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SCS ENGINEERS, PC

October 1, 2010
File No. 02201314.28

NC DEPT. OF ENVIRONMENT
AND NATURAL RESOURCES

OCT 4 2010

MOORESVILLE REGIONAL OFFICE
DIVISION OF WASTE MANAGEMENT, SWS

Mr. John Murray, P.E.
NCDENR - Division of Waste Management
Solid Waste Section - Permitting Branch
Mooresville Regional Office
610 East Center Avenue
Mooresville, North Carolina 28115
John.Murray@ncmail.net

Subject: Variance Request for Landfill Bottom Liner System Protective Cover Minimum Permeability Requirements
Charlotte Motor Speedway V MSW Landfill (Permit Number 13-04) – Phase 3, Cell 2I, 2J, 2K and 2M Construction

Dear Mr. Murray:

On behalf of Republic Services, Inc. and the Charlotte Motor Speedway (CMS) Landfill, SCS Engineers, PC (SCS) respectively requests a variance for the minimum permeability required for the native soils protective cover for the Phase 3, Cells 2I, 2J, 2K and 2M landfill bottom liner system. The variance requested is to change the Permit Application for the Phase 3 Permit to Construct minimum laboratory tested permeability for the base liner system protective from $1x10^{-3}$ cm/sec to $1x10^{-4}$ cm/sec. The required minimum testing frequency will be kept at one (1) test per 3,000 cubic yards of placed material. The permeability requirements are outlined in the Construction Quality Assurance (CQA) Plan; Section III, page 32 and Technical Specifications; Section IV; specification section 02253 as part of the Permit Application for the Phase 3 Permit to Construct prepared by Hodges, Harbin, Newberry and Tribble, Inc. (HHNT), dated May 2009.

SCS completed an evaluation of the Phase 3, Cells 2I, 2J, 2K and 2M landfill bottom liner system leachate collection system components with the variance requested $1x10^{-4}$ cm/sec protective cover to verify that they meet the requirements set forth in the Solid Waste Management Rule 15 NCAC 13B .1624.b.2 that less than one (1) foot of head is maintained on top of the landfill HDPE geomembrane liner. The leachate collection system consists of (from top to bottom): 24-inches of native soils protective cover, SKAPS TN330-2-8 double sided drainage geocomposite, and 8-inch diameter perforated pipes surrounded by ASTM No. 57 stone encapsulated by 8 oz/sy non-woven geotextile fabric. Beneath the leachate collection system is Agru America 60 mil microspike HDPE geomembrane.

Three (3) separate hydraulic transmissivity tests (ASTM D 4716) using the leachate collection system $1x10^{-4}$ cm/sec minimum permeability native soils protective cover, double sided drainage geocomposite and 60 mil microspike HDPE geomembrane has been completed. The hydraulic

transmissivity test results performed are included in Attachment A. A summary of the results are in the following Table 1-1.

Table 1-1. Summary of Drainage Geocomposite Conformance Hydraulic Transmissivity Test Results

Sample Id	Laboratory Tested Hydraulic Transmissivity Result (Note 1 & 2)
347510004	1.88×10^{-3} m²/sec
347510110	1.63×10^{-3} m²/sec (Note 3)
347510220	1.80×10^{-3} m²/sec

Notes
1. Laboratory tested (ASTM D 4716) with 2 feet of native soils protective cover, SKAPS Industries double sided drainage geocomposite Transnet 330-2-8, and Agru 60 mil microspike HDPE geomembrane.
2. Tested with a normal load of 10,000 psf and hydraulic gradient of 0.25.
3. The lowest hydraulic transmissivty testing result. Used for HELP model calculations.

To estimate the long-term hydraulic transmissivity for the leachate collection system drainage geocomposite, the lowest hydraulic transmissivity test result was reduced by reduction factors as outlined in Geosynthetic Research Institute (GRI) Standard GC 8. The GRI Standard GC 8 transmissivty reduction description and results is as follows:

$$T_{FACTORED} = \frac{T_{LABORATORY}}{RF_{IN} * RF_{CC} * RF_{BC} * RF_{CR} * FS}$$

Reduction Factors

RF_{IN} - Intrusion = 1.0

RF_{CC} - Chemical Clogging = 1.75

RF_{BC} - Biological Clogging = 1.20

RF_{CR} - Creep = 1.70

FS - Factor of Safety = 2.0

$$T_{FACTORED} = \frac{1.63 \times 10^{-3}\ m^2/sec}{1.0 * 1.75 * 1.20 * 1.70 * 2.0}$$

$$T_{FACTORED} = 2.28 \times 10^{-4}\ m^2/sec = 2.72\ cm/sec$$

To demonstrate that the leachate collection system $1x10^{-4}$ cm/sec minimum permeability native soils protective cover and drainage geocomposite meets the requirements set forth in Solid Waste Management Rules 15 NCAC 13B .1624.b.2 , US EPA's Hydrological Evaluation of Landfill Performance (HELP) model version 3.07 was used. The HELP model results show that the leachate collection system drainage geocomposite factored hydraulic transmissivity of $2.28x10^{-4}$ m^2/sec and the $1x10^{-4}$ cm/sec minimum permeability native soils protective cover will provide the necessary transmissivity and permeability to maintain less than one (1) foot of head on top of the landfill bottom liner system HDPE geomembrane. The HELP model results are included in Attachment B. A summary of the HELP model results are in the following Table 1-2:

Table 1-2. Summary of HELP Model Results for Typical One Acre Cell (Protective Cover with a Minimum Permeability of $1x10^{-4}$ cm/sec and Drainage Geocomposite with a Factored Hydraulic Transmissivity of $2.28x10^{-4}$ m^2/sec)

Evaluation Parameters	Drainage Geocomposite Tested Hydraulic Transmissivity Result with Reduction Factors (Note 1)	Native Soils Protective Cover Minimum Permeability	Average Annual Head on Geomembrane	Peak Daily Average Head on Geomembrane	Peak Daily Maximum Head on Geomembrane
15 feet of Waste with Daily Cover	$2.28x10^{-4}$ m^2/sec (2.72 cm/sec)[Note 1]	$1x10^{-4}$ cm/sec	0.038 inches	7.437 inches	11.284 inches
70 feet of Waste with Daily Cover	$2.28x10^{-4}$ m^2/sec (2.72 cm/sec)[Note 1]	$1x10^{-4}$ cm/sec	0.031 inches	0.146 inches	0.287 inches
130 feet of Waste with Intermediate Cover	$2.28x10^{-4}$ m^2/sec (2.72 cm/sec)[Note 1]	$1x10^{-4}$ cm/sec	0.044 inches	0.156 inches	0.305 inches

Notes
1. Based on a factored hydraulic transmissivity of $2.28x10^{-4}$ m^2/sec and material thickness of 0.8382 cm.

As shown in Table 1-2, the HELP model results using the drainage geocomposite factored lowest hydraulic transmissivity laboratory testing result and variance requested minimum permeability $1x10^{-4}$ cm/sec native soils protective cover meets the requirement set forth in the Solid Waste Management Rule 15 NCAC 13B .1624.b.2 of maintaining less than one (1) foot of hydraulic head on top of the bottom liner system geomembrane.

We trust that the information provided for this variance request meets the requirements of the State Solid Waste Management Rules. If you have any questions or need additional information please don't hesitate to contact me at (704) 504 – 3107 or Mike Gurley at (704) 782-2004 ext 391.

