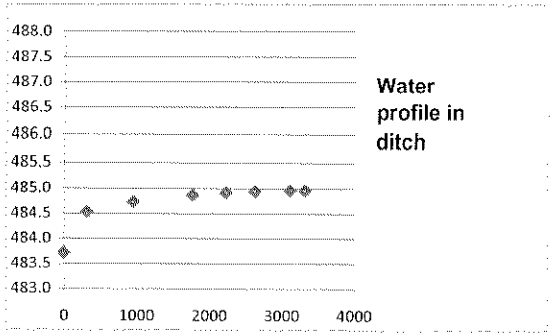
Ameren Labadie Energy Center Utility Waste Landfill
Perimeter Ditch Water Profile: 25-yr, 1-hr event
Elevation for Stated Flow
Counter Clockwise from Pond 3
Table N-7

			$S_{s,left}$ = 3		$S_{s,right}$ = 3		Base Width (ft) = 9		Mannings N = 0.02		So (ft) = 0		Runoff Factor for 2.63 in/ hr rainfall= 0.017					
Elevation	Depth	Channel Bottom Elevation	Slope of Water Surface	Adjusted Base	Adjusted Height	Area	Velocity	$v^2/2g$	Specific Energy	Hydraulic Radius	Slope	S-So	Distance	Total Distance	True Distance	Location	Distance from Culvert	Q
							Average Velocity		Change in Specfic Energy	Average Hydraulic Radius								
(ft)	(ft)	(ft)	(ft/ft)	(ft)	(ft)	(sf)	(fps)	(ft)	(ft)	(ft)	(ft/ft)	(ft/ft)	(ft)	(ft)	(ft)		(ft)	(cfs)
483.72	0.72	483				8.04	4.058	0.2557	0.976	0.593				0	0	Pond 3	0	32.61
	0.81		0.0024				2.813		0.592	0.853	1.77E-03	1.77E-03	334	334	320			
484.53	1.53	483		9.00	1.5300	20.79	1.568	0.0382	1.568	1.113						Letdown 13	320	32.61
	0.20		0.0003				1.415		0.187	1.172	2.94E-04	2.94E-04	635	969	960			
484.73	1.73	483		9.00	1.7300	24.55	1.262	0.0247	1.755	1.231						Letdown 12	960	30.97
	0.14		0.0002				1.106		0.129	1.271	1.61E-04	1.61E-04	803	1772	1780			
484.87	1.87	483		9.00	1.8700	27.32	0.950	0.0140	1.884	1.312						Letdown 29	1780	25.96
	0.05		0.0001				0.860		0.045	1.326	9.21E-05	9.21E-05	491	2262	2240			
484.92	1.92	483		9.00	1.9200	28.34	0.770	0.0092	1.929	1.340						Letdown 28	2240	21.82
	0.03		7E-05				0.670		0.021	1.347	5.47E-05	5.47E-05	381	2643	2640			
484.95	1.95	483		9.00	1.9450	28.85	0.570	0.0051	1.950	1.355						Letdown 27	2640	16.46
	0.02		3E-05				0.480		0.013	1.359	2.77E-05	2.77E-05	480	3123	3120			
484.96	1.96	483		9.00	1.9610	29.19	0.389	0.0023	1.963	1.364						Letdown 26	3120	11.35
	0.00		2E-05				0.250		0.002	1.365	7.50E-06	7.50E-06	246	3369	3330			
484.97	1.97	483		9.00	1.9650	29.27	0.112	0.0002	1.965	1.366						Letdown 25	3330	3.27

Notes:

1. Rainfall event used is 25-yr, 1-hr storm which produces 2.63 inches of rain.
2. Longitudinal slope of channel assumed to be as stated for So.
3. Flows are split generally at half the distance between the entrances to the pond along the perimeter ditch.
4. Flows coming to a letdown structure and from below the bench served by the letdown structure are combined as the flow at the letdown structure for modeling purposes.
5. Model is adapted from Illustrative problem on page 380 in "Elementary Fluid Mechanics" by John Vennard, Wiley and Sons, 1961.



