

October 10, 2000

Mr. Kim B. Ford, P.E.
Florida Department of Environmental Protection
Southwest District
Solid Waste Section
3804 Coconut Palm Drive
Tampa, FL 33619-8318

RE: Citrus County Central Landfill
Class I Landfill Geomembrane Remediation
Permit No. SO09-247381
JEA Project No.: 03860-003-01-1000

Dear Mr. Ford:

The purpose of this correspondence is to present a proposed plan which addresses the stress-cracked areas of geomembrane liner in the Citrus County Central Landfill. The proposed remediation plan is based on an investigation conducted by Dr. Ian D. Peggs, of I-CORP International, Inc. and engineering analysis performed by Jones, Edmunds & Associates, Inc. (JEA).

Dr. Peggs' investigation report, previously-submitted to your office, states that cracks appear in a portion of the apex-down folds and in areas adjacent to a few seams of the currently-exposed liner areas. To estimate the amount of potential leakage resulting from the cracked areas, JEA performed a hydrologic analysis using the HELP Model ("Hydrologic Evaluation of Landfill Performance, Version 3.01," Schroeder, 1994). As a conservative estimate, model conditions assume that a penetrating crack exists in every fold (apex-up and apex-down) and that each crack extends the entire length of the exposed liner slope that is currently exposed. These assumptions are conservative based on Peggs' investigations which revealed only 12 penetrating cracks which did not extend the entire length of slope. HELP model results show the leakage rate to be considerably greater than that expected with typical landfill operations. HELP model results are included as Attachment 1.

Due to potential high leakage rates, application of a soil cover over the exposed areas would not by itself provide an appropriate solution. Repair methods which include welding of the existing geomembrane material (as suggested by the liner manufacturer) were also rejected on Dr. Peggs recommendation that added thermal energy from seaming procedures may aggravate the stress cracking problem. Therefore, it appears that applying new material may be the most viable remediation alternative.

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Southwest District 7500

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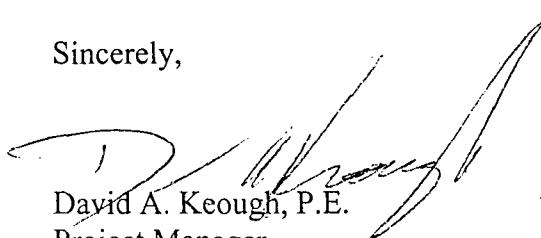
This alternative consists of using a geomembrane installer to place a new 60-mil HDPE geomembrane in the presently exposed liner areas, as shown in Drawing 1 (attached). Slope stability analyses to compare the factor of safety resulting from different geomembrane materials on the existing 2H:1V slope of smooth geomembrane have been performed. Results, provided as Attachment 2, show that a textured geomembrane liner would reduce the potential for material sloughing and slope failures when compared with a similar smooth geomembrane. Therefore, it is our recommendation that the proposed geomembrane consists of a 60-mil, HDPE, textured geomembrane. Please note that the proposed new material is composed of a different resin than that which was used for the original geomembrane material. As Dr. Peggs concluded in his investigative report, stress cracks were initiated due to the inadequacy of the antioxidant package incorporated into the geomembrane material. The proposed new geomembrane materials will contain a resin with improved oxidation resistance.

In addition, once a layer of solid waste is placed along the side slope, installation of a stormwater geomembrane is proposed. The stormwater geomembrane will provide erosion control and better leachate management.

We will advise the Department once arrangements for installation of the new liner are confirmed. It is anticipated that the time frame to fill the newly lined areas with solid waste to the level that will allow placement of the new stormwater liner and rain gutter will be between four and five months.

If you have any questions, please call me at 352/377-5821.

Sincerely,



David A. Keough, P.E.
Project Manager

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Attachments

XC: Susan Metcalfe, Citrus County

ATTACHMENT 1

**HELP MODEL RESULTS
AND SUPPORTING INFORMATION**

Citrus County Central Landfill
Geomembrane Liner Investigation

Comparison of HELP Model Results

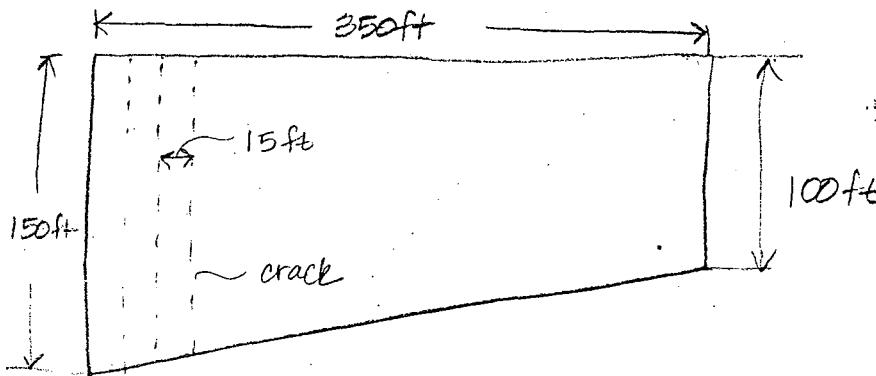
Model Condition	# holes/acre	Peak Leakage Rate (in/day)	Peak Leakage Rate (ft^3/day)
Conservative	953	0.157	5,697
Moderate	275	0.120	4,349
Standard	2	0.001	46

Notes:

- 1 - Area of each hole = 1 cm²
- 2 - See attached calculations for number of holes for conservative & moderate cases.
- 3 - Number of holes for standard case based on industry standard for installed liner.

PROBLEM: RELATE OPEN AREAS OF LINER CRACKS TO STANDARD HOLE AREA

ASSUMPTIONS: STANDARD LINER HOLE AREA = 1 cm^2
HORIZONTAL DISTANCE B/T CRACKS = 15 ft
Avg VERTICAL LENGTH OF CRACK = 125 ft
WIDTH OF CRACK = 0.01 cm



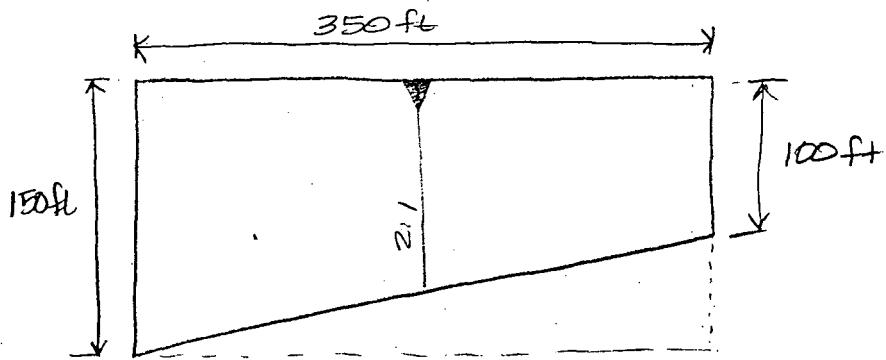
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$$\text{TOTAL NUMBER OF CRACKS} = \frac{350 \text{ ft}}{15 \text{ ft}} = 23.3 \Rightarrow \underline{\underline{25}}$$

$$\begin{aligned} \text{OPEN AREA OF 1 CRACK} &= \left(\frac{125 \text{ ft}}{0.01 \text{ cm}} \right) \left(\frac{30.48 \text{ cm}}{1 \text{ ft}} \right) \\ &= 38.1 \text{ cm}^2 \end{aligned}$$

$$\text{TOTAL OPEN AREA} = 25 (38.1 \text{ cm}^2) = \underline{\underline{952.5 \text{ cm}^2}}$$

