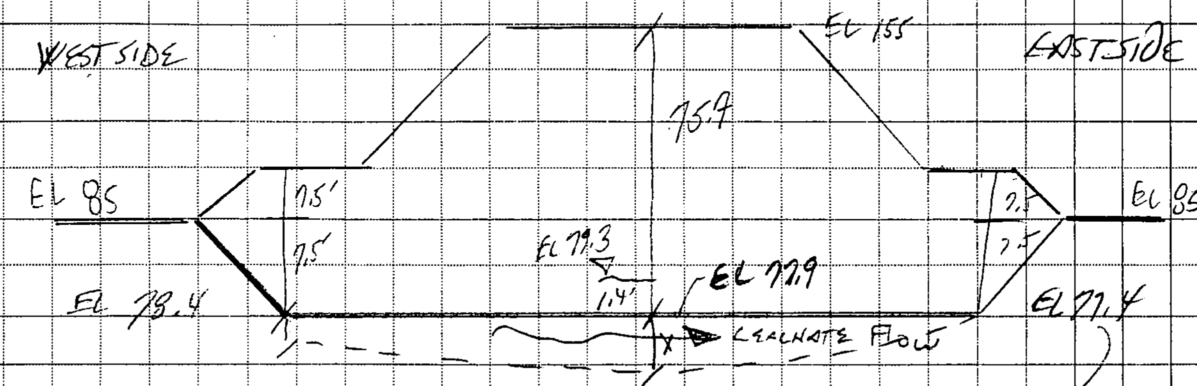
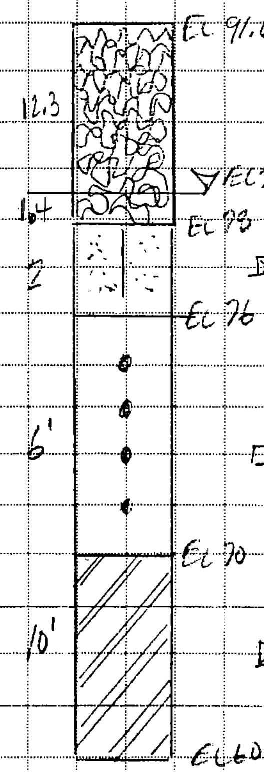
CLIENT Handex Co	PROJECT Permit Modification	JOB NO. 09200020.11
SUBJECT Bearing Capacity	BY JHD	DATE ?/2000
	CHECKED [illegible]	DATE 11/28/00

Bearing capacity – @ what pressure over the revised permit amount cause a depression in the center of the landfill



from PBSJ Drawings Manhole inverts

Pressure @ toe

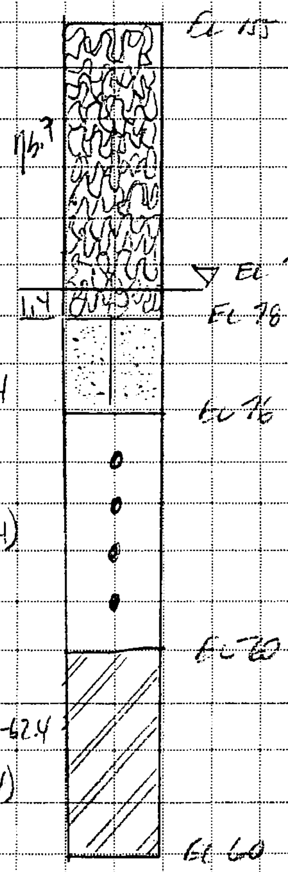


$P_{TOE_1} = \gamma_w 12.3 + (\gamma_w - 62.4)1.4 + 1(110-62.4) =$

$P_{TOE_2} = P_{TOE_1} + 1(110-62.4) + 3(120-62.4)$

$P_{TOE_3} = P_{TOE_2} + 3(120-62.4) + 5(105-62.4)$

Pressure @ center



Vary to determine bearing capacity

$P_{mid_1} = \gamma_w(75.7) + 1.4(\gamma_w - 62.4) + 1(110-62.4) =$

$P_{mid_2} = P_{mid_1} + 1(110-62.4) + 3(120-62.4) =$

$P_{mid_3} = P_{mid_2} + 3(120-62.4) + 5(105-62.4) =$

Determine settlements based upon various unit weights

See attached spreadsheet

Sheet 2 of 2

Bearing Capacity

Estimated Net Bearing Capacity

Hardee County Landfill
Permit Modification
Hardee County, Florida
f:/projects/091999033.03/geotech/bearing.xls

Layers	Description	Initial Stress (psf)	Final Stress @ Toe (psf)	Final Stress @ Mid (psf)	Change in Stress @ Toe (psf)	Change in Stress @ Mid (psf)
1	Med. Dense SP-SM	450	1,399	8,056	949	7,606
2	Med. Dense SC	1,020	1,619	8,276	599	7,256
3	Stiff CL/CH	1,406	2,005	8,662	599	7,256