Sincerely,

NORTH CAROLINA PROFESSIONAL SEAL 031802 ENGINEER ALBERT D. GLENN 10/1/2010

Albert D. Glenn, P.E.
Project Manager
SCS ENGINEERS, PC

Attachments

Cc: Mike Gurley - CMS Landfill, Richard Deason - Atlantic Coast Consulting, Inc., and File

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ATTACHMENT A

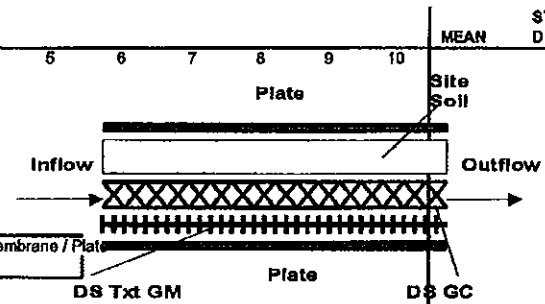
Hydraulic Transmissivity Test Results

GEOCOMPOSITE TEST RESULTS

TRI Client: Republic Services
Project: Charlotte Motor Speedway

Material: SKAPS TN330-2-8 Double Sided Geocomposite
Sample Identification: 347510004
TRI Log #: E2334-98-06

PARAMETER	TEST REPLICATE NUMBER 1	2	3	4	5	6	7	8	9	10	MEAN	STD. DEV.	PROJ. SPEC.
Hydraulic Transmissivity (ASTM D 4716)													
Direction Tested: Machine Direction													
Normal Load (psf):	10,000												
Hydraulic Gradient:	0.25												
Test Length (in)	12												
Test Width (in)	12												
Seat Time (hours)	Specimen		1										
Volume (cc)		713	710	724									
Time (s)		5.09	5.10	5.14									
24 Flow Rate (GPM/ft width)		2.22	2.21	2.23							2.22	0.01	
24 Transmissivity (m^2/s)		1.88E-03	1.87E-03	1.89E-03							1.88E-03	1.10E-05	5.0E-4 min
Test Temp (C)			19.0										
Temp. Corr. Factor			1.025										
Peel Strength (ASTM F 904, mod.)													
A - MD Average Peel Strength (ppi)	1.9	1.7	2.5	1.3	3.9						2.3	1.0	
A - MD Average Peel Strength (g/in)	863	772	1135	590	1771						1026	460	150 min
B - MD Average Peel Strength (ppi)	2.7	1.8	3.7	2.3	6.9						3.5	2.0	
B - MD Average Peel Strength (g/in)	1226	817	1680	1044	3133						1580	924	150 min



Note: A and B represent a randomly assigned top and bottom of the sample

MD Machine Direction TD Transverse Direction

The testing herein is based upon accepted industry practice as well as the test method listed. Test results reported herein do not apply to samples other than those tested. TRI neither accepts responsibility for nor makes claim as to the final use and purpose of the material. TRI observes and maintains client confidentiality. TRI limits reproduction: of this report, except in full, without prior approval of TRI.

RW

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9063 Bee Caves Road / Austin, TX 78733 / 512 263 2101 / fax 512 263 2558

GEOCOMPOSITE TEST RESULTS

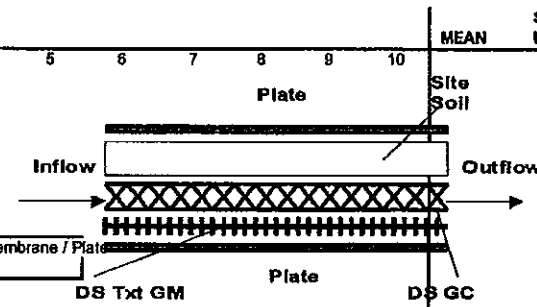
TRI Client: Republic Services
Project: Charlotte Motor Speedway

Material: SKAPS TN330-2-8 Double Sided Geocomposite
Sample Identification: 347610110
TRI Log #: E2334-98-06

PARAMETER	TEST REPLICATE NUMBER 1	2	3	4	5	6	7	8	9	10	MEAN	STD. DEV.	PROJ. SPEC.
Hydraulic Transmissivity (ASTM D 4716)													

Direction Tested: Machine Direction

Normal Load (psf):	10,000
Hydraulic Gradient:	0.25
Test Length (in)	12
Test Width (in)	12



Seat Time (hours)		Specimen 1			MEAN	STD. DEV.	PROJ. SPEC.
	Volume (cc)	607	599	614			
	Time (s)	5.10	5.01	5.13			
24	Flow Rate (GPM/ft width)	1.89	1.90	1.90	1.89	0.01	
	Transmissivity (m^2/s)	1.62E-03	1.63E-03	1.63E-03	1.63E-03	4.84E-06	5.0E-4 min
	Test Temp (C)		18.5				
	Temp. Corr. Factor		1.038				

Peel Strength (ASTM F 904, mod.)

	1	2	3	4	5	MEAN	STD. DEV.	PROJ. SPEC.
A - MD Average Peel Strength (ppi)	2.3	2.2	2.7	4.2	2.9	2.9	0.8	
A - MD Average Peel Strength (g/in)	1044	999	1226	1907	1317	1298	364	150 min
B - MD Average Peel Strength (ppi)	4.0	2.1	4.2	2.9	4.2	3.5	0.9	
B - MD Average Peel Strength (g/in)	1816	953	1907	1317	1907	1580	428	150 min

Note: A and B represent a randomly assigned top and bottom of the sample

MD Machine Direction TD Transverse Direction

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GEOCOMPOSITE TEST RESULTS

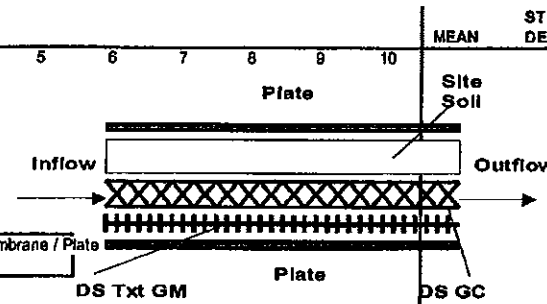
TRI Client: Republic Services
Project: Charlotte Motor Speedway

Material: SKAPS TN330-2-8 Double Sided Geocomposite
Sample Identification: 347510220
TRI Log #: E2334-98-06

PARAMETER	TEST REPLICATE NUMBER 1	2	3	4	5	6	7	8	9	10	MEAN	STD. DEV.	PROJ. SPEC.
Hydraulic Transmissivity (ASTM D 4716)													

Direction Tested: Machine Direction

Normal Load (psf):	10,000
Hydraulic Gradient:	0.25
Test Length (in)	12
Test Width (in)	12



Seat Time (hours)	Specimen	1											
	Volume (cc)		686	678	674								
	Time (s)		5.10	5.06	5.04								
24	Flow Rate (GPM/ft width)		2.13	2.12	2.12						2.13	0.01	
	Transmissivity (m^2/s)		1.81E-03	1.80E-03	1.80E-03						1.80E-03	5.34E-06	5.0E-4 min
	Test Temp (C)			19.0									
	Temp. Corr. Factor			1.025									
Peel Strength (ASTM F 904, mod.)													
A - MD Average Peel Strength (ppi)		2.2	1.7	3.9	2.5	1.8					2.4	0.9	
A - MD Average Peel Strength (g/in)		999	772	1771	1135	817					1099	403	150 min
B - MD Average Peel Strength (ppi)		4.6	1.0	7.7	1.8	1.0					3.2	2.9	
B - MD Average Peel Strength (g/in)		2088	454	3495	817	454					1462	1321	150 min