PROBLEM: ESTIMATE LINER REMEDIATION AREA



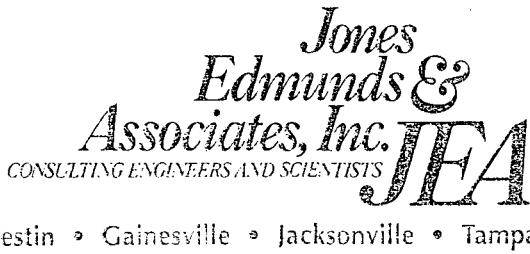
$$\text{AREA} = (150 \text{ ft})(350 \text{ ft}) - (0.5)(50 \text{ ft})(150 \text{ ft})$$

$$\text{AREA} = 43,750 \text{ ft}^2 \approx 1 \text{ ac}$$

→ SAME REMEDIATION AREA ON OPPOSITE SIDE
 OF LANDFILL

$$\Rightarrow \text{AREA} = 2(43,750 \text{ ft}^2)$$

$$\text{AREA} = 87,500 \text{ ft}^2 \approx \underline{\underline{90,000 \text{ ft}^2}}$$



PROJECT NUM: _____ SHEET ____ OF ____
 PROJECT NAME: CITRUS CO LINER INVEST.
 BY: JLD DATE: 10-4-00
 SUBJECT: LINER "CRACKS"
 CHECKED BY: _____ DATE: _____

PROBLEM: ESTIMATE LINER OPENINGS BASED ON IAN PEZZI'S INVESTIGATION REPORT & RELATE TO STANDARD HOLES IN LINER

REPORT INFO: NUMBER OF FULLY PENETRATING CRACKS = 12
 (PEZZI, 7/00)

ASSUMPTIONS: AVG VERTICAL LENGTH OF CRACK = 75 ft
 WIDTH OF CRACK = 0.01 cm
 STANDARD LINER HOLE AREA = 1 cm²

1) CALCULATE TOTAL AREA OF LINER OPENINGS (CRACKS)
 $A_T = N W L$

A_T = TOTAL AREA OF LINER OPENINGS
 N = NUMBER OF CRACKS
 W = WIDTH OF EACH CRACK
 L = LENGTH OF EACH CRACK

$$A_T = (12)(0.01 \text{ cm})(75 \text{ ft}) \left(\frac{30.5 \text{ cm}}{\text{ft}} \right)$$

$$A_T = 274.5 \text{ cm}^2$$

2) RELATE A_T TO NUMBER OF STANDARD HOLES (N_H)

$$N_H = \frac{274.5 \text{ cm}^2}{1 \text{ cm}^2} \approx \underline{\underline{275}}$$

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**
** HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE **
** HELP MODEL VERSION 3.07 (1 NOVEMBER 1997) **
** DEVELOPED BY ENVIRONMENTAL LABORATORY **
** USAE WATERWAYS EXPERIMENT STATION **
** FOR USEPA RISK REDUCTION ENGINEERING LABORATORY **
**

PRECIPITATION DATA FILE: C:\HELP3\CITRUS4.D4
TEMPERATURE DATA FILE: C:\HELP3\CITRUS7.D7
SOLAR RADIATION DATA FILE: C:\HELP3\CITRUS13.D13
EVAPOTRANSPIRATION DATA: C:\HELP3\CITRUS11.D11
SOIL AND DESIGN DATA FILE: C:\HELP3\950DEF.D10
OUTPUT DATA FILE: C:\HELP3\950def.OUT

TIME: 16:58 DATE: 9/29/2000

TITLE: Citrus County Liner - Solid Waste Fill -Average Slope Length
CONSERVATIVE CASE

NOTE: INITIAL MOISTURE CONTENT OF THE LAYERS AND SNOW WATER WERE
COMPUTED AS NEARLY STEADY-STATE VALUES BY THE PROGRAM.

LAYER 1

TYPE 1 - VERTICAL PERCOLATION LAYER
MATERIAL TEXTURE NUMBER 5

THICKNESS	=	6.00 INCHES
POROSITY	=	0.4570 VOL/VOL
FIELD CAPACITY	=	0.1310 VOL/VOL
WILTING POINT	=	0.0580 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.1084 VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.10000005000E-02 CM/SEC

NOTE: SATURATED HYDRAULIC CONDUCTIVITY IS MULTIPLIED BY 3.00
FOR ROOT CHANNELS IN TOP HALF OF EVAPORATIVE ZONE.

LAYER 2

TYPE 1 - VERTICAL PERCOLATION LAYER
MATERIAL TEXTURE NUMBER 18

THICKNESS	=	840.00	INCHES
POROSITY	=	0.6710	VOL/VOL
FIELD CAPACITY	=	0.2920	VOL/VOL
WILTING POINT	=	0.0770	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.2896	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.10000005000E-02	CM/SEC

LAYER 3

TYPE 2 - LATERAL DRAINAGE LAYER
MATERIAL TEXTURE NUMBER 2

THICKNESS	=	24.00	INCHES
POROSITY	=	0.4370	VOL/VOL
FIELD CAPACITY	=	0.0620	VOL/VOL
WILTING POINT	=	0.0240	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0786	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.579999993000E-02	CM/SEC
SLOPE	=	50.00	PERCENT
DRAINAGE LENGTH	=	134.0	FEET

LAYER 4

TYPE 4 - FLEXIBLE MEMBRANE LINER
MATERIAL TEXTURE NUMBER 35

THICKNESS	=	0.06	INCHES
POROSITY	=	0.0000	VOL/VOL
FIELD CAPACITY	=	0.0000	VOL/VOL
WILTING POINT	=	0.0000	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0000	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.199999996000E-12	CM/SEC
FML PINHOLE DENSITY	=	0.00	HOLES/ACRE
FML INSTALLATION DEFECTS	=	950.00	HOLES/ACRE
FML PLACEMENT QUALITY	=	4 - POOR	

GENERAL DESIGN AND EVAPORATIVE ZONE DATA

NOTE: SCS RUNOFF CURVE NUMBER WAS USER-SPECIFIED.

SCS RUNOFF CURVE NUMBER	=	50.00	
FRACTION OF AREA ALLOWING RUNOFF	=	100.0	PERCENT
AREA PROJECTED ON HORIZONTAL PLANE	=	10.000	ACRES
EVAPORATIVE ZONE DEPTH	=	22.0	INCHES
INITIAL WATER IN EVAPORATIVE ZONE	=	3.335	INCHES
UPPER LIMIT OF EVAPORATIVE STORAGE	=	13.478	INCHES
LOWER LIMIT OF EVAPORATIVE STORAGE	=	1.580	INCHES
INITIAL SNOW WATER	=	0.000	INCHES
INITIAL WATER IN LAYER MATERIALS	=	245.829	INCHES
TOTAL INITIAL WATER	=	245.829	INCHES
TOTAL SUBSURFACE INFLOW	=	0.00	INCHES/YEAR

EVAPOTRANSPIRATION AND WEATHER DATA

NOTE: EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
TAMPA FLORIDA

STATION LATITUDE	=	27.58 DEGREES
MAXIMUM LEAF AREA INDEX	=	2.00
START OF GROWING SEASON (JULIAN DATE)	=	0
END OF GROWING SEASON (JULIAN DATE)	=	367
EVAPORATIVE ZONE DEPTH	=	22.0 INCHES
AVERAGE ANNUAL WIND SPEED	=	8.60 MPH
AVERAGE 1ST QUARTER RELATIVE HUMIDITY	=	74.00 %
AVERAGE 2ND QUARTER RELATIVE HUMIDITY	=	72.00 %
AVERAGE 3RD QUARTER RELATIVE HUMIDITY	=	78.00 %
AVERAGE 4TH QUARTER RELATIVE HUMIDITY	=	76.00 %

NOTE: PRECIPITATION DATA FOR TAMPA FLORIDA
WAS ENTERED FROM THE DEFAULT DATA FILE.