Notes: SP-SM - Poorly graded / Silty sand
SC - Clayey Sand
CL/CH - Low Plasticity Clay/High Plasticity Clay

Layers	Layer Height (ft)	Initial Void Ratio	Cc	Settlement @Mid (ft)	Settlement @ Mid (ft)
1	2	0.72	0.038	0.02	0.06
2	6	0.855	0.1	0.06	0.29
3	10	1.417	0.15	0.10	0.49
	Estimated Settlement (@ Toe)			0.18	
	Estimated Settlement (@ Mid)				0.84

Change in Pressure @ Toe
Unit Weight Waste (pcf) = 105

Ptoe 1 = 1398.74 psf
Ptoe 2 = 1619.14 psf
Ptoe 3 = 2004.94 psf

Change in Pressure @ ~~Toe~~ middle of Landfill
Unit Weight Waste (pcf) = 105

Ptoe 1 = 8055.74 psf
Ptoe 2 = 8276.14 psf
Ptoe 3 = 8661.94 psf

	Westside		Midpoint		Eastside
El =	78.4	El =	77.9	El =	77.41
Settlement	0.18		0.84		0.18
	78.22		77.06		77.23

possible ponding

Net Bearing Capacity (@center)

Waste Unit Weight 64.8 Pressure 4908.72 psf

Excess Unit Weight 105 Pressure 8008.14 psf

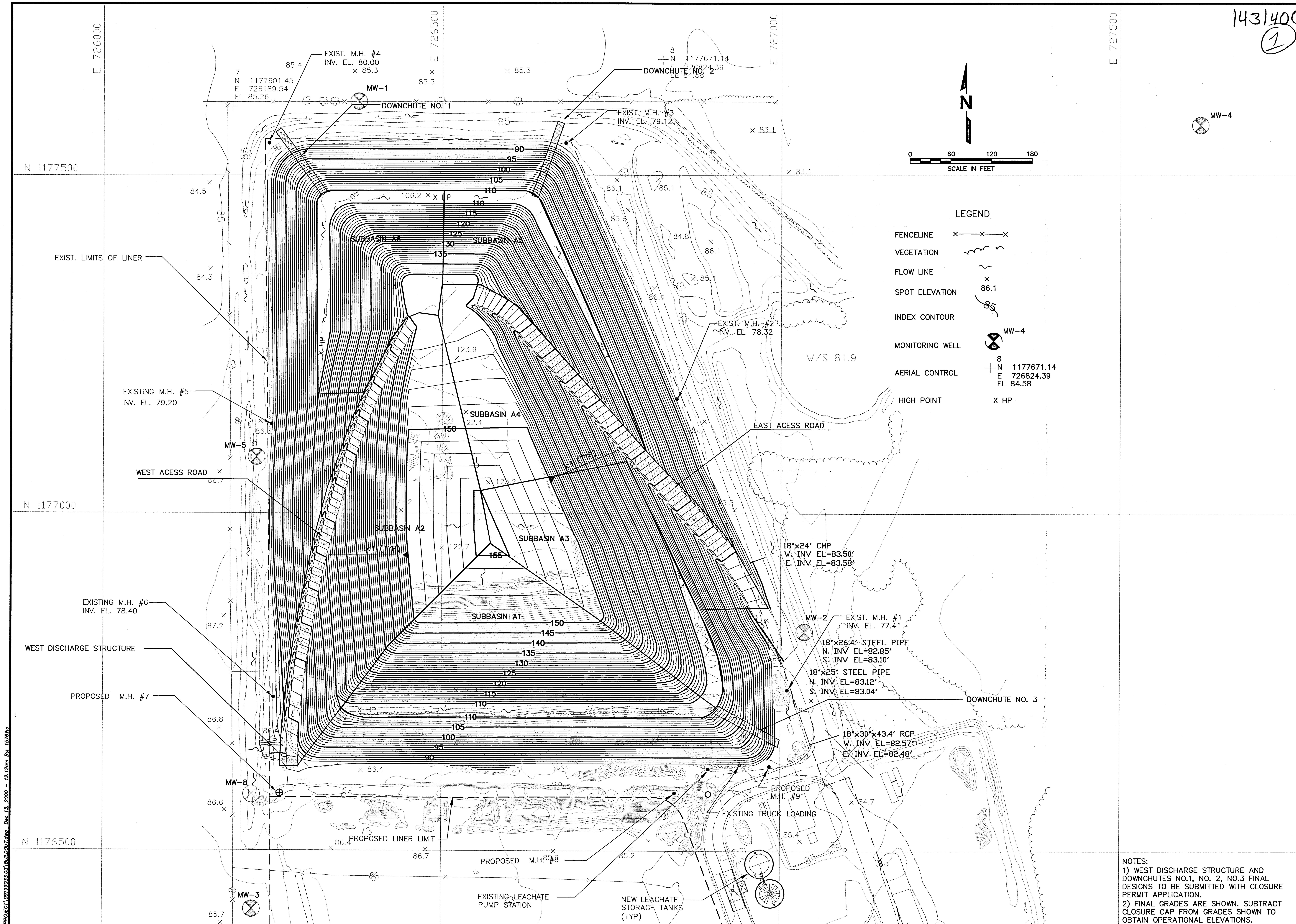
Net 3099.42 psf

(Amount of pressure above current permit levels)