Note: A and B represent a randomly assigned top and bottom of the sample

MD Machine Direction TD Transverse Direction

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ATTACHMENT B

HELP Model Results

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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:\CMSLF\DATA4.D4
TEMPERATURE DATA FILE:       C:\CMSLF\DATA7.D7
SOLAR RADIATION DATA FILE:   C:\CMSLF\DATA13.D13
EVAPOTRANSPIRATION DATA:     C:\CMSLF\DATA11.D11
SOIL AND DESIGN DATA FILE:   C:\CMSLF\15FT\DATA10.D10
OUTPUT DATA FILE:            C:\CMSLF\15FT\INITIAL.OUT


TIME:  10:56     DATE:  10/ 1/2010


******************************************************************************

     TITLE:  CMS LANDFILL V PHASE 3 - 15 FEET OF WASTE

******************************************************************************


     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   7
          THICKNESS                  =      6.00   INCHES
          POROSITY                   =      0.4730 VOL/VOL
          FIELD CAPACITY             =      0.2220 VOL/VOL
          WILTING POINT              =      0.1040 VOL/VOL
          INITIAL SOIL WATER CONTENT =      0.1532 VOL/VOL
          EFFECTIVE SAT. HYD. COND.  =  0.520000001000E-03 CM/SEC


                                  LAYER  2
                                  --------

                 TYPE 1 - VERTICAL PERCOLATION LAYER
                     MATERIAL TEXTURE NUMBER  18
          THICKNESS                  =     60.00   INCHES
          POROSITY                   =      0.6710 VOL/VOL
          FIELD CAPACITY             =      0.2920 VOL/VOL
          WILTING POINT              =      0.0770 VOL/VOL
          INITIAL SOIL WATER CONTENT =      0.3220 VOL/VOL
          EFFECTIVE SAT. HYD. COND.  =  0.100000005000E-02 CM/SEC
```

```
                         LAYER  3
                         --------

          TYPE 1 - VERTICAL PERCOLATION LAYER
              MATERIAL TEXTURE NUMBER   0
THICKNESS                    =      24.00   INCHES
POROSITY                     =       0.3980 VOL/VOL
FIELD CAPACITY               =       0.2440 VOL/VOL
WILTING POINT                =       0.1360 VOL/VOL
INITIAL SOIL WATER CONTENT   =       0.2922 VOL/VOL
EFFECTIVE SAT. HYD. COND.    =  0.999999975000E-04 CM/SEC
```

1×10^{-4} cm/sec

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                         LAYER  4
                         --------

            TYPE 2 - LATERAL DRAINAGE LAYER
              MATERIAL TEXTURE NUMBER   0
THICKNESS                    =       0.33   INCHES
POROSITY                     =       0.8500 VOL/VOL
FIELD CAPACITY               =       0.0100 VOL/VOL
WILTING POINT                =       0.0050 VOL/VOL
INITIAL SOIL WATER CONTENT   =       0.0263 VOL/VOL
EFFECTIVE SAT. HYD. COND.    =   2.72000003000      CM/SEC
SLOPE                        =       2.00   PERCENT
DRAINAGE LENGTH              =     300.0    FEET
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```
                         LAYER  5
                         --------

            TYPE 4 - FLEXIBLE MEMBRANE LINER
              MATERIAL TEXTURE NUMBER  35
THICKNESS                    =       0.06   INCHES
POROSITY                     =       0.0000 VOL/VOL
FIELD CAPACITY               =       0.0000 VOL/VOL
WILTING POINT                =       0.0000 VOL/VOL
INITIAL SOIL WATER CONTENT   =       0.0000 VOL/VOL
EFFECTIVE SAT. HYD. COND.    =  0.199999996000E-12 CM/SEC
FML PINHOLE DENSITY          =       4.00   HOLES/ACRE
FML INSTALLATION DEFECTS     =       3.00   HOLES/ACRE
FML PLACEMENT QUALITY        =  3 - GOOD
```

```
                         LAYER  6
                         --------

              TYPE 3 - BARRIER SOIL LINER
              MATERIAL TEXTURE NUMBER  16
THICKNESS                    =      24.00   INCHES
POROSITY                     =       0.4270 VOL/VOL
FIELD CAPACITY               =       0.4180 VOL/VOL
WILTING POINT                =       0.3670 VOL/VOL
INITIAL SOIL WATER CONTENT   =       0.4270 VOL/VOL
EFFECTIVE SAT. HYD. COND.    =  0.100000001000E-06 CM/SEC
```

1×10^{-7} cm/sec

GENERAL DESIGN AND EVAPORATIVE ZONE DATA

NOTE: SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT SOIL DATA BASE USING SOIL TEXTURE # 7 WITH BARE GROUND CONDITIONS, A SURFACE SLOPE OF 2.% AND A SLOPE LENGTH OF 300. FEET.

SCS RUNOFF CURVE NUMBER	=	88.20	
FRACTION OF AREA ALLOWING RUNOFF	=	0.0	PERCENT
AREA PROJECTED ON HORIZONTAL PLANE	=	1.000	ACRES
EVAPORATIVE ZONE DEPTH	=	10.0	INCHES
INITIAL WATER IN EVAPORATIVE ZONE	=	1.915	INCHES
UPPER LIMIT OF EVAPORATIVE STORAGE	=	5.522	INCHES
LOWER LIMIT OF EVAPORATIVE STORAGE	=	0.932	INCHES
INITIAL SNOW WATER	=	0.000	INCHES
INITIAL WATER IN LAYER MATERIALS	=	37.508	INCHES
TOTAL INITIAL WATER	=	37.508	INCHES
TOTAL SUBSURFACE INFLOW	=	0.00	INCHES/YEAR

EVAPOTRANSPIRATION AND WEATHER DATA

NOTE: EVAPOTRANSPIRATION DATA WAS OBTAINED FROM CHARLOTTE NORTH CAROLINA

STATION LATITUDE	=	35.20	DEGREES
MAXIMUM LEAF AREA INDEX	=	0.00	
START OF GROWING SEASON (JULIAN DATE)	=	83	
END OF GROWING SEASON (JULIAN DATE)	=	312	
EVAPORATIVE ZONE DEPTH	=	10.0	INCHES
AVERAGE ANNUAL WIND SPEED	=	7.50	MPH
AVERAGE 1ST QUARTER RELATIVE HUMIDITY	=	64.00	%
AVERAGE 2ND QUARTER RELATIVE HUMIDITY	=	67.00	%
AVERAGE 3RD QUARTER RELATIVE HUMIDITY	=	74.00	%
AVERAGE 4TH QUARTER RELATIVE HUMIDITY	=	70.00	%

NOTE: PRECIPITATION DATA WAS SYNTHETICALLY GENERATED USING COEFFICIENTS FOR CHARLOTTE NORTH CAROLINA

NORMAL MEAN MONTHLY PRECIPITATION (INCHES)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
3.80	3.81	4.83	3.27	3.64	3.57
3.92	3.75	3.59	2.72	2.86	3.40