NOTE: TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR TAMPA FLORIDA

NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
-----	-----	-----	-----	-----	-----
59.80	60.80	66.20	71.60	77.10	80.90
82.20	82.20	80.90	74.50	66.70	61.30

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR TAMPA FLORIDA
AND STATION LATITUDE = 27.58 DEGREES

ANNUAL TOTALS FOR YEAR 1974

	INCHES	CU. FEET	PERCENT
PRECIPITATION	33.90	1230569.870	100.00
RUNOFF	0.207	7499.246	0.61
EVAPOTRANSPIRATION	29.074	1055369.870	85.76
DRAINAGE COLLECTED FROM LAYER 3	0.1855	6735.255	0.55
PERC./LEAKAGE THROUGH LAYER 4	4.290434	155742.766	12.66
AVG. HEAD ON TOP OF LAYER 4	0.0052		
CHANGE IN WATER STORAGE	0.144	5223.775	0.42
SOIL WATER AT START OF YEAR	246.573	8950607.000	
SOIL WATER AT END OF YEAR	246.717	8955831.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	-0.969	0.00

ANNUAL TOTALS FOR YEAR 1975

	INCHES	CU. FEET	PERCENT
PRECIPITATION	43.44	1576871.500	100.00
RUNOFF	0.000	0.000	0.00
EVAPOTRANSPIRATION	40.143	1457192.870	92.41
DRAINAGE COLLECTED FROM LAYER 3	0.1334	4843.349	0.31
PERC./LEAKAGE THROUGH LAYER 4	3.165879	114921.414	7.29
AVG. HEAD ON TOP OF LAYER 4	0.0039		

CHANGE IN WATER STORAGE	-0.002	-85.854	-0.01
SOIL WATER AT START OF YEAR	246.717	8955831.000	
SOIL WATER AT END OF YEAR	246.715	8955745.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	-0.268	0.00

ANNUAL TOTALS FOR YEAR 1976

	INCHES	CU. FEET	PERCENT
PRECIPITATION	41.73	1514799.120	100.00
RUNOFF	0.000	0.000	0.00
EVAPOTRANSPIRATION	42.911	1557683.620	102.83
DRAINAGE COLLECTED FROM LAYER 3	0.0096	348.717	0.02
PERC./LEAKAGE THROUGH LAYER 4	0.501326	18198.117	1.20
AVG. HEAD ON TOP OF LAYER 4	0.0005		
CHANGE IN WATER STORAGE	-1.692	-61431.836	-4.06
SOIL WATER AT START OF YEAR	246.715	8955745.000	
SOIL WATER AT END OF YEAR	245.022	8894313.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.446	0.00

ANNUAL TOTALS FOR YEAR 1977

INCHES	CU. FEET	PERCENT
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PRECIPITATION	32.03	1162689.250	100.00
RUNOFF	0.000	0.000	0.00
EVAPOTRANSPIRATION	29.255	1061961.750	91.34
DRAINAGE COLLECTED FROM LAYER 3	0.0020	74.084	0.01
PERC./LEAKAGE THROUGH LAYER 4	0.146270	5309.605	0.46
AVG. HEAD ON TOP OF LAYER 4	0.0001		
CHANGE IN WATER STORAGE	2.627	95344.000	8.20
SOIL WATER AT START OF YEAR	245.022	8894313.000	
SOIL WATER AT END OF YEAR	247.649	8989657.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	-0.186	0.00

ANNUAL TOTALS FOR YEAR 1978

	INCHES	CU. FEET	PERCENT
PRECIPITATION	39.85	1446554.750	100.00
RUNOFF	0.000	0.000	0.00
EVAPOTRANSPIRATION	37.746	1370187.870	94.72
DRAINAGE COLLECTED FROM LAYER 3	0.1117	4053.679	0.28
PERC./LEAKAGE THROUGH LAYER 4	2.862452	103906.992	7.18
AVG. HEAD ON TOP OF LAYER 4	0.0033		
CHANGE IN WATER STORAGE	-0.870	-31593.562	-2.18
SOIL WATER AT START OF YEAR	247.649	8989657.000	
SOIL WATER AT END OF YEAR	246.779	8958064.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00

ANNUAL WATER BUDGET BALANCE 0.0000 -0.216 0.00

AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1974 THROUGH 1978

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	1.46 5.24	2.16 5.54	1.65 5.78	0.98 2.07	3.41 0.76	6.80 2.34
STD. DEVIATIONS	1.35 1.27	1.88 1.10	0.75 3.22	0.53 2.05	3.13 0.89	4.89 1.10
RUNOFF						
TOTALS	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.041 0.000
STD. DEVIATIONS	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.092 0.000
EVAPOTRANSPIRATION						
TOTALS	1.279 6.340	2.558 5.326	2.197 4.822	1.336 2.295	2.598 1.313	4.652 1.111
STD. DEVIATIONS	0.702 0.986	0.680 0.746	1.372 0.820	0.516 1.963	2.090 0.848	2.362 0.318
LATERAL DRAINAGE COLLECTED FROM LAYER 3						
TOTALS	0.0006 0.0133	0.0052 0.0222	0.0153 0.0016	0.0017 0.0064	0.0006 0.0199	0.0004 0.0013
STD. DEVIATIONS	0.0007 0.0290	0.0105 0.0489	0.0333 0.0022	0.0031 0.0125	0.0009 0.0435	0.0004 0.0020
PERCOLATION/LEAKAGE THROUGH LAYER 4						
TOTALS	0.0340 0.2969	0.1411 0.4946	0.3555 0.0667	0.0726 0.1641	0.0327 0.4538	0.0222 0.0589
STD. DEVIATIONS	0.0289 0.6172	0.2548 1.0618	0.7403 0.0855	0.1194 0.2761	0.0357 0.9534	0.0183 0.0835

AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)

DAILY AVERAGE HEAD ON TOP OF LAYER 4

AVERAGES	0.0004	0.0020	0.0052	0.0007	0.0004	0.0003
	0.0045	0.0074	0.0007	0.0023	0.0069	0.0006
STD. DEVIATIONS	0.0003	0.0038	0.0109	0.0011	0.0004	0.0002
	0.0095	0.0160	0.0009	0.0041	0.0147	0.0007

AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1974 THROUGH 1978

	INCHES	CU. FEET	PERCENT
PRECIPITATION	38.19 (4.980)	1386296.7	100.00
RUNOFF	0.041 (0.0924)	1499.85	0.108
EVAPOTRANSPIRATION	35.826 (6.3502)	1300479.25	93.810
LATERAL DRAINAGE COLLECTED FROM LAYER 3	0.08846 (0.08011)	3211.017	0.23163
PERCOLATION/LEAKAGE THROUGH LAYER 4	2.19327 (1.79198)	79615.781	5.74305
AVERAGE HEAD ON TOP OF LAYER 4	0.003 (0.002)		
CHANGE IN WATER STORAGE	0.041 (1.6227)	1491.30	0.108

PEAK DAILY VALUES FOR YEARS 1974 THROUGH 1978

	(INCHES)	(CU. FT.)
PRECIPITATION	5.47	198561.000
RUNOFF	0.207	7499.2456
DRAINAGE COLLECTED FROM LAYER 3	0.00858	311.27985
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.156935	5696.75439
AVERAGE HEAD ON TOP OF LAYER 4	0.087	
MAXIMUM HEAD ON TOP OF LAYER 4	0.182	
LOCATION OF MAXIMUM HEAD IN LAYER 3 (DISTANCE FROM DRAIN)	0.0 FEET	
SNOW WATER	0.00	0.0000
MAXIMUM VEG. SOIL WATER (VOL/VOL)	0.4762	
MINIMUM VEG. SOIL WATER (VOL/VOL)	0.0718	

*** Maximum heads are computed using McEnroe's equations. ***

Reference: Maximum Saturated Depth over Landfill Liner
by Bruce M. McEnroe, University of Kansas
ASCE Journal of Environmental Engineering
Vol. 119, No. 2, March 1993, pp. 262-270.