Ameren Labadie Energy Center Utility Waste Landfill
Stormwater Management Pond 1
Pond Volume Calculations
Table N-8

Base Width of Pond in feet	373
Base Length of Pond in feet	573
Rise of Slope in feet	1
Run of Slope in feet	3

WIDTH (FT)	LENGTH	WATER LEVEL (FT)	AVERAGE AREA (SQ FT)	VOLUME PER INCREMENT (VOL/FT)	TOTAL VOLUME OF POND (CU FT)	TOTAL VOLUME OF POND (ACRE FEET)	CAPACITY IN USE (ACRE FEET	REMAINING CAPACITY (ACRE FEET)	Elevation (FEET)
373	573								468
379	579	1	108,293	108,293	108,293	2.5	-----	-----	469
385	585	2	111,167	111,167	219,459	5.0	-----	-----	470
391	591	3	114,077	114,077	333,536	7.7	-----	-----	471
397	597	4	117,023	117,023	450,558	10.3	0.0	34.3	472
403	603	5	120,005	120,005	570,563	13.1	2.8	31.5	473
409	609	6	123,023	123,023	693,585	15.9	5.6	28.7	474
415	615	7	126,077	126,077	819,662	18.8	8.5	25.8	475
421	621	8	129,167	129,167	948,828	21.8	11.4	22.8	476
427	627	9	132,293	132,293	1,081,121	24.8	14.5	19.8	477
433	633	10	135,455	135,455	1,216,575	27.9	17.6	16.7	478
439	639	11	138,653	138,653	1,355,228	31.1	20.8	13.5	479
445	645	12	141,887	141,887	1,497,114	34.4	24.0	10.2	480
451	651	13	145,157	145,157	1,642,271	37.7	27.4	6.9	481
457	657	14	148,463	148,463	1,790,733	41.1	30.8	3.5	482
463	663	15	151,805	151,805	1,942,538	44.6	34.3	0.0	483
469	669	16	155,183	155,183	2,097,720	48.2	37.8		484

NOTES:

1. The table is valid for a triangular pond with a uniform interior side slope.
2. The table utilizes the 'end area method' of volume estimation utilizing the area of each one foot increment of pond depth, beginning at the bottom.
3. The volume due to the bottom slope below the 468 feet elevation was not considered in the capacity volume calculations. A minimum depth of three feet in the pond bottom is planned at all times.
4. The upper three feet of the pond are not counted in the capacity volume calculations due to the need to maintain a minimum freeboard to prevent wave damage above the maximum water level at all times.

Elevation:

468	Pond Bottom	
471	Minimum working depth	Three feet of water to prevent growth of objectionable vegetation.
483	Reserve for storm	25 year, 24 hour storm event.
484	Maximum high water	Three feet below emergency spillway.
487	Flood protection elevation	Height of emergency spillway.

[1] Rainfall intensities are from RAINFALL FREQUENCY ATLAS OF THE MIDWEST by Floyd A. Huff and James R. Angel, Midwestern Climate Center, 1992, http://www.sws.uiuc.edu/pubdoc/B/ISWSB-71.pdf

Ameren Labadie Energy Center Utility Waste Landfill
Stormwater Management Pond 2
Pond Volume Calculations
Table N-9

Base Width of Pond in feet	144
Base Length of Pond in feet	714
Rise of Slope in feet	1
Run of Slope in feet	3

WIDTH (FT)	LENGTH	WATER LEVEL (FT)	AVERAGE AREA (SQ FT)	VOLUME PER INCREMENT (VOL/FT)	TOTAL VOLUME OF POND (CU FT)	TOTAL VOLUME OF POND (ACRE FEET)	CAPACITY IN USE (ACRE FEET	REMAINING CAPACITY (ACRE FEET)	Elevation (FEET)
144	714								468
150	720	1	105,408	105,408	105,408	2.4	-----	-----	469
156	726	2	110,628	110,628	216,036	5.0	-----	-----	470
162	732	3	115,920	115,920	331,956	7.6	0.0	42.0	471
168	738	4	121,284	121,284	453,240	10.4	2.8	39.2	472
174	744	5	126,720	126,720	579,960	13.3	5.7	36.3	473
180	750	6	132,228	132,228	712,188	16.3	8.7	33.3	474
186	756	7	137,808	137,808	849,996	19.5	11.9	30.1	475
192	762	8	143,460	143,460	993,456	22.8	15.2	26.8	476
198	768	9	149,184	149,184	1,142,640	26.2	18.6	23.4	477
204	774	10	154,980	154,980	1,297,620	29.8	22.2	19.8	478
210	780	11	160,848	160,848	1,458,468	33.5	25.9	16.2	479
216	786	12	166,788	166,788	1,625,256	37.3	29.7	12.3	480
222	792	13	172,800	172,800	1,798,056	41.3	33.7	8.4	481
228	798	14	178,884	178,884	1,976,940	45.4	37.8	4.2	482
234	804	15	185,040	185,040	2,161,980	49.6	42.0	0.0	483
240	810	16	191,268	191,268	2,353,248	54.0	46.4		484