ATTACHMENT D

STORMWATER ANALYSIS

1431406
(1)



NOTES:
1) WEST DISCHARGE STRUCTURE AND DOWNCHUTES NO.1, NO. 2, NO.3 FINAL DESIGNS TO BE SUBMITTED WITH CLOSURE PERMIT APPLICATION.
2) FINAL GRADES ARE SHOWN. SUBTRACT CLOSURE CAP FROM GRADES SHOWN TO OBTAIN OPERATIONAL ELEVATIONS.

REV.	DATE	DESCRIPTION	CK. BY

DRAWING TITLE: WATERSHED BASINS

PROJECT TITLE: MINOR OPERATIONAL FILL SEQUENCE REVISIONS

CLIENT: HARDEE COUNTY BOARD OF COUNTY COMMISIONERS

SCS ENGINEERS
STEARNS, CONRAD AND SCHMIDT
CONSULTING ENGINEERS
3012 U.S. HWY. 301 NORTH, SUITE 700, TAMPA, FL 33619
PH (813) 621-0080 FAX NO. (813) 623-6757

PROJ. NO. 09199033.03 | DWN. BY: JHO | Q/A RVW BY: JHO/RJD
DSN. BY: JHO | CHK. BY: JHO | APP. BY: RJD

CADD FILE: BUILDOUT.DWG
DATE: December, 2000
SCALE: 1"=60'
DRAWING NO. 1 of 1

G:\PROJECT\09199033.03\BUILDOUT.dwg Dec 13, 2000 - 12:12pm Bv: 1576bo

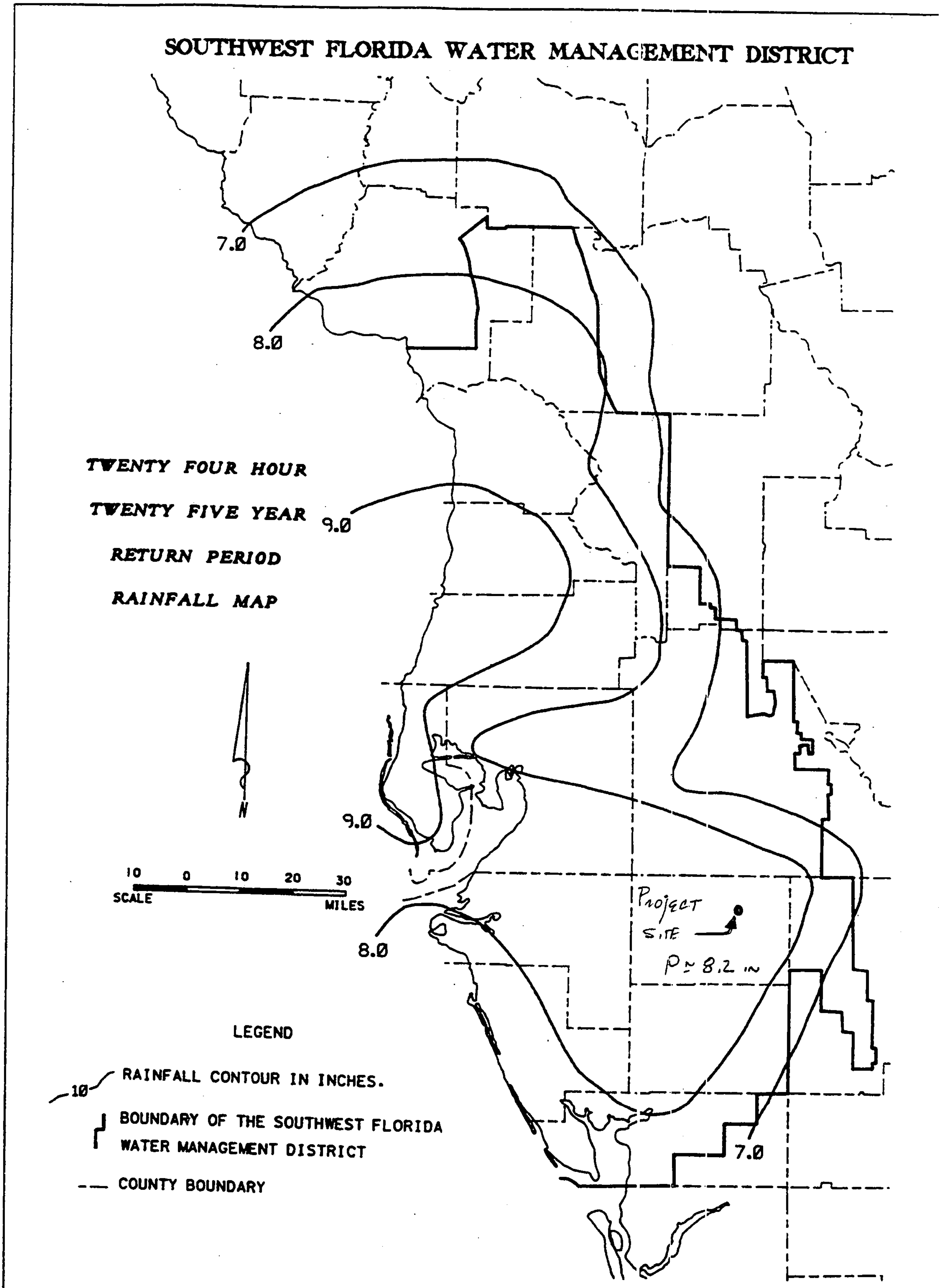

SOUTHWEST FLORIDA WATER MANAGEMENT DISTRICT
TWENTY FOUR HOUR
TWENTY FIVE YEAR
RETURN PERIOD
RAINFALL MAP
7.0
8.0
9.0
9.0
8.0
7.0
N
10 0 10 20 30
SCALE
MILES
Project
Site
P ≈ 8.2 in
LEGEND
10 RAINFALL CONTOUR IN INCHES.
BOUNDARY OF THE SOUTHWEST FLORIDA