FINAL WATER STORAGE AT END OF YEAR 1978

LAYER	(INCHES)	(VOL/VOL)
1	1.2132	0.2022
2	243.0350	0.2893
3	1.7864	0.0744
4	0.0000	0.0000
SNOW WATER	0.000	

D.E.P
OCT 12 2007
Southwest District Ranger

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** HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE
** HELP MODEL VERSION 3.07 (1 NOVEMBER 1997)
** DEVELOPED BY ENVIRONMENTAL LABORATORY
** USAE WATERWAYS EXPERIMENT STATION
** FOR USEPA RISK REDUCTION ENGINEERING LABORATORY
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PRECIPITATION DATA FILE: C:\HELP3\CITRUS4.D4
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EVAPOTRANSPIRATION DATA: C:\HELP3\CITRUS11.D11
SOIL AND DESIGN DATA FILE: C:\HELP3\275DEF.D10
OUTPUT DATA FILE: C:\HELP3\275def.OUT

TIME: 13:14 DATE: 10/ 4/2000

TITLE: Citrus County Liner - Solid Waste Fill -Average Slope Length

Moderate Case

NOTE: INITIAL MOISTURE CONTENT OF THE LAYERS AND SNOW WATER WERE COMPUTED AS NEARLY STEADY-STATE VALUES BY THE PROGRAM.

LAYER 1

TYPE 1 - VERTICAL PERCOLATION LAYER

MATERIAL TEXTURE NUMBER 5

THICKNESS	=	6.00	INCHES
POROSITY	=	0.4570	VOL/VOL
FIELD CAPACITY	=	0.1310	VOL/VOL
WILTING POINT	=	0.0580	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.1084	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.10000005000E-02	CM/SEC

NOTE: SATURATED HYDRAULIC CONDUCTIVITY IS MULTIPLIED BY 3.00 FOR ROOT CHANNELS IN TOP HALF OF EVAPORATIVE ZONE.

LAYER 2

TYPE 1 - VERTICAL PERCOLATION LAYER
MATERIAL TEXTURE NUMBER 18

THICKNESS	=	840.00	INCHES
POROSITY	=	0.6710	VOL/VOL
FIELD CAPACITY	=	0.2920	VOL/VOL
WILTING POINT	=	0.0770	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.2896	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.10000005000E-02	CM/SEC

LAYER 3

TYPE 2 - LATERAL DRAINAGE LAYER
MATERIAL TEXTURE NUMBER 2

THICKNESS	=	24.00	INCHES
POROSITY	=	0.4370	VOL/VOL
FIELD CAPACITY	=	0.0620	VOL/VOL
WILTING POINT	=	0.0240	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0786	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.579999993000E-02	CM/SEC
SLOPE	=	50.00	PERCENT
DRAINAGE LENGTH	=	134.0	FEET

LAYER 4

TYPE 4 - FLEXIBLE MEMBRANE LINER
MATERIAL TEXTURE NUMBER 35

THICKNESS	=	0.06	INCHES
POROSITY	=	0.0000	VOL/VOL
FIELD CAPACITY	=	0.0000	VOL/VOL
WILTING POINT	=	0.0000	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0000	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.199999996000E-12	CM/SEC
FML PINHOLE DENSITY	=	0.00	HOLLES/ACRE
FML INSTALLATION DEFECTS	=	275.00	HOLLES/ACRE
FML PLACEMENT QUALITY	=	4 - POOR	

GENERAL DESIGN AND EVAPORATIVE ZONE DATA

NOTE: SCS RUNOFF CURVE NUMBER WAS USER-SPECIFIED.

SCS RUNOFF CURVE NUMBER	=	50.00	
FRACTION OF AREA ALLOWING RUNOFF	=	100.0	PERCENT
AREA PROJECTED ON HORIZONTAL PLANE	=	10.000	ACRES
EVAPORATIVE ZONE DEPTH	=	22.0	INCHES
INITIAL WATER IN EVAPORATIVE ZONE	=	3.335	INCHES
UPPER LIMIT OF EVAPORATIVE STORAGE	=	13.478	INCHES
LOWER LIMIT OF EVAPORATIVE STORAGE	=	1.580	INCHES
INITIAL SNOW WATER	=	0.000	INCHES
INITIAL WATER IN LAYER MATERIALS	=	245.829	INCHES
TOTAL INITIAL WATER	=	245.829	INCHES
TOTAL SUBSURFACE INFLOW	=	0.00	INCHES/YEAR

EVAPOTRANSPIRATION AND WEATHER DATA

NOTE: EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
TAMPA FLORIDA

STATION LATITUDE	=	27.58	DEGREES
MAXIMUM LEAF AREA INDEX	=	2.00	
START OF GROWING SEASON (JULIAN DATE)	=	0	
END OF GROWING SEASON (JULIAN DATE)	=	367	
EVAPORATIVE ZONE DEPTH	=	22.0	INCHES
AVERAGE ANNUAL WIND SPEED	=	8.60	MPH
AVERAGE 1ST QUARTER RELATIVE HUMIDITY	=	74.00	%
AVERAGE 2ND QUARTER RELATIVE HUMIDITY	=	72.00	%
AVERAGE 3RD QUARTER RELATIVE HUMIDITY	=	78.00	%
AVERAGE 4TH QUARTER RELATIVE HUMIDITY	=	76.00	%

NOTE: PRECIPITATION DATA FOR TAMPA FLORIDA
WAS ENTERED FROM THE DEFAULT DATA FILE.

NOTE: TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR TAMPA FLORIDA

NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
-----	-----	-----	-----	-----	-----
59.80	60.80	66.20	71.60	77.10	80.90
82.20	82.20	80.90	74.50	66.70	61.30

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR TAMPA FLORIDA
AND STATION LATITUDE = 27.58 DEGREES

ANNUAL TOTALS FOR YEAR 1974

	INCHES	CU. FEET	PERCENT
PRECIPITATION	33.90	1230569.870	100.00
RUNOFF	0.207	7499.246	0.61
EVAPOTRANSPIRATION	29.074	1055369.870	85.76
DRAINAGE COLLECTED FROM LAYER 3	0.7595	27571.320	2.24
PERC./LEAKAGE THROUGH LAYER 4	3.716438	134906.703	10.96
Avg. HEAD ON TOP OF LAYER 4	0.0208		
CHANGE IN WATER STORAGE	0.144	5223.775	0.42
SOIL WATER AT START OF YEAR	246.573	8950615.000	
SOIL WATER AT END OF YEAR	246.717	8955839.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	-0.969	0.00

ANNUAL TOTALS FOR YEAR 1975

	INCHES	CU. FEET	PERCENT
PRECIPITATION	43.44	1576871.500	100.00
RUNOFF	0.000	0.000	0.00
EVAPOTRANSPIRATION	40.143	1457192.870	92.41
DRAINAGE COLLECTED FROM LAYER 3	0.5483	19904.799	1.26
PERC./LEAKAGE THROUGH LAYER 4	2.751010	99861.664	6.33
Avg. HEAD ON TOP OF LAYER 4	0.0154		

CHANGE IN WATER STORAGE	-0.002	-87.515	-0.01
SOIL WATER AT START OF YEAR	246.717	8955839.000	
SOIL WATER AT END OF YEAR	246.715	8955751.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	-0.303	0.00

ANNUAL TOTALS FOR YEAR 1976

	INCHES	CU. FEET	PERCENT
PRECIPITATION	41.73	1514799.120	100.00
RUNOFF	0.000	0.000	0.00
EVAPOTRANSPIRATION	42.911	1557683.620	102.83
DRAINAGE COLLECTED FROM LAYER 3	0.0313	1137.900	0.08
PERC./LEAKAGE THROUGH LAYER 4	0.479595	17409.293	1.15
AVG. HEAD ON TOP OF LAYER 4	0.0009		
CHANGE IN WATER STORAGE	-1.692	-61432.387	-4.06
SOIL WATER AT START OF YEAR	246.715	8955751.000	
SOIL WATER AT END OF YEAR	245.023	8894319.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.642	0.00