NOTES:
1. The table is valid for a rectangular pond with a uniform interior side slope.
2. The table utilizes the 'end area method' of volume estimation utilizing the area of each one foot increment of pond depth, beginning at the bottom.
3. The volume due to the bottom slope below the 468 feet elevation was not considered in the capacity volume calculations. A minimum depth of three feet in the pond bottom is planned at all times.
4. The upper three feet of the pond are not counted in the capacity volume calculations due to the need to maintain a minimum freeboard to prevent wave damage above the maximum water level at all times.

Elevation:

468	Pond Bottom	
471	Minimum working depth	Three feet of water to prevent growth of objectionable vegetation.
483	Reserve for storm	25 year, 24 hour storm event.
484	Maximum high water	Three feet below emergency spillway.
487	Flood protection elevation	Height of emergency spillway.

[1] Rainfall intensities are from RAINFALL FREQUENCY ATLAS OF THE MIDWEST by Floyd A. Huff and James R. Angel, Midwestern Climate Center, 1992, http://www.sws.uiuc.edu/pubdoc/B/ISWSB-71.pdf

Ameren Labadie Energy Center Utility Waste Landfill
Stormwater Management Pond 3
Pond Volume Calculations
Table N-10

Base Width of Pond in feet	233
Base Length of Pond in feet	598
Rise of Slope in feet	1
Run of Slope in feet	3

WIDTH (FT)	LENGTH	WATER LEVEL (FT)	AVERAGE AREA (SQ FT)	VOLUME PER INCREMENT (VOL/FT)	TOTAL VOLUME OF POND (CU FT)	TOTAL VOLUME OF POND (ACRE FEET)	CAPACITY IN USE (ACRE FEET	REMAINING CAPACITY (ACRE FEET)	Elevation (FEET)
233	598								468
239	604	1	70,923	70,923	70,923	1.6	------	------	469
245	610	2	73,452	73,452	144,374	3.3	------	------	470
251	616	3	76,017	76,017	220,391	5.1	------	------	471
257	622	4	78,618	78,618	299,008	6.9	0.0	24.0	472
263	628	5	81,255	81,255	380,263	8.7	1.9	22.2	473
269	634	6	83,928	83,928	464,190	10.7	3.8	20.2	474
275	640	7	86,637	86,637	550,827	12.6	5.8	18.2	475
281	646	8	89,382	89,382	640,208	14.7	7.8	16.2	476
287	652	9	92,163	92,163	732,371	16.8	9.9	14.1	477
293	658	10	94,980	94,980	827,350	19.0	12.1	11.9	478
299	664	11	97,833	97,833	925,183	21.2	14.4	9.7	479
305	670	12	100,722	100,722	1,025,904	23.6	16.7	7.3	480
311	676	13	103,647	103,647	1,129,551	25.9	19.1	5.0	481
317	682	14	106,608	106,608	1,236,158	28.4	21.5	2.5	482
323	688	15	109,605	109,605	1,345,763	30.9	24.0	0.0	483
329	694	16	112,638	112,638	1,458,400	33.5	26.6		484