NOTE: TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING COEFFICIENTS FOR CHARLOTTE NORTH CAROLINA

NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
40.50	42.90	50.40	60.30	68.20	75.00
78.50	77.90	72.00	60.70	50.70	42.60

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING COEFFICIENTS FOR CHARLOTTE NORTH CAROLINA AND STATION LATITUDE = 35.20 DEGREES

****

ANNUAL TOTALS FOR YEAR 1

	INCHES	CU. FEET	PERCENT
PRECIPITATION	39.37	142913.141	100.00
RUNOFF	0.000	0.000	0.00
EVAPOTRANSPIRATION	31.253	113447.562	79.38
DRAINAGE COLLECTED FROM LAYER 4	8.1127	29449.238	20.61
PERC./LEAKAGE THROUGH LAYER 6	0.000036	0.130	0.00
AVG. HEAD ON TOP OF LAYER 5	0.0216		
CHANGE IN WATER STORAGE	0.004	16.215	0.01
SOIL WATER AT START OF YEAR	37.508	136155.219	
SOIL WATER AT END OF YEAR	37.513	136171.437	
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	-0.005	0.00

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ANNUAL TOTALS FOR YEAR 2

	INCHES	CU. FEET	PERCENT
PRECIPITATION	45.97	166871.141	100.00
RUNOFF	0.000	0.000	0.00
EVAPOTRANSPIRATION	31.352	113806.711	68.20
DRAINAGE COLLECTED FROM LAYER 4	18.1254	65795.289	39.43
PERC./LEAKAGE THROUGH LAYER 6	0.000073	0.266	0.00
AVG. HEAD ON TOP OF LAYER 5	0.0487		
CHANGE IN WATER STORAGE	-3.507	-12731.144	-7.63
SOIL WATER AT START OF YEAR	37.513	136171.437	
SOIL WATER AT END OF YEAR	34.006	123440.289	
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	0.025	0.00

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ANNUAL TOTALS FOR YEAR 3

	INCHES	CU. FEET	PERCENT
PRECIPITATION	48.06	174457.781	100.00
RUNOFF	0.000	0.000	0.00
EVAPOTRANSPIRATION	34.071	123677.273	70.89
DRAINAGE COLLECTED FROM LAYER 4	13.1096	47587.926	27.28
PERC./LEAKAGE THROUGH LAYER 6	0.000088	0.318	0.00
AVG. HEAD ON TOP OF LAYER 5	0.0730		
CHANGE IN WATER STORAGE	0.879	3192.309	1.83
SOIL WATER AT START OF YEAR	34.006	123440.289	
SOIL WATER AT END OF YEAR	34.636	125727.242	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.249	905.349	0.52
ANNUAL WATER BUDGET BALANCE	0.0000	-0.044	0.00

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ANNUAL TOTALS FOR YEAR 4

	INCHES	CU. FEET	PERCENT
PRECIPITATION	36.84	133729.203	100.00
RUNOFF	0.000	0.000	0.00
EVAPOTRANSPIRATION	29.719	107880.891	80.67
DRAINAGE COLLECTED FROM LAYER 4	5.9478	21590.621	16.15
PERC./LEAKAGE THROUGH LAYER 6	0.000028	0.102	0.00
AVG. HEAD ON TOP OF LAYER 5	0.0157		
CHANGE IN WATER STORAGE	1.173	4257.594	3.18
SOIL WATER AT START OF YEAR	34.636	125727.242	
SOIL WATER AT END OF YEAR	36.058	130890.187	
SNOW WATER AT START OF YEAR	0.249	905.349	0.68
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	-0.008	0.00

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ANNUAL TOTALS FOR YEAR 5

	INCHES	CU. FEET	PERCENT
PRECIPITATION	45.76	166108.812	100.00
RUNOFF	0.000	0.000	0.00
EVAPOTRANSPIRATION	31.762	115295.172	69.41
DRAINAGE COLLECTED FROM LAYER 4	12.4553	45212.863	27.22
PERC./LEAKAGE THROUGH LAYER 6	0.000053	0.194	0.00
AVG. HEAD ON TOP OF LAYER 5	0.0332		
CHANGE IN WATER STORAGE	1.543	5600.603	3.37
SOIL WATER AT START OF YEAR	36.058	130890.187	
SOIL WATER AT END OF YEAR	37.601	136490.797	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	-0.021	0.00

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AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1 THROUGH 5

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	3.35	3.78	5.11	2.89	3.89	4.60
	3.88	3.64	3.32	3.80	1.67	3.27
STD. DEVIATIONS	2.40	1.67	1.54	1.83	2.41	1.14
	1.36	2.89	1.20	2.01	1.40	1.72
RUNOFF						
TOTALS	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000
STD. DEVIATIONS	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000
EVAPOTRANSPIRATION						
TOTALS	1.691	2.158	3.241	3.202	3.473	3.046
	4.222	2.755	2.693	2.096	1.717	1.337
STD. DEVIATIONS	0.169	0.276	0.210	1.023	1.799	1.022
	1.800	1.656	1.525	1.076	0.651	0.119

LATERAL DRAINAGE COLLECTED FROM LAYER 4

TOTALS	1.5207	1.5543	1.4910	1.3978	0.7404	0.7220
	0.5786	0.4107	0.7797	0.8517	0.9874	0.5158
STD. DEVIATIONS	1.5713	1.7369	1.1433	0.6712	0.8707	1.2362
	0.5613	0.4055	0.9138	0.7323	0.6381	0.2502

PERCOLATION/LEAKAGE THROUGH LAYER 6

TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)

DAILY AVERAGE HEAD ON TOP OF LAYER 5

AVERAGES	0.0477	0.1435	0.0468	0.0453	0.0232	0.0234
	0.0182	0.0129	0.0253	0.0267	0.0320	0.0162
STD. DEVIATIONS	0.0493	0.2539	0.0359	0.0218	0.0273	0.0401
	0.0176	0.0127	0.0296	0.0230	0.0207	0.0079

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AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1 THROUGH 5

	INCHES		CU. FEET	PERCENT
PRECIPITATION	43.20	(4.821)	156816.0	100.00
RUNOFF	0.000	(0.0000)	0.00	0.000
EVAPOTRANSPIRATION	31.631	(1.5690)	114821.52	73.221
LATERAL DRAINAGE COLLECTED FROM LAYER 4	11.55019	(4.73517)	41927.187	26.73655
PERCOLATION/LEAKAGE THROUGH LAYER 6	0.00006	(0.00002)	0.202	0.00013
AVERAGE HEAD ON TOP OF LAYER 5	0.038	(0.023)		
CHANGE IN WATER STORAGE	0.018	(2.0511)	67.12	0.043

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PEAK DAILY VALUES FOR YEARS 1 THROUGH 5

	(INCHES)	(CU. FT.)
PRECIPITATION	2.43	8820.900

RUNOFF	0.000	0.0000
DRAINAGE COLLECTED FROM LAYER 4	0.33938	1231.94141
PERCOLATION/LEAKAGE THROUGH LAYER 6	0.000020	0.07369
AVERAGE HEAD ON TOP OF LAYER 5	7.437	
MAXIMUM HEAD ON TOP OF LAYER 5	11.284	
LOCATION OF MAXIMUM HEAD IN LAYER 4 (DISTANCE FROM DRAIN)	72.3 FEET	
SNOW WATER	2.24	8132.3433