ANNUAL TOTALS FOR YEAR 1977

INCHES	CU. FEET	PERCENT
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PRECIPITATION	32.03	1162689.250	100.00
RUNOFF	0.000	0.000	0.00
EVAPOTRANSPIRATION	29.255	1061961.750	91.34
DRAINAGE COLLECTED FROM LAYER 3	0.0062	223.414	0.02
PERC./LEAKAGE THROUGH LAYER 4	0.142343	5167.036	0.44
AVG. HEAD ON TOP OF LAYER 4	0.0002		
CHANGE IN WATER STORAGE	2.626	95337.906	8.20
SOIL WATER AT START OF YEAR	245.023	8894319.000	
SOIL WATER AT END OF YEAR	247.649	8989657.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	-0.853	0.00

ANNUAL TOTALS FOR YEAR 1978

	INCHES	CU. FEET	PERCENT
PRECIPITATION	39.85	1446554.750	100.00
RUNOFF	0.000	0.000	0.00
EVAPOTRANSPIRATION	37.746	1370187.870	94.72
DRAINAGE COLLECTED FROM LAYER 3	0.4559	16549.777	1.14
PERC./LEAKAGE THROUGH LAYER 4	2.518106	91407.266	6.32
AVG. HEAD ON TOP OF LAYER 4	0.0128		
CHANGE IN WATER STORAGE	-0.870	-31590.238	-2.18
SOIL WATER AT START OF YEAR	247.649	8989657.000	
SOIL WATER AT END OF YEAR	246.779	8958066.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00

ANNUAL WATER BUDGET BALANCE 0.0000 0.095 0.00

AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1974 THROUGH 1978

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	1.46 5.24	2.16 5.54	1.65 5.78	0.98 2.07	3.41 0.76	6.80 2.34
STD. DEVIATIONS	1.35 1.27	1.88 1.10	0.75 3.22	0.53 2.05	3.13 0.89	4.89 1.10
RUNOFF						
TOTALS	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.041 0.000
STD. DEVIATIONS	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.092 0.000
EVAPOTRANSPIRATION						
TOTALS	1.279 6.340	2.558 5.326	2.197 4.822	1.336 2.295	2.598 1.313	4.652 1.111
STD. DEVIATIONS	0.702 0.986	0.680 0.746	1.372 0.820	0.516 1.963	2.090 0.848	2.362 0.318
LATERAL DRAINAGE COLLECTED FROM LAYER 3						
TOTALS	0.0021 0.0525	0.0209 0.0935	0.0624 0.0058	0.0072 0.0237	0.0021 0.0840	0.0012 0.0050
STD. DEVIATIONS	0.0023 0.1150	0.0433 0.2068	0.1367 0.0088	0.0141 0.0470	0.0029 0.1842	0.0013 0.0087
PERCOLATION/LEAKAGE THROUGH LAYER 4						
TOTALS	0.0326 0.2465	0.1243 0.4332	0.3074 0.0634	0.0693 0.1359	0.0313 0.4001	0.0214 0.0562
STD. DEVIATIONS	0.0274 0.5062	0.2195 0.9268	0.6345 0.0807	0.1133 0.2170	0.0337 0.8354	0.0174 0.0790

AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)

DAILY AVERAGE HEAD ON TOP OF LAYER 4

AVERAGES	0.0007	0.0076	0.0205	0.0025	0.0007	0.0004
	0.0173	0.0307	0.0020	0.0078	0.0285	0.0016
STD. DEVIATIONS	0.0007	0.0157	0.0449	0.0048	0.0010	0.0004
	0.0378	0.0680	0.0030	0.0155	0.0626	0.0028

AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1974 THROUGH 1978

	INCHES	CU. FEET	PERCENT
PRECIPITATION	38.19 (4.980)	1386296.7	100.00
RUNOFF	0.041 (0.0924)	1499.85	0.108
EVAPOTRANSPIRATION	35.826 (6.3502)	1300479.25	93.810
LATERAL DRAINAGE COLLECTED FROM LAYER 3	0.36026 (0.33073)	13077.442	0.94334
PERCOLATION/LEAKAGE THROUGH LAYER 4	1.92150 (1.54194)	69750.398	5.03142
AVERAGE HEAD ON TOP OF LAYER 4	0.010 (0.009)		
CHANGE IN WATER STORAGE	0.041 (1.6226)	1490.31	0.108

PEAK DAILY VALUES FOR YEARS 1974 THROUGH 1978

	(INCHES)	(CU. FT.)
PRECIPITATION	5.47	198561.000
RUNOFF	0.207	7499.2456
DRAINAGE COLLECTED FROM LAYER 3	0.03046	1105.72412
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.119820	4349.44824
AVERAGE HEAD ON TOP OF LAYER 4	0.310	
MAXIMUM HEAD ON TOP OF LAYER 4	0.625	
LOCATION OF MAXIMUM HEAD IN LAYER 3 (DISTANCE FROM DRAIN)	0.0 FEET	
SNOW WATER	0.00	0.0000
MAXIMUM VEG. SOIL WATER (VOL/VOL)	0.4762	
MINIMUM VEG. SOIL WATER (VOL/VOL)	0.0718	

*** Maximum heads are computed using McEnroe's equations. ***

Reference: Maximum Saturated Depth over Landfill Liner
 by Bruce M. McEnroe, University of Kansas
 ASCE Journal of Environmental Engineering
 Vol. 119, No. 2, March 1993, pp. 262-270.

FINAL WATER STORAGE AT END OF YEAR 1978

LAYER	(INCHES)	(VOL/VOL)
1	1.2132	0.2022
2	243.0350	0.2893
3	1.7865	0.0744
4	0.0000	0.0000
SNOW WATER	0.000	

**
**
** HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE **
** HELP MODEL VERSION 3.07 (1 NOVEMBER 1997) **
** DEVELOPED BY ENVIRONMENTAL LABORATORY **
** USAE WATERWAYS EXPERIMENT STATION **
** FOR USEPA RISK REDUCTION ENGINEERING LABORATORY **
**

PRECIPITATION DATA FILE: C:\HELP3\CITRUS4.D4
TEMPERATURE DATA FILE: C:\HELP3\CITRUS7.D7
SOLAR RADIATION DATA FILE: C:\HELP3\CITRUS13.D13
EVAPOTRANSPIRATION DATA: C:\HELP3\CITRUS11.D11
SOIL AND DESIGN DATA FILE: C:\HELP3\2DEF.D10
OUTPUT DATA FILE: C:\HELP3\2def.OUT

TIME: 14:16 DATE: 10/ 4/2000

TITLE: Citrus County Liner - Solid Waste Fill -Average Slope Length

STANDARD CASE

NOTE: INITIAL MOISTURE CONTENT OF THE LAYERS AND SNOW WATER WERE
COMPUTED AS NEARLY STEADY-STATE VALUES BY THE PROGRAM.

LAYER 1

TYPE 1 - VERTICAL PERCOLATION LAYER
MATERIAL TEXTURE NUMBER 5

THICKNESS	=	6.00 INCHES
POROSITY	=	0.4570 VOL/VOL
FIELD CAPACITY	=	0.1310 VOL/VOL
WILTING POINT	=	0.0580 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.1084 VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.10000005000E-02 CM/SEC

NOTE: SATURATED HYDRAULIC CONDUCTIVITY IS MULTIPLIED BY 3.00
FOR ROOT CHANNELS IN TOP HALF OF EVAPORATIVE ZONE.