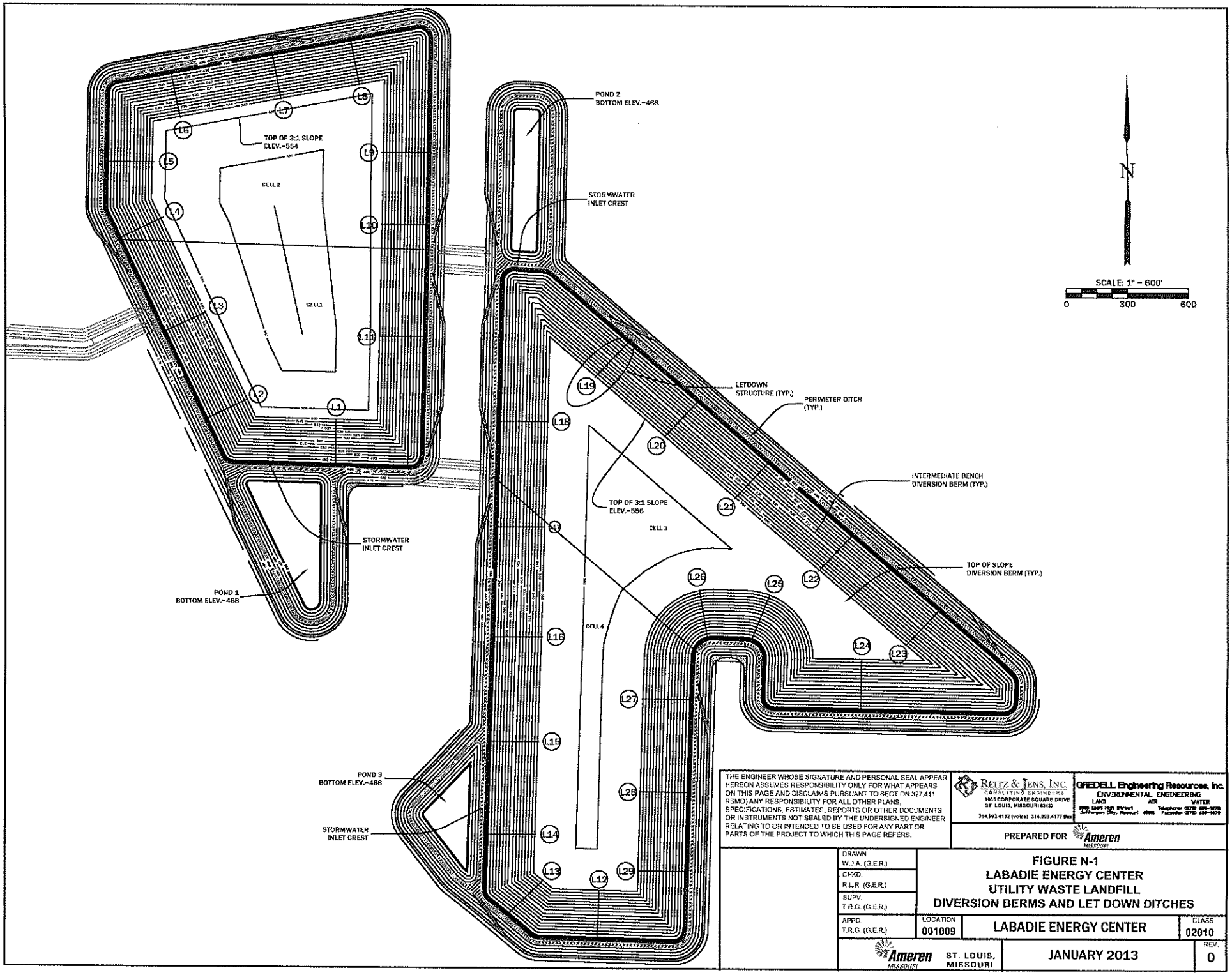
NOTES
1. The table is valid for a triangular pond with a uniform interior side slope.
2. The table utilizes the 'end area method' of volume estimation utilizing the area of each one foot increment of pond depth, beginning at the bottom.
3. The volume due to the bottom slope below the 468 feet elevation was not considered in the capacity volume calculations. A minimum depth of three feet in the pond bottom is planned at all times.
4. The upper three feet of the pond are not counted in the capacity volume calculations due to the need to maintain a minimum freeboard to prevent wave damage above the maximum water level at all times.

Elevation:

468	Pond Bottom	
471	Minimum working depth	Three feet of water to prevent growth of objectionable vegetation.
483	Reserve for storm	25 year, 24 hour storm event.
484	Maximum high water	Three feet below emergency spillway.
487	Flood protection elevation	Height of emergency spillway.