MAXIMUM VEG. SOIL WATER (VOL/VOL)	0.3967
MINIMUM VEG. SOIL WATER (VOL/VOL)	0.0932

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

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

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FINAL WATER STORAGE AT END OF YEAR 5

LAYER	(INCHES)	(VOL/VOL)
1	1.5183	0.2530
2	19.0046	0.3167
3	6.7942	0.2831
4	0.0356	0.1080
5	0.0000	0.0000
6	10.2480	0.4270
SNOW WATER	0.000	

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**              HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE               **
**                HELP MODEL VERSION 3.07  (1 NOVEMBER 1997)                **
**                  DEVELOPED BY ENVIRONMENTAL LABORATORY                   **
**                    USAE WATERWAYS EXPERIMENT STATION                     **
**             FOR USEPA RISK REDUCTION ENGINEERING LABORATORY              **
**                                                                          **
**                                                                          **
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PRECIPITATION DATA FILE:     C:\CMSLF\DATA4.D4
TEMPERATURE DATA FILE:       C:\CMSLF\DATA7.D7
SOLAR RADIATION DATA FILE:   C:\CMSLF\DATA13.D13
EVAPOTRANSPIRATION DATA:     C:\CMSLF\DATA11.D11
SOIL AND DESIGN DATA FILE:   C:\CMSLF\70ft\DATA10.D10
OUTPUT DATA FILE:            C:\CMSLF\70FT\70FT.OUT


TIME:  10:58     DATE:  10/ 1/2010


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     TITLE:  CMS LANDFILL V PHASE 3 - 70 FEET OF WASTE

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     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   7
          THICKNESS                  =      6.00   INCHES
          POROSITY                   =      0.4730 VOL/VOL
          FIELD CAPACITY             =      0.2220 VOL/VOL
          WILTING POINT              =      0.1040 VOL/VOL
          INITIAL SOIL WATER CONTENT =      0.1532 VOL/VOL
          EFFECTIVE SAT. HYD. COND.  =  0.520000001000E-03 CM/SEC


                                  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 =      0.2951 VOL/VOL
          EFFECTIVE SAT. HYD. COND.  =  0.100000005000E-02 CM/SEC
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                         LAYER  3
                         --------

          TYPE 1 - VERTICAL PERCOLATION LAYER
              MATERIAL TEXTURE NUMBER   0
THICKNESS                    =     24.00   INCHES
POROSITY                     =      0.3980 VOL/VOL
FIELD CAPACITY               =      0.2440 VOL/VOL
WILTING POINT                =      0.1360 VOL/VOL
INITIAL SOIL WATER CONTENT   =      0.2617 VOL/VOL
EFFECTIVE SAT. HYD. COND.    =  0.999999975000E-04 CM/SEC
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1×10^{-4} cm/sec

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                         LAYER  4
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            TYPE 2 - LATERAL DRAINAGE LAYER
              MATERIAL TEXTURE NUMBER   0
THICKNESS                    =      0.33   INCHES
POROSITY                     =      0.8500 VOL/VOL
FIELD CAPACITY               =      0.0100 VOL/VOL
WILTING POINT                =      0.0050 VOL/VOL
INITIAL SOIL WATER CONTENT   =      0.0302 VOL/VOL
EFFECTIVE SAT. HYD. COND.    =   2.72000003000     CM/SEC
SLOPE                        =      2.00   PERCENT
DRAINAGE LENGTH              =    300.0    FEET
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                         LAYER  5
                         --------

            TYPE 4 - FLEXIBLE MEMBRANE LINER
              MATERIAL TEXTURE NUMBER  35
THICKNESS                    =      0.06   INCHES
POROSITY                     =      0.0000 VOL/VOL
FIELD CAPACITY               =      0.0000 VOL/VOL
WILTING POINT                =      0.0000 VOL/VOL
INITIAL SOIL WATER CONTENT   =      0.0000 VOL/VOL
EFFECTIVE SAT. HYD. COND.    =  0.199999996000E-12 CM/SEC
FML PINHOLE DENSITY          =      4.00   HOLES/ACRE
FML INSTALLATION DEFECTS     =      3.00   HOLES/ACRE
FML PLACEMENT QUALITY        =  3 - GOOD
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                         LAYER  6
                         --------