WATER MANAGEMENT DISTRICT
COUNTY BOUNDARY

FIGURE D-5

Final Closure Plan
Contributing Subbasin; A1-A6
Hardee County, Florida

********** Basin Summary - POST **********************************

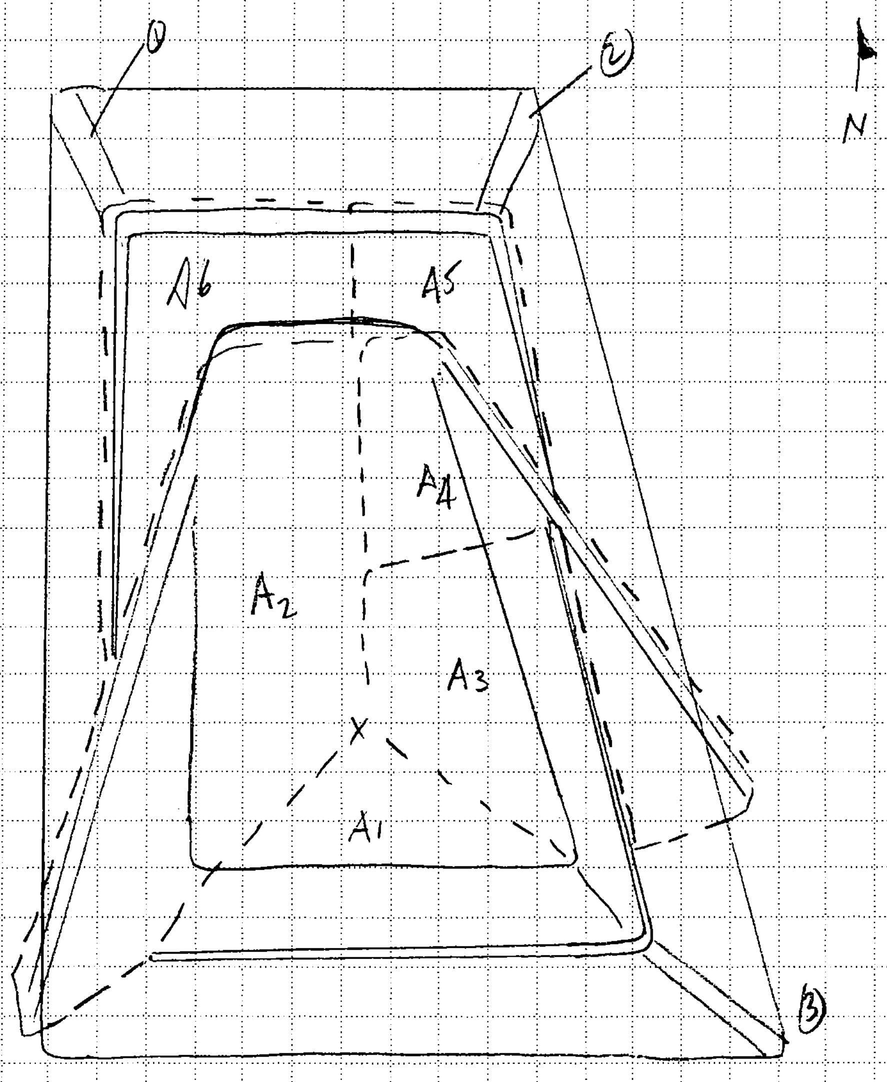
Basin Name:	A1	A2	A3	A4	A5
Group Name:	BASE	BASE	BASE	BASE	BASE
Node Name:	1	1	1	1	1
Hydrograph Type:	UH	UH	UH	UH	UH
Unit Hydrograph:	UH484	UH484	UH484	UH484	UH484
Peaking Factor:	484.00	484.00	484.00	484.00	484.00
Spec Time Inc (min):	0.80	0.80	0.80	0.80	0.80
Comp Time Inc (min):	0.80	0.80	0.80	0.80	0.80
Rainfall File:	FLMOD	FLMOD	FLMOD	FLMOD	FLMOD
Rainfall Amount (in):	8.20	8.20	8.20	8.20	8.20
Storm Duration (hr):	24.00	24.00	24.00	24.00	24.00
Status:	ONSITE	ONSITE	ONSITE	ONSITE	ONSITE
Time of Conc. (min):	6.00	6.00	6.00	6.00	6.00
Lag Time (hr):	0.00	0.00	0.00	0.00	0.00
Area (acres):	1.79	2.37	1.36	1.65	0.85
Vol of Unit Hyd (in):	1.00	1.00	1.00	1.00	1.00
Curve Number:	85.00	85.00	85.00	85.00	85.00
DCIA (%):	0.00	0.00	0.00	0.00	0.00
Time Max (hrs):	12.00	12.00	12.00	12.00	12.00
Flow Max (cfs):	**10.05**	**13.31**	**7.64**	**9.27**	**4.77**
Runoff Volume (in):	6.40	6.40	6.40	6.40	6.40
Runoff Volume (cf):	41571	55041	31585	38319	19740