LAYER 2

TYPE 1 - VERTICAL PERCOLATION LAYER
MATERIAL TEXTURE NUMBER 18

THICKNESS	=	840.00	INCHES
POROSITY	=	0.6710	VOL/VOL
FIELD CAPACITY	=	0.2920	VOL/VOL
WILTING POINT	=	0.0770	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.2896	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.10000005000E-02	CM/SEC

LAYER 3

TYPE 2 - LATERAL DRAINAGE LAYER
MATERIAL TEXTURE NUMBER 2

THICKNESS	=	24.00	INCHES
POROSITY	=	0.4370	VOL/VOL
FIELD CAPACITY	=	0.0620	VOL/VOL
WILTING POINT	=	0.0240	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0788	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.579999993000E-02	CM/SEC
SLOPE	=	50.00	PERCENT
DRAINAGE LENGTH	=	134.0	FEET

LAYER 4

TYPE 4 - FLEXIBLE MEMBRANE LINER
MATERIAL TEXTURE NUMBER 35

THICKNESS	=	0.06	INCHES
POROSITY	=	0.0000	VOL/VOL
FIELD CAPACITY	=	0.0000	VOL/VOL
WILTING POINT	=	0.0000	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0000	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.199999996000E-12	CM/SEC
FML PINHOLE DENSITY	=	1.00	HOLES/ACRE
FML INSTALLATION DEFECTS	=	1.00	HOLES/ACRE
FML PLACEMENT QUALITY	=	3 - GOOD	

GENERAL DESIGN AND EVAPORATIVE ZONE DATA

NOTE: SCS RUNOFF CURVE NUMBER WAS USER-SPECIFIED.

SCS RUNOFF CURVE NUMBER	=	50.00	
FRACTION OF AREA ALLOWING RUNOFF	=	100.0	PERCENT
AREA PROJECTED ON HORIZONTAL PLANE	=	10.000	ACRES
EVAPORATIVE ZONE DEPTH	=	22.0	INCHES
INITIAL WATER IN EVAPORATIVE ZONE	=	3.335	INCHES
UPPER LIMIT OF EVAPORATIVE STORAGE	=	13.478	INCHES
LOWER LIMIT OF EVAPORATIVE STORAGE	=	1.580	INCHES
INITIAL SNOW WATER	=	0.000	INCHES
INITIAL WATER IN LAYER MATERIALS	=	245.833	INCHES
TOTAL INITIAL WATER	=	245.833	INCHES
TOTAL SUBSURFACE INFLOW	=	0.00	INCHES/YEAR

EVAPOTRANSPIRATION AND WEATHER DATA

NOTE: EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
TAMPA FLORIDA

STATION LATITUDE	=	27.58 DEGREES
MAXIMUM LEAF AREA INDEX	=	2.00
START OF GROWING SEASON (JULIAN DATE)	=	0
END OF GROWING SEASON (JULIAN DATE)	=	367
EVAPORATIVE ZONE DEPTH	=	22.0 INCHES
AVERAGE ANNUAL WIND SPEED	=	8.60 MPH
AVERAGE 1ST QUARTER RELATIVE HUMIDITY	=	74.00 %
AVERAGE 2ND QUARTER RELATIVE HUMIDITY	=	72.00 %
AVERAGE 3RD QUARTER RELATIVE HUMIDITY	=	78.00 %
AVERAGE 4TH QUARTER RELATIVE HUMIDITY	=	76.00 %

NOTE: PRECIPITATION DATA FOR TAMPA FLORIDA
WAS ENTERED FROM THE DEFAULT DATA FILE.

NOTE: TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR TAMPA FLORIDA

NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
-----	-----	-----	-----	-----	-----
59.80	60.80	66.20	71.60	77.10	80.90
82.20	82.20	80.90	74.50	66.70	61.30

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR TAMPA FLORIDA
AND STATION LATITUDE = 27.58 DEGREES

ANNUAL TOTALS FOR YEAR 1974

	INCHES	CU. FEET	PERCENT
PRECIPITATION	33.90	1230569.870	100.00
RUNOFF	0.207	7499.246	0.61
EVAPOTRANSPIRATION	29.074	1055369.870	85.76
DRAINAGE COLLECTED FROM LAYER 3	4.4173	160347.875	13.03
PERC./LEAKAGE THROUGH LAYER 4	0.058687	2130.330	0.17
AVG. HEAD ON TOP OF LAYER 4	0.1214		
CHANGE IN WATER STORAGE	0.144	5223.221	0.42
SOIL WATER AT START OF YEAR	246.577	8950754.000	
SOIL WATER AT END OF YEAR	246.721	8955977.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	-0.595	0.00

ANNUAL TOTALS FOR YEAR 1975

	INCHES	CU. FEET	PERCENT
PRECIPITATION	43.44	1576871.500	100.00
RUNOFF	0.000	0.000	0.00
EVAPOTRANSPIRATION	40.143	1457192.870	92.41
DRAINAGE COLLECTED FROM LAYER 3	3.2443	117769.867	7.47
PERC./LEAKAGE THROUGH LAYER 4	0.044475	1614.427	0.10
AVG. HEAD ON TOP OF LAYER 4	0.0912		

CHANGE IN WATER STORAGE	0.008	294.672	0.02
SOIL WATER AT START OF YEAR	246.721	8955977.000	
SOIL WATER AT END OF YEAR	246.729	8956272.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	-0.328	0.00

ANNUAL TOTALS FOR YEAR 1976

	INCHES	CU. FEET	PERCENT
PRECIPITATION	41.73	1514799.120	100.00
RUNOFF	0.000	0.000	0.00
EVAPOTRANSPIRATION	42.911	1557683.620	102.83
DRAINAGE COLLECTED FROM LAYER 3	0.5071	18408.816	1.22
PERC./LEAKAGE THROUGH LAYER 4	0.015154	550.074	0.04
Avg. HEAD ON TOP OF LAYER 4	0.0141		
CHANGE IN WATER STORAGE	-1.704	-61843.930	-4.08
SOIL WATER AT START OF YEAR	246.729	8956272.000	
SOIL WATER AT END OF YEAR	245.026	8894428.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.488	0.00

ANNUAL TOTALS FOR YEAR 1977

	INCHES	CU. FEET	PERCENT
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PRECIPITATION	32.03	1162689.250	100.00
RUNOFF	0.000	0.000	0.00
EVAPOTRANSPIRATION	29.255	1061961.750	91.34
DRAINAGE COLLECTED FROM LAYER 3	0.1448	5256.613	0.45
PERC./LEAKAGE THROUGH LAYER 4	0.005907	214.414	0.02
AVG. HEAD ON TOP OF LAYER 4	0.0041		
CHANGE IN WATER STORAGE	2.624	95257.039	8.19
SOIL WATER AT START OF YEAR	245.026	8894428.000	
SOIL WATER AT END OF YEAR	247.650	8989685.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	-0.562	0.00

ANNUAL TOTALS FOR YEAR 1978

	INCHES	CU. FEET	PERCENT
PRECIPITATION	39.85	1446554.750	100.00
RUNOFF	0.000	0.000	0.00
EVAPOTRANSPIRATION	37.746	1370187.870	94.72
DRAINAGE COLLECTED FROM LAYER 3	2.9288	106314.523	7.35
PERC./LEAKAGE THROUGH LAYER 4	0.044412	1612.156	0.11
AVG. HEAD ON TOP OF LAYER 4	0.0823		
CHANGE IN WATER STORAGE	-0.869	-31559.775	-2.18
SOIL WATER AT START OF YEAR	247.650	8989685.000	
SOIL WATER AT END OF YEAR	246.780	8958125.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00