              TYPE 3 - BARRIER SOIL LINER
              MATERIAL TEXTURE NUMBER  16
THICKNESS                    =     24.00   INCHES
POROSITY                     =      0.4270 VOL/VOL
FIELD CAPACITY               =      0.4180 VOL/VOL
WILTING POINT                =      0.3670 VOL/VOL
INITIAL SOIL WATER CONTENT   =      0.4270 VOL/VOL
EFFECTIVE SAT. HYD. COND.    =  0.100000001000E-06 CM/SEC
```

1×10^{-7} cm/sec

GENERAL DESIGN AND EVAPORATIVE ZONE DATA

NOTE: SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT SOIL DATA BASE USING SOIL TEXTURE # 7 WITH BARE GROUND CONDITIONS, A SURFACE SLOPE OF 2.% AND A SLOPE LENGTH OF 30. FEET.

SCS RUNOFF CURVE NUMBER	=	89.50	
FRACTION OF AREA ALLOWING RUNOFF	=	0.0	PERCENT
AREA PROJECTED ON HORIZONTAL PLANE	=	1.000	ACRES
EVAPORATIVE ZONE DEPTH	=	10.0	INCHES
INITIAL WATER IN EVAPORATIVE ZONE	=	1.915	INCHES
UPPER LIMIT OF EVAPORATIVE STORAGE	=	5.522	INCHES
LOWER LIMIT OF EVAPORATIVE STORAGE	=	0.932	INCHES
INITIAL SNOW WATER	=	0.000	INCHES
INITIAL WATER IN LAYER MATERIALS	=	265.345	INCHES
TOTAL INITIAL WATER	=	265.345	INCHES
TOTAL SUBSURFACE INFLOW	=	0.00	INCHES/YEAR

EVAPOTRANSPIRATION AND WEATHER DATA

NOTE: EVAPOTRANSPIRATION DATA WAS OBTAINED FROM CHARLOTTE NORTH CAROLINA

STATION LATITUDE	=	35.20	DEGREES
MAXIMUM LEAF AREA INDEX	=	0.00	
START OF GROWING SEASON (JULIAN DATE)	=	83	
END OF GROWING SEASON (JULIAN DATE)	=	312	
EVAPORATIVE ZONE DEPTH	=	10.0	INCHES
AVERAGE ANNUAL WIND SPEED	=	7.50	MPH
AVERAGE 1ST QUARTER RELATIVE HUMIDITY	=	64.00	%
AVERAGE 2ND QUARTER RELATIVE HUMIDITY	=	67.00	%
AVERAGE 3RD QUARTER RELATIVE HUMIDITY	=	74.00	%
AVERAGE 4TH QUARTER RELATIVE HUMIDITY	=	70.00	%

NOTE: PRECIPITATION DATA WAS SYNTHETICALLY GENERATED USING COEFFICIENTS FOR CHARLOTTE NORTH CAROLINA

NORMAL MEAN MONTHLY PRECIPITATION (INCHES)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
3.80	3.81	4.83	3.27	3.64	3.57
3.92	3.75	3.59	2.72	2.86	3.40

NOTE: TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING COEFFICIENTS FOR CHARLOTTE NORTH CAROLINA

NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
40.50	42.90	50.40	60.30	68.20	75.00
78.50	77.90	72.00	60.70	50.70	42.60

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING COEFFICIENTS FOR CHARLOTTE NORTH CAROLINA AND STATION LATITUDE = 35.20 DEGREES

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ANNUAL TOTALS FOR YEAR 1

	INCHES	CU. FEET	PERCENT
PRECIPITATION	39.37	142913.141	100.00
RUNOFF	0.000	0.000	0.00
EVAPOTRANSPIRATION	31.253	113447.562	79.38
DRAINAGE COLLECTED FROM LAYER 4	8.1128	29449.545	20.61
PERC./LEAKAGE THROUGH LAYER 6	0.000036	0.132	0.00
AVG. HEAD ON TOP OF LAYER 5	0.0219		
CHANGE IN WATER STORAGE	0.004	15.841	0.01
SOIL WATER AT START OF YEAR	265.345	963202.437	
SOIL WATER AT END OF YEAR	265.349	963218.312	
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	0.059	0.00

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ANNUAL TOTALS FOR YEAR 2

	INCHES	CU. FEET	PERCENT
PRECIPITATION	45.97	166871.141	100.00
RUNOFF	0.000	0.000	0.00
EVAPOTRANSPIRATION	31.352	113806.711	68.20
DRAINAGE COLLECTED FROM LAYER 4	17.8375	64750.215	38.80
PERC./LEAKAGE THROUGH LAYER 6	0.000074	0.267	0.00
AVG. HEAD ON TOP OF LAYER 5	0.0478		
CHANGE IN WATER STORAGE	-3.219	-11685.945	-7.00
SOIL WATER AT START OF YEAR	265.349	963218.312	
SOIL WATER AT END OF YEAR	262.130	951532.375	
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	-0.101	0.00

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ANNUAL TOTALS FOR YEAR 3

	INCHES	CU. FEET	PERCENT
PRECIPITATION	48.06	174457.781	100.00
RUNOFF	0.000	0.000	0.00
EVAPOTRANSPIRATION	34.071	123677.273	70.89
DRAINAGE COLLECTED FROM LAYER 4	13.4278	48743.094	27.94
PERC./LEAKAGE THROUGH LAYER 6	0.000057	0.207	0.00
AVG. HEAD ON TOP OF LAYER 5	0.0357		
CHANGE IN WATER STORAGE	0.561	2037.176	1.17
SOIL WATER AT START OF YEAR	262.130	951532.375	
SOIL WATER AT END OF YEAR	262.442	952664.187	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.249	905.349	0.52
ANNUAL WATER BUDGET BALANCE	0.0000	0.029	0.00

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ANNUAL TOTALS FOR YEAR 4

	INCHES	CU. FEET	PERCENT
PRECIPITATION	36.84	133729.203	100.00
RUNOFF	0.000	0.000	0.00
EVAPOTRANSPIRATION	29.719	107880.891	80.67
DRAINAGE COLLECTED FROM LAYER 4	5.9689	21666.936	16.20
PERC./LEAKAGE THROUGH LAYER 6	0.000028	0.102	0.00
AVG. HEAD ON TOP OF LAYER 5	0.0158		
CHANGE IN WATER STORAGE	1.152	4181.392	3.13
SOIL WATER AT START OF YEAR	262.442	952664.187	
SOIL WATER AT END OF YEAR	263.843	957750.937	
SNOW WATER AT START OF YEAR	0.249	905.349	0.68
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	-0.119	0.00

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ANNUAL TOTALS FOR YEAR 5

	INCHES	CU. FEET	PERCENT
PRECIPITATION	45.76	166108.812	100.00
RUNOFF	0.000	0.000	0.00
EVAPOTRANSPIRATION	31.762	115295.172	69.41
DRAINAGE COLLECTED FROM LAYER 4	12.3569	44855.664	27.00
PERC./LEAKAGE THROUGH LAYER 6	0.000053	0.194	0.00
AVG. HEAD ON TOP OF LAYER 5	0.0328		
CHANGE IN WATER STORAGE	1.641	5957.685	3.59
SOIL WATER AT START OF YEAR	263.843	957750.937	
SOIL WATER AT END OF YEAR	265.484	963708.625	
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	0.094	0.00

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AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1 THROUGH 5

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	3.35	3.78	5.11	2.89	3.89	4.60
	3.88	3.64	3.32	3.80	1.67	3.27
STD. DEVIATIONS	2.40	1.67	1.54	1.83	2.41	1.14
	1.36	2.89	1.20	2.01	1.40	1.72
RUNOFF						
TOTALS	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000
STD. DEVIATIONS	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000
EVAPOTRANSPIRATION						
TOTALS	1.691	2.158	3.241	3.202	3.473	3.046
	4.222	2.755	2.693	2.096	1.717	1.337
STD. DEVIATIONS	0.169	0.276	0.210	1.023	1.799	1.022
	1.800	1.656	1.525	1.076	0.651	0.119

LATERAL DRAINAGE COLLECTED FROM LAYER 4

TOTALS	0.7794	0.8731	1.2092	2.0089	1.4044	0.9268
	0.7782	0.4709	0.5527	0.7004	0.8778	0.9591
STD. DEVIATIONS	0.5151	0.8301	0.8679	0.8830	0.7018	0.9076
	0.8489	0.4264	0.6524	0.6777	0.7613	0.6638

PERCOLATION/LEAKAGE THROUGH LAYER 6

TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)

DAILY AVERAGE HEAD ON TOP OF LAYER 5

AVERAGES	0.0245	0.0303	0.0380	0.0652	0.0441	0.0301
	0.0244	0.0148	0.0179	0.0220	0.0285	0.0301
STD. DEVIATIONS	0.0162	0.0289	0.0272	0.0286	0.0220	0.0294
	0.0266	0.0134	0.0212	0.0213	0.0247	0.0208