Basin Name:	A6
Group Name:	BASE
Node Name:	1
Hydrograph Type:	UH
Unit Hydrograph:	UH484
Peaking Factor:	484.00
Spec Time Inc (min):	0.80
Comp Time Inc (min):	0.80
Rainfall File:	FLMOD
Rainfall Amount (in):	8.20
Storm Duration (hr):	24.00
Status:	ONSITE
Time of Conc. (min):	6.00
Lag Time (hr):	0.00
Area (acres):	1.03
Vol of Unit Hyd (in):	1.00
Curve Number:	85.00
DCIA (%):	0.00
Time Max (hrs):	12.00
Flow Max (cfs):	**5.79**
Runoff Volume (in):	6.40
Runoff Volume (cf):	23921

SCS ENGINEERS

SHEET ______ OF ______

CLIENT Hardee County	PROJECT Permit Modification	JOB NO. 09199037.07
SUBJECT Stormwater	BY JNU	DATE Dec 11 2000
	CHECKED	DATE



CONVEYANCE STRUCTURES

1. SUBBASIN A4
2. SUBBASIN A5
3. SUBBASIN A1 & A3

TERRACE LEADING TO CONVEYANCE

1. SUBBASIN A4
2. SUBBASIN A5
3. SUBBASIN A1 & A3

WEST ROAD

SUBBASIN A_2

EAST ROAD

SUBBASIN A4

SCS ENGINEERS

SHEET ______ OF ______

CLIENT Hardee County	PROJECT Permit Modification		JOB NO. 09199073.03
SUBJECT Stormwater		BY MHO	DATE Dec 11 2000
		CHECKED	DATE

Terraces

Subbasin A1 = 10.05 cfs @ 0.5% bottom slope
Subbasin A3 = 7.64 cfs @ 1.1% bottom slope
Subbasin A6 = 5.79 cfs @ 0.5-0.8% bottom slope
Subbasin A5 = 4.77 cfs @ 0.5-1.1% bottom slope

Downchute

Subbasin A1 + A3 = 10.05 + 7.64 = 17.69 cfs

East Road

Subbasin A4 = 9.27 cfs

West Road

Subbasin A2 = 13.31 cfs

Subbasin A1
Worksheet for Trapezoidal Channel

Project Description	
Project File	c:\haestad\fmw\hardee.fm2
Worksheet	Typical Terrace Swale
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Discharge

Input Data		
Mannings Coefficient	0.022	
Channel Slope	0.005000	ft/ft
Depth	0.32	ft
Left Side Slope	3.000000	H : V
Right Side Slope	3.000000	H : V
Bottom Width	13.50	ft

Results		
Discharge	10.05	cfs
Flow Area	4.68	ft²
Wetted Perimeter	15.55	ft
Top Width	15.44	ft
Critical Depth	0.25	ft
Critical Slope	0.011423	ft/ft
Velocity	2.15	ft/s
Velocity Head	0.07	ft
Specific Energy	0.40	ft
Froude Number	0.69	
Flow is subcritical.		