ANNUAL WATER BUDGET BALANCE 0.0000 -0.013 0.00

AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1974 THROUGH 1978

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
<hr/>						
PRECIPITATION						
TOTALS	1.46 5.24	2.16 5.54	1.65 5.78	0.98 2.07	3.41 0.76	6.80 2.34
STD. DEVIATIONS	1.35 1.27	1.88 1.10	0.75 3.22	0.53 2.05	3.13 0.89	4.89 1.10
<hr/>						
RUNOFF						
TOTALS	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.041 0.000
STD. DEVIATIONS	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.092 0.000
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EVAPOTRANSPIRATION						
TOTALS	1.279 6.340	2.558 5.326	2.197 4.822	1.336 2.295	2.598 1.313	4.652 1.111
STD. DEVIATIONS	0.702 0.986	0.680 0.746	1.372 0.820	0.516 1.963	2.090 0.848	2.362 0.318
<hr/>						
LATERAL DRAINAGE COLLECTED FROM LAYER 3						
TOTALS	0.0354 0.2338	0.1263 0.5627	0.3451 0.0833	0.1091 0.1110	0.0344 0.5099	0.0227 0.0747
STD. DEVIATIONS	0.0316 0.4767	0.2210 1.2174	0.7165 0.1217	0.2009 0.1539	0.0398 1.0770	0.0195 0.1181
<hr/>						
PERCOLATION/LEAKAGE THROUGH LAYER 4						
TOTALS	0.0011 0.0032	0.0022 0.0068	0.0047 0.0018	0.0021 0.0021	0.0010 0.0064	0.0008 0.0017
STD. DEVIATIONS	0.0007 0.0054	0.0028 0.0136	0.0086 0.0022	0.0031 0.0020	0.0009 0.0122	0.0005 0.0021

AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)

DAILY AVERAGE HEAD ON TOP OF LAYER 4

AVERAGES	0.0116	0.0458	0.1134	0.0371	0.0113	0.0077
	0.0768	0.1849	0.0283	0.0365	0.1731	0.0245
STD. DEVIATIONS	0.0104	0.0805	0.2355	0.0682	0.0131	0.0066
	0.1567	0.4001	0.0413	0.0506	0.3658	0.0388

AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1974 THROUGH 1978

	INCHES	CU. FEET	PERCENT
PRECIPITATION	38.19 (4.980)	1386296.7	100.00
RUNOFF	0.041 (0.0924)	1499.85	0.108
EVAPOTRANSPIRATION	35.826 (6.3502)	1300479.25	93.810
LATERAL DRAINAGE COLLECTED FROM LAYER 3	2.24847 (1.84500)	81619.539	5.88760
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.03373 (0.02220)	1224.280	0.08831
AVERAGE HEAD ON TOP OF LAYER 4	0.063 (0.051)		
CHANGE IN WATER STORAGE	0.041 (1.6246)	1474.24	0.106

PEAK DAILY VALUES FOR YEARS 1974 THROUGH 1978

	(INCHES)	(CU. FT.)
PRECIPITATION	5.47	198561.000
RUNOFF	0.207	7499.2456
DRAINAGE COLLECTED FROM LAYER 3	0.11877	4311.25439
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.001272	46.18091
AVERAGE HEAD ON TOP OF LAYER 4	1.210	
MAXIMUM HEAD ON TOP OF LAYER 4	2.388	
LOCATION OF MAXIMUM HEAD IN LAYER 3 (DISTANCE FROM DRAIN)	0.0 FEET	
SNOW WATER	0.00	0.0000
MAXIMUM VEG. SOIL WATER (VOL/VOL)	0.4762	
MINIMUM VEG. SOIL WATER (VOL/VOL)	0.0718	

*** Maximum heads are computed using McEnroe's equations. ***

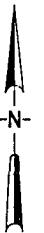
Reference: Maximum Saturated Depth over Landfill Liner
by Bruce M. McEnroe, University of Kansas
ASCE Journal of Environmental Engineering
Vol. 119, No. 2, March 1993, pp. 262-270.