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AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1 THROUGH 5

	INCHES		CU. FEET	PERCENT
PRECIPITATION	43.20	(4.821)	156816.0	100.00
RUNOFF	0.000	(0.0000)	0.00	0.000
EVAPOTRANSPIRATION	31.631	(1.5690)	114821.52	73.221
LATERAL DRAINAGE COLLECTED FROM LAYER 4	11.54080	(4.65493)	41893.090	26.71480
PERCOLATION/LEAKAGE THROUGH LAYER 6	0.00005	(0.00002)	0.180	0.00011
AVERAGE HEAD ON TOP OF LAYER 5	0.031	(0.012)		
CHANGE IN WATER STORAGE	0.028	(1.9167)	101.23	0.065

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PEAK DAILY VALUES FOR YEARS 1 THROUGH 5

	(INCHES)	(CU. FT.)
PRECIPITATION	2.43	8820.900

RUNOFF	0.000	0.0000
DRAINAGE COLLECTED FROM LAYER 4	0.15016	545.06360
PERCOLATION/LEAKAGE THROUGH LAYER 6	0.000001	0.00207
AVERAGE HEAD ON TOP OF LAYER 5	0.146	
MAXIMUM HEAD ON TOP OF LAYER 5	0.287	
LOCATION OF MAXIMUM HEAD IN LAYER 4 (DISTANCE FROM DRAIN)	5.3 FEET	
SNOW WATER	2.24	8132.3433

MAXIMUM VEG. SOIL WATER (VOL/VOL)	0.3967
MINIMUM VEG. SOIL WATER (VOL/VOL)	0.0932

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

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

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FINAL WATER STORAGE AT END OF YEAR 5

LAYER	(INCHES)	(VOL/VOL)
1	1.5183	0.2530
2	246.7646	0.2938
3	6.9066	0.2878
4	0.0470	0.1424
5	0.0000	0.0000
6	10.2480	0.4270
SNOW WATER	0.000	

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**              HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE               **
**                HELP MODEL VERSION 3.07  (1 NOVEMBER 1997)                **
**                  DEVELOPED BY ENVIRONMENTAL LABORATORY                   **
**                    USAE WATERWAYS EXPERIMENT STATION                     **
**             FOR USEPA RISK REDUCTION ENGINEERING LABORATORY              **
**                                                                          **
**                                                                          **
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PRECIPITATION DATA FILE:     C:\CMSLF\DATA4.D4
TEMPERATURE DATA FILE:       C:\CMSLF\DATA7.D7
SOLAR RADIATION DATA FILE:   C:\CMSLF\DATA13.D13
EVAPOTRANSPIRATION DATA:     C:\CMSLF\DATA11.D11
SOIL AND DESIGN DATA FILE:   C:\CMSLF\130FT\DATA10.D10
OUTPUT DATA FILE:            C:\CMSLF\130FT\130FT.OUT


TIME:  11: 0     DATE:  10/ 1/2010


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     TITLE:  CMS LANDFILL V PHASE 3 - 130 FEET OF WASTE

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     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   7
          THICKNESS                  =     12.00   INCHES
          POROSITY                   =      0.4730 VOL/VOL
          FIELD CAPACITY             =      0.2220 VOL/VOL
          WILTING POINT              =      0.1040 VOL/VOL
          INITIAL SOIL WATER CONTENT =      0.2078 VOL/VOL
          EFFECTIVE SAT. HYD. COND.  =  0.520000001000E-03 CM/SEC


                                  LAYER  2
                                  --------

                 TYPE 1 - VERTICAL PERCOLATION LAYER
                     MATERIAL TEXTURE NUMBER  18
          THICKNESS                  =   1560.00   INCHES
          POROSITY                   =      0.6710 VOL/VOL
          FIELD CAPACITY             =      0.2920 VOL/VOL
          WILTING POINT              =      0.0770 VOL/VOL
          INITIAL SOIL WATER CONTENT =      0.2937 VOL/VOL
          EFFECTIVE SAT. HYD. COND.  =  0.100000005000E-02 CM/SEC
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                         LAYER  3
                         --------

          TYPE 1 - VERTICAL PERCOLATION LAYER
              MATERIAL TEXTURE NUMBER   0
THICKNESS                    =      24.00   INCHES
POROSITY                     =       0.3980 VOL/VOL
FIELD CAPACITY               =       0.2440 VOL/VOL
WILTING POINT                =       0.1360 VOL/VOL
INITIAL SOIL WATER CONTENT   =       0.2674 VOL/VOL
EFFECTIVE SAT. HYD. COND.    =  0.999999975000E-04 CM/SEC   /x10^-4 cm/sec


                         LAYER  4
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            TYPE 2 - LATERAL DRAINAGE LAYER
              MATERIAL TEXTURE NUMBER   0
THICKNESS                    =       0.33   INCHES
POROSITY                     =       0.7500 VOL/VOL
FIELD CAPACITY               =       0.7470 VOL/VOL
WILTING POINT                =       0.4000 VOL/VOL
INITIAL SOIL WATER CONTENT   =       0.7471 VOL/VOL
EFFECTIVE SAT. HYD. COND.    =   2.72000003000      CM/SEC
SLOPE                        =       2.00   PERCENT
DRAINAGE LENGTH              =     300.0    FEET


                         LAYER  5
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            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          =       4.00   HOLES/ACRE
FML INSTALLATION DEFECTS     =       3.00   HOLES/ACRE
FML PLACEMENT QUALITY        =  3 - GOOD


                         LAYER  6
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              TYPE 3 - BARRIER SOIL LINER
              MATERIAL TEXTURE NUMBER  16
THICKNESS                    =      24.00   INCHES
POROSITY                     =       0.4270 VOL/VOL
FIELD CAPACITY               =       0.4180 VOL/VOL
WILTING POINT                =       0.3670 VOL/VOL
INITIAL SOIL WATER CONTENT   =       0.4270 VOL/VOL
EFFECTIVE SAT. HYD. COND.    =  0.100000001000E-06 CM/SEC   /x10^-7 cm/sec
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GENERAL DESIGN AND EVAPORATIVE ZONE DATA

NOTE: SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT SOIL DATA BASE USING SOIL TEXTURE # 7 WITH BARE GROUND CONDITIONS, A SURFACE SLOPE OF 2.% AND A SLOPE LENGTH OF 30. FEET.

SCS RUNOFF CURVE NUMBER	=	89.50	
FRACTION OF AREA ALLOWING RUNOFF	=	0.0	PERCENT
AREA PROJECTED ON HORIZONTAL PLANE	=	1.000	ACRES
EVAPORATIVE ZONE DEPTH	=	10.0	INCHES
INITIAL WATER IN EVAPORATIVE ZONE	=	1.953	INCHES
UPPER LIMIT OF EVAPORATIVE STORAGE	=	4.730	INCHES
LOWER LIMIT OF EVAPORATIVE STORAGE	=	1.040	INCHES
INITIAL SNOW WATER	=	0.000	INCHES
INITIAL WATER IN LAYER MATERIALS	=	477.577	INCHES
TOTAL INITIAL WATER	=	477.577	INCHES
TOTAL SUBSURFACE INFLOW	=	0.00	INCHES/YEAR

EVAPOTRANSPIRATION AND WEATHER DATA

NOTE: EVAPOTRANSPIRATION DATA WAS OBTAINED FROM CHARLOTTE NORTH CAROLINA

STATION LATITUDE	=	35.20	DEGREES
MAXIMUM LEAF AREA INDEX	=	0.00	
START OF GROWING SEASON (JULIAN DATE)	=	83	
END OF GROWING SEASON (JULIAN DATE)	=	312	