LOW VELOCITY
ASPHALT EMULSION ON
EROSION CONTROL MAT

Subbasin A3
Worksheet for Trapezoidal Channel

Project Description	
Project File	c:\haestad\fmw\hardee.fm2
Worksheet	Typical Terrace Swale
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Discharge

Input Data		
Mannings Coefficient	0.022	
Channel Slope	0.011000	ft/ft
Depth	0.22	ft
Left Side Slope	3.000000	H : V
Right Side Slope	3.000000	H : V
Bottom Width	13.50	ft

Results		
Discharge	7.64	cfs
Flow Area	3.08	ft²
Wetted Perimeter	14.88	ft
Top Width	14.81	ft
Critical Depth	0.21	ft
Critical Slope	0.012081	ft/ft
Velocity	2.48	ft/s
Velocity Head	0.10	ft
Specific Energy	0.31	ft
Froude Number	0.96	
Flow is subcritical.		

MED FLOW VELOCITY
SOD/ EROSION CONTROL MAT

Subbasin A4
Worksheet for Trapezoidal Channel

Project Description	
Project File	c:\haestad\fmw\hardee.fm2
Worksheet	Typical Terrace Swale ←
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Discharge

Input Data		
Mannings Coefficient	0.022	
Channel Slope	0.008000	ft/ft
Depth	0.27	ft
Left Side Slope	3.000000	H : V
Right Side Slope	3.000000	H : V
Bottom Width	13.50	ft

Results		
Discharge	9.27	cfs
Flow Area	3.84	ft^2
Wetted Perimeter	15.20	ft
Top Width	15.11	ft
Critical Depth	0.24	ft
Critical Slope	0.011612	ft/ft
Velocity	2.41	ft/s
Velocity Head	0.09	ft
Specific Energy	0.36	ft
Froude Number	0.84	
Flow is subcritical.		

MED FLOW VELOCITY
SOD W/ EROSION CONTROL MAT

Subbasin A5
Worksheet for Trapezoidal Channel

Project Description	
Project File	c:\haestad\fmw\hardee.fm2
Worksheet	Typical Terrace Swale
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Discharge

Input Data		
Mannings Coefficient	0.022	
Channel Slope	0.011000	ft/ft
Depth	0.16	ft
Left Side Slope	3.000000	H : V
Right Side Slope	3.000000	H : V
Bottom Width	13.50	ft

Results		
Discharge	4.77	cfs
Flow Area	2.30	ft²
Wetted Perimeter	14.54	ft
Top Width	14.49	ft
Critical Depth	0.16	ft
Critical Slope	0.013324	ft/ft
Velocity	2.07	ft/s
Velocity Head	0.07	ft
Specific Energy	0.23	ft
Froude Number	0.92	
Flow is subcritical.		

Slow flow velocity
Asphalt emulsion or
erosion control mat

Subbasin A6

Worksheet for Trapezoidal Channel

Project Description	
Project File	c:\haestad\fmw\hardee.fm2
Worksheet	Typical Terrace Swale
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Discharge

Input Data		
Mannings Coefficient	0.022	
Channel Slope	0.008000	ft/ft
Depth	0.20	ft
Left Side Slope	3.000000	H : V
Right Side Slope	3.000000	H : V
Bottom Width	13.50	ft

Results		
Discharge	5.79	cfs
Flow Area	2.86	ft²
Wetted Perimeter	14.78	ft
Top Width	14.72	ft
Critical Depth	0.18	ft
Critical Slope	0.012794	ft/ft
Velocity	2.02	ft/s
Velocity Head	0.06	ft
Specific Energy	0.27	ft
Froude Number	0.81	
Flow is subcritical.		

Slow flow velocity
Asphalt emulsion on
Erosion control mat

East Road
Worksheet for Trapezoidal Channel

Project Description	
Project File	c:\haestad\fmw\hardee.fm2
Worksheet	Typical Terrace Swale
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Discharge

EAST ROAD

Input Data		
Mannings Coefficient	0.022	
Channel Slope	0.100000	ft/ft
Depth	0.29	ft
Left Side Slope	3.000000	H : V
Right Side Slope	3.000000	H : V
Bottom Width	3.00	ft

← channel 9" deep OK

Results		
Discharge	9.28	cfs
Flow Area	1.14	ft²
Wetted Perimeter	4.86	ft
Top Width	4.76	ft
Critical Depth	0.55	ft
Critical Slope	0.009881	ft/ft
Velocity	8.13	ft/s
Velocity Head	1.03	ft
Specific Energy	1.32	ft
Froude Number	2.93	
Flow is supercritical.		

High flow velocity
- SOD w/ EROSION CONTROL MAT
- HEAVY ASPHALT EMULSION LAYER(S)
- LINE WITH GEOMEMBRANE OR SAND CEMENT BAGS

West Road
Worksheet for Trapezoidal Channel

Project Description	
Project File	c:\haestad\fmw\hardee.fm2
Worksheet	Typical Terrace Swale
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Discharge

WEST ROAD

Input Data		
Mannings Coefficient	0.022	
Channel Slope	0.100000	ft/ft
Depth	0.43	ft
Left Side Slope	2.000000	H : V
Right Side Slope	2.000000	H : V
Bottom Width	2.25	ft

channel 5" deep ok

Results		
Discharge	13.31	cfs
Flow Area	1.33	ft²
Wetted Perimeter	4.17	ft
Top Width	3.97	ft
Critical Depth	0.81	ft
Critical Slope	0.009311	ft/ft
Velocity	9.99	ft/s
Velocity Head	1.55	ft
Specific Energy	1.98	ft
Froude Number	3.04	
Flow is supercritical.		