FINAL WATER STORAGE AT END OF YEAR 1978

LAYER	(INCHES)	(VOL/VOL)
1	1.2132	0.2022
2	243.0350	0.2893
3	1.7881	0.0745
4	0.0000	0.0000
SNOW WATER	0.000	

ATTACHMENT 2

DRAWINGS

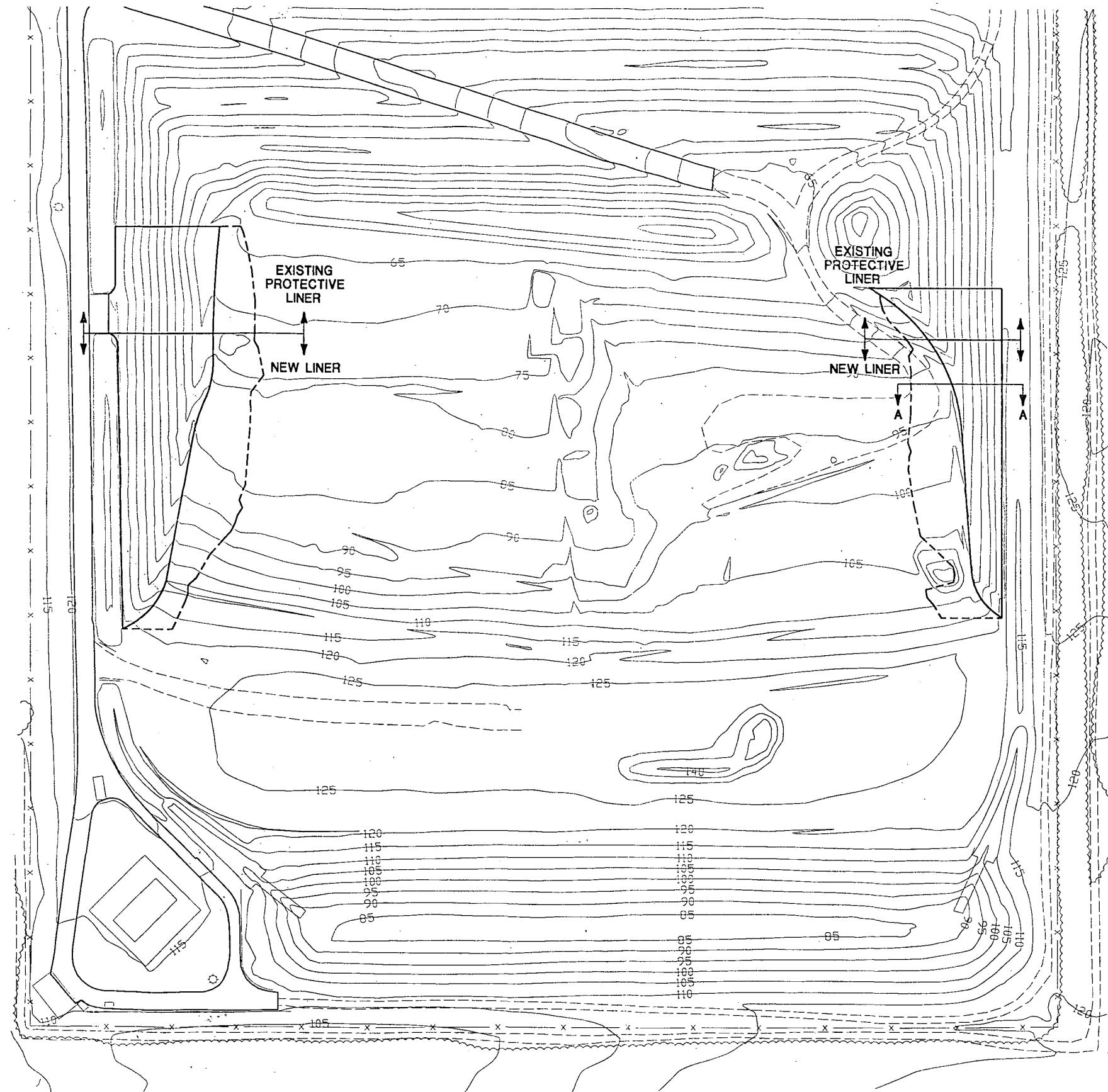


GRAPHIC SCALE
0 40 80 160
SCALE IN FEET

LEGEND

- LIMITS OF EXISTING EXPOSED GEOMEMBRANE
- - - LIMITS OF SOIL/SOLID WASTE 3H:1V SLOPE

NOTE:
SURVEY DATA PROVIDED BY PTI, 6/20/00



09/29/00 15:00 TA JE003001.dwg

DESIGNED	JLD
DRAWN	JAW
CHECKED	DAK
REVISIONS	BY APPROD
PROJECT ENGINEER	

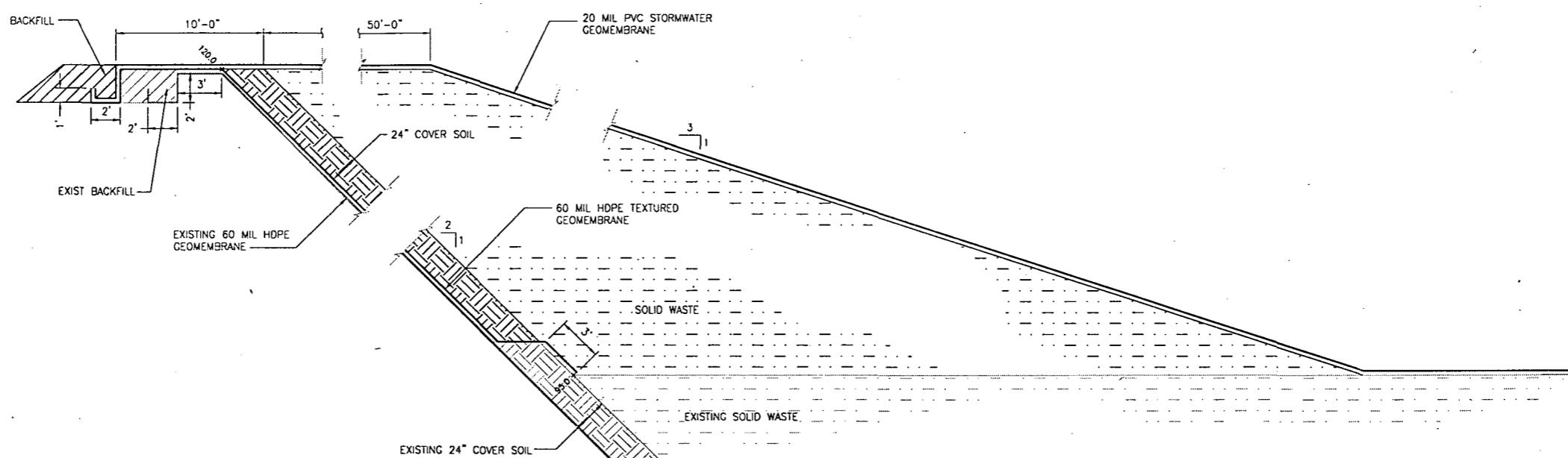
*Jones
Edmunds &
Associates, Inc.* **JEA** CONSULTING ENGINEERS AND SCIENTISTS

750 Northeast Valley Road/Gainesville, Florida 32641 / (352) 377-6221

CITRUS COUNTY
CENTRAL LANDFILL

LINER REMEDIATION

APPROVED FOR JEA BY	DATE	PROJECT NO.
	SEP 2000	03860-003-01
	SCALE	DWG. NO.
	1" = 60'	1
REC. PROF. ENGINEER		



SECTION A-A
SCALE: 1"=5'

09/29/00 16:06 TA JE003002.dwg

LIR.	DATE	REVISIONS	BY	APPRD.	PROJECT ENGINEER

DESIGNED JLD
DRAWN JAW
CHECKED DAK

700 Northeast Florida Road/Citrusville, Florida 34421 / (352) 377-1601
Jones
Edmunds &
Associates, Inc. **JEA** CONSULTING ENGINEERS AND SCIENTISTS

CITRUS COUNTY
CENTRAL LANDFILL

LINER REMEDIATION

APPROVED FOR JEA BY	DATE	PROJECT NO.
	SEP 2000	03860-003-01
SCALE	DWG. NO.	
REC. PROF. ENGINEER	1"= 60'	2

ATTACHMENT 3

SLOPE STABILITY ANALYSIS

Reference: Analysis and Design of Veneer Cover Soils
 Robert M. Koerner, T-Yang Soong
 1998 Sixth International Conference on Geosynthetics

Slope stability

Given: 2(H) : 1(V) existing slope

h	=	2 feet	
L	=	22.5 feet	
β	=	26.5 degrees	0.46251186 radians
γ	=	110 lbs/ft ³	
ϕ	=	32 degrees	0.55850489 radians
δ	=	18 degrees	0.314159 radians (non-textured geomembrane)
δ	=	26 degrees	0.45378522 radians (textured geomembrane)
C_a	=	0	

Calculate "a"

$$a \approx (W_a - N_a \cos\beta) * \cos\beta$$

$$W_a = \gamma h^2 * [L/h - 1/\sin\beta - \tan\beta/2]$$

$$N_a = W_a \cos\beta$$

$$W_a = 3854$$

$$N_a = 3449$$

$$\underline{\underline{a = 687}}$$

Calculate "b"

$$b = -[(W_a - N_a \cos\beta) * \sin\beta * \tan\phi + (N_a \tan\delta + C_a) * \sin\beta * \cos\beta + \sin\beta (C + W_p \tan\phi)]$$

$$W_p = (\gamma h^2) / (\sin 2\beta)$$

$$W_p = 550.940014$$

$$\begin{aligned} b &= 214 + \\ &\quad 672 + \\ &\quad 154 = \\ \underline{\underline{b}} &= -1039 \quad 815 \end{aligned}$$

Calculate "c"

$$c = (N_a \tan\delta + C_a) * \sin^2\beta * \tan\phi$$

$$\underline{\underline{c = 209}}$$

Calculate FS

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

$$FS = 1.27 \quad (2 \text{ feet of soil, 10 feet high on textured geomembrane})$$

Slope stability

Given: 2(H) : 1(V) existing slope

h	=	2 feet	
L	=	22.5 feet	
β	=	26.5 degrees	0.46251186 radians
γ	=	110 lbs/ft ³	
ϕ	=	32 degrees	0.55850489 radians
δ	=	18 degrees	0.314159 radians (non-textured geomembrane)
δ	=	26 degrees	0.45378522 radians (textured geomembrane)
C_a	=	0	

Calculate "a"

$$a = (W_a - N_a \cos \beta) * \cos \beta$$

$$W_a = \gamma h^2 * [L/h - 1/\sin \beta - \tan \beta / 2]$$

$$N_a = W_a \cos \beta$$

$$W_a = 3854$$

$$N_a = 3449$$

$$\underline{\underline{a = 687}}$$

Calculate "b"

$$b = - [(W_a - N_a \cos \beta) * \sin \beta * \tan \phi + (N_a \tan \delta + C_a) * \sin \beta * \cos \beta + \sin \beta (C + W_p \tan \phi)]$$

$$W_p = (\gamma * h^2) / (\sin 2\beta)$$

$$W_p = 550.940014$$

$$\begin{aligned} b &= 214 + \\ &\quad 448 + \\ &\quad 154 = \\ \underline{\underline{b = -815}} \end{aligned}$$

Calculate "c"

$$c = (N_a \tan \delta + C_a) * \sin^2 \beta * \tan \phi$$

$$\underline{\underline{c = 139}}$$

Calculate FS

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

$$FS = \frac{1}{(2 \text{ feet of soil, 10 feet high on } \underline{\text{smooth}} \text{ textured geomembrane})}$$

Reference: Analysis and Design of Veneer Cover Soils
 Robert M. Koerner, T-Yang Soong
 1998 Sixth International Conference on Geosynthetics

Symbols

Wa	total weight of the active wedge
Wp	total weight of the passive wedge
Na	effective force normal to the failure plane of the active wedge
Np	effective force normal to the failure plane of the passive wedge
g	soil unit weight
h	thickness of soil cover
L	length of slope measured along the geomembrane
b	soil slope angle beneath the geomembrane
f	soil friction angle
g	interface friction angle
Ca	adhesive forces between soil and geomembrane
ca	adhesion between soil and geomembrane
C	cohesive force
Ea	interwedge force acting on the active wedge
Ep	interwedge force acting on the passive wedge
FS	factor of safety