EVAPORATIVE ZONE DEPTH	=	10.0	INCHES
AVERAGE ANNUAL WIND SPEED	=	7.50	MPH
AVERAGE 1ST QUARTER RELATIVE HUMIDITY	=	64.00	%
AVERAGE 2ND QUARTER RELATIVE HUMIDITY	=	67.00	%
AVERAGE 3RD QUARTER RELATIVE HUMIDITY	=	74.00	%
AVERAGE 4TH QUARTER RELATIVE HUMIDITY	=	70.00	%

NOTE: PRECIPITATION DATA WAS SYNTHETICALLY GENERATED USING COEFFICIENTS FOR CHARLOTTE NORTH CAROLINA

NORMAL MEAN MONTHLY PRECIPITATION (INCHES)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
3.80	3.81	4.83	3.27	3.64	3.57
3.92	3.75	3.59	2.72	2.86	3.40

NOTE: TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING COEFFICIENTS FOR CHARLOTTE NORTH CAROLINA

NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
40.50	42.90	50.40	60.30	68.20	75.00
78.50	77.90	72.00	60.70	50.70	42.60

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING COEFFICIENTS FOR CHARLOTTE NORTH CAROLINA AND STATION LATITUDE = 35.20 DEGREES

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ANNUAL TOTALS FOR YEAR 1

	INCHES	CU. FEET	PERCENT
PRECIPITATION	39.37	142913.141	100.00
RUNOFF	0.000	0.000	0.00
EVAPOTRANSPIRATION	24.427	88668.859	62.04
DRAINAGE COLLECTED FROM LAYER 4	14.8387	53864.594	37.69
PERC./LEAKAGE THROUGH LAYER 6	0.000063	0.228	0.00
AVG. HEAD ON TOP OF LAYER 5	0.0399		
CHANGE IN WATER STORAGE	0.105	379.417	0.27
SOIL WATER AT START OF YEAR	477.577	1733604.000	
SOIL WATER AT END OF YEAR	477.681	1733983.370	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.039	0.00

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ANNUAL TOTALS FOR YEAR 2

	INCHES	CU. FEET	PERCENT
PRECIPITATION	45.97	166871.141	100.00
RUNOFF	0.000	0.000	0.00
EVAPOTRANSPIRATION	28.297	102718.000	61.56
DRAINAGE COLLECTED FROM LAYER 4	20.3311	73802.070	44.23
PERC./LEAKAGE THROUGH LAYER 6	0.000083	0.302	0.00
AVG. HEAD ON TOP OF LAYER 5	0.0542		
CHANGE IN WATER STORAGE	-2.658	-9649.277	-5.78
SOIL WATER AT START OF YEAR	477.681	1733983.370	
SOIL WATER AT END OF YEAR	475.023	1724334.120	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.051	0.00

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ANNUAL TOTALS FOR YEAR 3

	INCHES	CU. FEET	PERCENT
PRECIPITATION	48.06	174457.781	100.00
RUNOFF	0.000	0.000	0.00
EVAPOTRANSPIRATION	31.699	115065.648	65.96
DRAINAGE COLLECTED FROM LAYER 4	16.7755	60894.910	34.91
PERC./LEAKAGE THROUGH LAYER 6	0.000070	0.255	0.00
AVG. HEAD ON TOP OF LAYER 5	0.0446		
CHANGE IN WATER STORAGE	-0.414	-1502.871	-0.86
SOIL WATER AT START OF YEAR	475.023	1724334.120	
SOIL WATER AT END OF YEAR	474.360	1721925.870	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.249	905.349	0.52
ANNUAL WATER BUDGET BALANCE	0.0000	-0.167	0.00

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ANNUAL TOTALS FOR YEAR 4

	INCHES	CU. FEET	PERCENT
PRECIPITATION	36.84	133729.203	100.00
RUNOFF	0.000	0.000	0.00
EVAPOTRANSPIRATION	21.674	78674.914	58.83
DRAINAGE COLLECTED FROM LAYER 4	14.1719	51444.145	38.47
PERC./LEAKAGE THROUGH LAYER 6	0.000060	0.219	0.00
AVG. HEAD ON TOP OF LAYER 5	0.0377		
CHANGE IN WATER STORAGE	0.994	3609.773	2.70
SOIL WATER AT START OF YEAR	474.360	1721925.870	
SOIL WATER AT END OF YEAR	475.604	1726441.000	
SNOW WATER AT START OF YEAR	0.249	905.349	0.68
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.147	0.00

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ANNUAL TOTALS FOR YEAR 5

	INCHES	CU. FEET	PERCENT
PRECIPITATION	45.76	166108.812	100.00
RUNOFF	0.000	0.000	0.00
EVAPOTRANSPIRATION	27.795	100894.703	60.74
DRAINAGE COLLECTED FROM LAYER 4	16.0629	58308.227	35.10
PERC./LEAKAGE THROUGH LAYER 6	0.000067	0.244	0.00
AVG. HEAD ON TOP OF LAYER 5	0.0427		
CHANGE IN WATER STORAGE	1.902	6905.619	4.16
SOIL WATER AT START OF YEAR	475.604	1726441.000	
SOIL WATER AT END OF YEAR	477.506	1733346.620	
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	0.019	0.00

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AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1 THROUGH 5

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	3.35	3.78	5.11	2.89	3.89	4.60
	3.88	3.64	3.32	3.80	1.67	3.27
STD. DEVIATIONS	2.40	1.67	1.54	1.83	2.41	1.14
	1.36	2.89	1.20	2.01	1.40	1.72
RUNOFF						
TOTALS	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000
STD. DEVIATIONS	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000
EVAPOTRANSPIRATION						
TOTALS	1.463	1.887	3.089	2.589	2.599	2.551
	3.705	2.104	2.415	1.836	1.265	1.277
STD. DEVIATIONS	0.219	0.545	0.344	1.366	1.805	0.897
	2.218	1.934	1.449	1.245	1.042	0.181

LATERAL DRAINAGE COLLECTED FROM LAYER 4

TOTALS	0.9117	1.0078	1.2961	1.8163	1.8565	1.6659
	1.4033	1.6190	1.1491	1.2197	1.1185	1.3720
STD. DEVIATIONS	0.3913	0.6610	0.5382	0.6153	0.9003	0.6307
	0.7270	0.7347	0.2229	0.8022	0.4227	0.9022

PERCOLATION/LEAKAGE THROUGH LAYER 6

TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)

DAILY AVERAGE HEAD ON TOP OF LAYER 5

AVERAGES	0.0286	0.0350	0.0408	0.0589	0.0583	0.0541
	0.0441	0.0509	0.0373	0.0383	0.0363	0.0431
STD. DEVIATIONS	0.0123	0.0231	0.0168	0.0200	0.0283	0.0205
	0.0228	0.0230	0.0073	0.0251	0.0137	0.0283

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AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1 THROUGH 5

	INCHES		CU. FEET	PERCENT
PRECIPITATION	43.20	(4.821)	156816.0	100.00
RUNOFF	0.000	(0.0000)	0.00	0.000
EVAPOTRANSPIRATION	26.778	(3.8450)	97204.43	61.986
LATERAL DRAINAGE COLLECTED FROM LAYER 4	16.43603	(2.40332)	59662.793	38.04636
PERCOLATION/LEAKAGE THROUGH LAYER 6	0.00007	(0.00001)	0.250	0.00016
AVERAGE HEAD ON TOP OF LAYER 5	0.044	(0.006)		
CHANGE IN WATER STORAGE	-0.014	(1.7216)	-51.47	-0.033

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PEAK DAILY VALUES FOR YEARS 1 THROUGH 5

	(INCHES)	(CU. FT.)
PRECIPITATION	2.43	8820.900

RUNOFF	0.000	0.0000
DRAINAGE COLLECTED FROM LAYER 4	0.16001	580.85175
PERCOLATION/LEAKAGE THROUGH LAYER 6	0.000001	0.00218
AVERAGE HEAD ON TOP OF LAYER 5	0.156	
MAXIMUM HEAD ON TOP OF LAYER 5	0.305	
LOCATION OF MAXIMUM HEAD IN LAYER 4 (DISTANCE FROM DRAIN)	5.7 FEET	
SNOW WATER	2.24	8132.3433

MAXIMUM VEG. SOIL WATER (VOL/VOL)	0.3835
MINIMUM VEG. SOIL WATER (VOL/VOL)	0.1040

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

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

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FINAL WATER STORAGE AT END OF YEAR 5

LAYER	(INCHES)	(VOL/VOL)
1	3.3555	0.2796
2	456.5770	0.2927
3	7.0788	0.2950
4	0.2467	0.7474
5	0.0000	0.0000
6	10.2480	0.4270
SNOW WATER	0.000	

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