High velocity
- SOD/WITH EROSION CONTROL MAT
- HEAVY ASPHALT EMULSION LAYER(S)
- LINE WITH GEOMEMBRANE OR SAND CEMENT BAGS

Downchute
Worksheet for Trapezoidal Channel

Project Description	
Project File	c:\haestad\fmw\hardee.fm2
Worksheet	Typical Terrace Swale
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Discharge

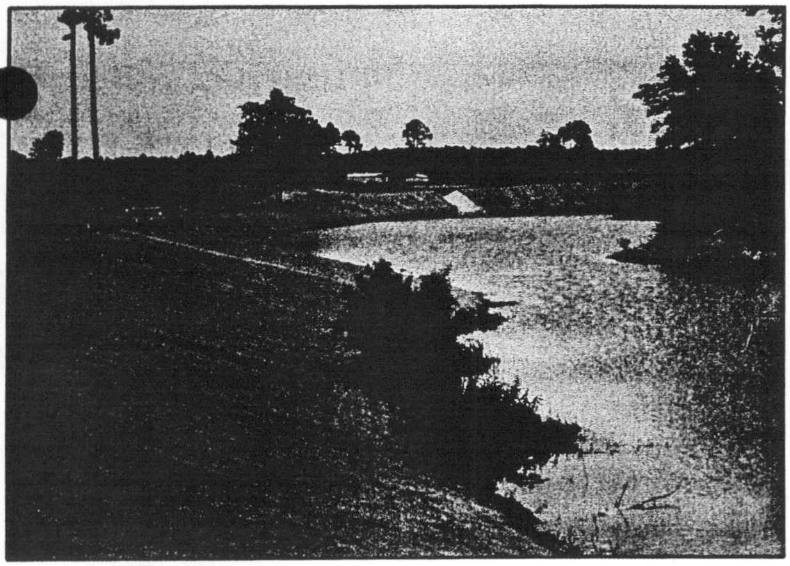
Downchutes

Input Data		
Mannings Coefficient	0.022	
Channel Slope	0.100000	ft/ft
Depth	0.25	ft
Left Side Slope	10.000000	H : V
Right Side Slope	10.000000	H : V
Bottom Width	7.50	ft

Results		
Discharge	17.69	cfs
Flow Area	2.45	ft²
Wetted Perimeter	12.44	ft
Top Width	12.42	ft
Critical Depth	0.45	ft
Critical Slope	0.010257	ft/ft
Velocity	7.23	ft/s
Velocity Head	0.81	ft
Specific Energy	1.06	ft
Froude Number	2.87	
Flow is supercritical.		

High flow velocity
- Sod w/ erosion control mat
- Heavy asphalt emulsion layer(s)

Curlex® QuickGrass



SPECIFICATION

A dyed green Aspen wood fiber mat constructed from curled excelsior, of which 80% is six-inches or longer in length. It has uniform color and consistent thickness, and the fibers are evenly distributed over the entire blanket. Each blanket is covered with a photodegradable, extruded plastic mesh and shall not contain any chemical additives.

Recommended Use:	Slopes to 1.5:1, Channels to 5 fps, Green color makes this product ideal for sensitive areas such as Landfills, Residential areas, Parks, etc.
Roll Sizes:	4'x 180', 4'x 112.5' 8'x 90'
Weight:	1.06 lbs./sq. yd.
Options:	Also available with a short 30-60 day life-cycle netting

Curlex® *III* (HV)

SPECIFICATION

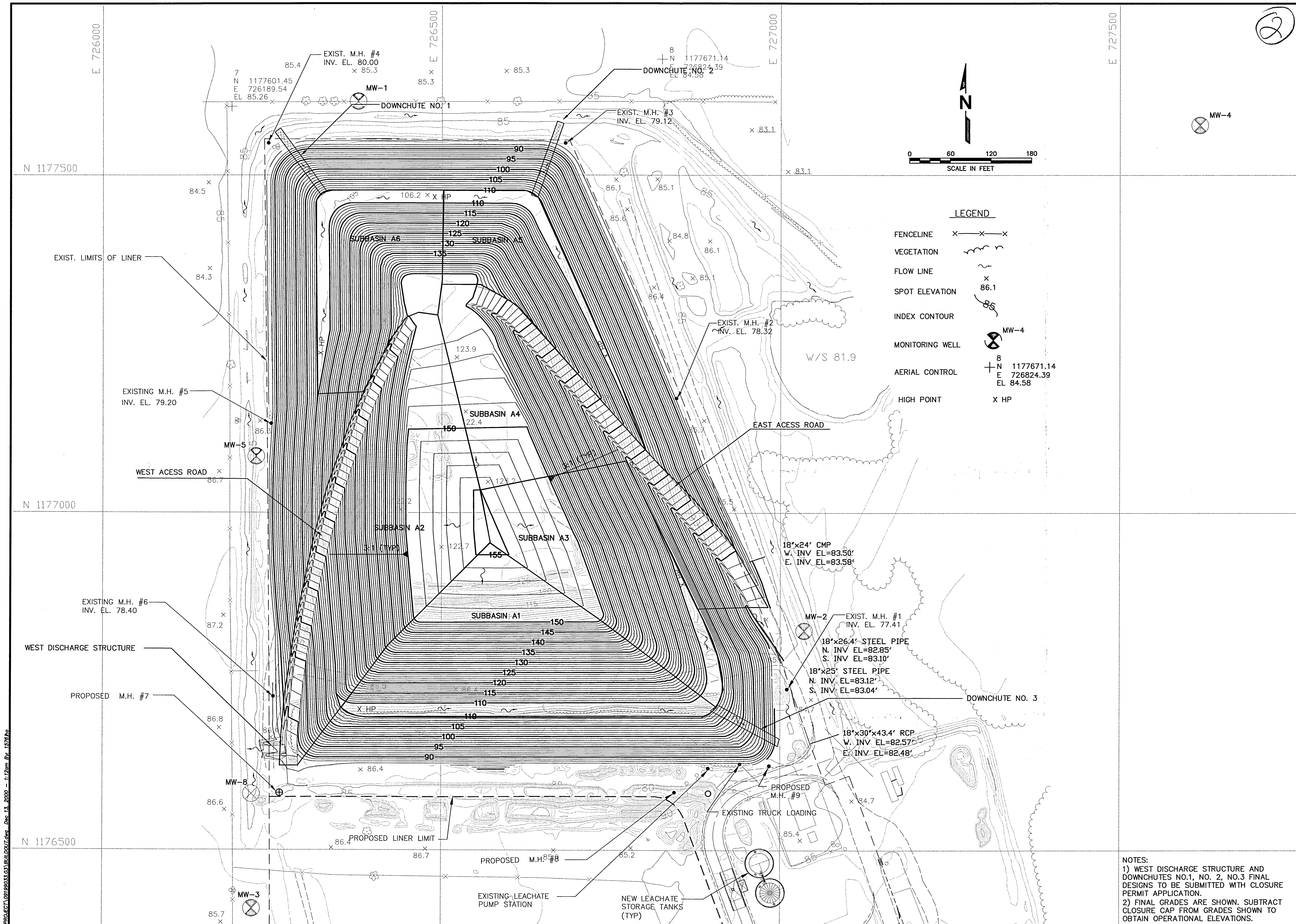
The excelsior blanket shall consist of a heavy weight construction of a machined, curled wood fiber, produced in a mat form. Fibers shall consist of 80% six-inch or longer fibers with consistent thickness and evenly distributed over its entire areas. Each side is covered with black, heavy-duty, extruded plastic mesh designed to last for years and reinforce the root system after the excelsior mat has decomposed. Material shall not contain any chemical additives.

Recommended Use:	Channels to 10 fps, Slopes needing long-term protection
Roll Sizes:	4'x 100', 8'x 50'
Weight:	1.62 lbs./sq. yd.

ATTACHMENT E

REVISED PERMIT OPERATIONS PLANS

(Refer to 24"x36" drawings)



NOTES:
1) WEST DISCHARGE STRUCTURE AND DOWNCHUTES NO.1, NO. 2, NO.3 FINAL DESIGNS TO BE SUBMITTED WITH CLOSURE PERMIT APPLICATION.
2) FINAL GRADES ARE SHOWN. SUBTRACT CLOSURE CAP FROM GRADES SHOWN TO OBTAIN OPERATIONAL ELEVATIONS.

REV.	DATE	DESCRIPTION	CK. BY

DRAWING TITLE: WATERSHED BASINS

PROJECT TITLE: MINOR OPERATIONAL FILL SEQUENCE REVISIONS

CLIENT: HARDEE COUNTY BOARD OF COUNTY COMMISIONERS

SCS ENGINEERS
STEARNS, CONRAD AND SCHMIDT CONSULTING ENGINEERS
3012 U.S. HWY. 301 NORTH, SUITE 700, TAMPA, FL 33619
PH (813) 621-0080 FAX NO. (813) 623-6757

PROJ. NO. 09199033.03 | DSN. BY: JHO | DWN. BY: JHO | CHK. BY: JHO | Q/A RVW BY: JHO/RJD | APP. BY: RJD

CADD FILE: BUILDOUT.DWG
DATE: December, 2000
SCALE: 1"=60'
DRAWING NO. 1 of 1