[1] Rainfall intensities are from RAINFALL FREQUENCY ATLAS OF THE MIDWEST by Floyd A. Huff and James R. Angel, Midwestern Climate Center, 1992, http://www.sws.uiuc.edu/pubdoc/B/ISWSB-71.pdf

FIGURES



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PREPARED FOR Ameren MISSOURI

DRAWN W.J.A. (G.E.R.)	FIGURE N-1 LABADIE ENERGY CENTER UTILITY WASTE LANDFILL DIVERSION BERMS AND LET DOWN DITCHES		
CHKD. R.L.R (G.E.R.)			
SUPV. T.R.G. (G.E.R.)			
APPD. T.R.G. (G.E.R.)	LOCATION 001009	LABADIE ENERGY CENTER	CLASS 02010
Ameren MISSOURI	ST. LOUIS, MISSOURI	JANUARY 2013	REV. 0

Appendix O

H.E.L.P Model Results

Ameren Missouri Labadie Energy Center
Utility Waste Landfill
Franklin County, MO
December 2012

H.E.L.P. Model Summary Results
Appendix O

This appendix summarizes the H.E.L.P. model results. The model cases and inputs follow the liner and leachate collection design details provided on Sheets 16 through 19 of the plan sheets. Version 3.07 of the Hydrologic Evaluation of Landfill Performance (H.E.L.P.) computer model was used to evaluate the anticipated performance of the design of the leachate collection and cover systems for selected cases. Three cases were modeled: 1.) The initial Coal Combustion Products (CCP) placement, 2.) An "operational" condition, and 3.) The final closed condition. The cases are described below.

Table O-1 (Cell 1), Summary of H.E.L.P. Model Results & Input Parameters, provides a summary of the results from the H.E.L.P. model cases. H.E.L.P. model reports for each case listed in Table O-1 are included in sub-appendices. For consistency, the following assumptions were made:

- The aggregate drainage layer is unaffected by textile intrusion.
- The geocomposite drainage layer is affected by textile intrusion as described by Robert M. Koerner in "Designing with Geosynthetics", fifth edition published in 2005 (Table O-2).
- Where textile intrusion is anticipated, the amount of intrusion resulting from the maximum height of CCP placed on the geocomposite is modeled beginning with the initial placement of CCP and is held constant as additional CCP was placed on the liner.
- The drainage layer is not affected by biological clogging.
- Initial moisture content was user specified in all cases. All layers, where applicable, were modeled at field capacity except for fly ash, which was modeled at 0.22 vol/vol (Provided by Reitz & Jens, Inc.).

The H.E.L.P. Model evaluations were run using precipitation, temperature, solar radiation, and evapotranspiration for St. Louis, Missouri and soil data for the Ameren Missouri Labadie Energy Center UWL. The H.E.L.P. model cases were run for appropriate periods and the peak daily values are presented to represent worst-case conditions.

Properties of the various materials for design of the layers were considered. The H.E.L.P. Model cases utilizing an aggregate drain layer with a minimum hydraulic conductivity of 0.25 cm/sec and only the initial layer of CCP indicates that the minimum value of hydraulic

conductivity of locally available aggregate materials resulted in less head on the liner than the regulatory limit of 12 inches. The particle gradation of the protective layer above the drain layer was designed to prevent the fine fly ash from migrating into, and plugging, the drain layer. The protective layer gradation analysis is provided in memo by Bruce Dawson, P.E., dated June 22, 2012 (Appendix O-1). For the alternate use of geocomposites, the manufacturer's stated transmissivity, shown on the product sheets, was reduced using Koerner's method (Table O-2).

Results in Table O-1 are reported for the cases of initial, operating and closed conditions, for aggregate material and geocomposite drain layers for: (1) the 1% base (floor) for the landfill, (2) the 33% side slope; (3) and the Schroeder approximation. Results for the maximum head on the liner, peak daily leachate flow, average annual leachate flow and the annual leachate volume are reported.

The potential effect of geotextile intrusion in the drainage layer was evaluated for the initial placement of CCP over a geocomposite drainage layer. The product data sheets (Appendix O-1) are summarized in the attached table titled "Effect of Reduction Factors on Hydraulic Conductivity", Table O-2. The H.E.L.P. Model cases for the geocomposite drain layer were run with a resultant hydraulic conductivity of 1.3 cm/sec as specified by the GSE PermaNet HL ($10oz/yd^2$) geocomposite in Table O-2. The transmissivities reported for each geonet are converted into hydraulic conductivity by dividing the transmissivity by the thickness of the geonet. These transmissivities are further reduced by factors for creep, chemical clogging, geotextile intrusion and particle clogging in a method proposed by Koerner in *Designing with Geosynthetics* 5^{th} Edition. Koerner divided (reduced) the transmissivity by each factor. The reduction factors assumed by Koerner are also summarized in the attached table. A brief description of each of the reduction factors follows:

> Creep is the deformation of the geonet under an applied load. The pressure from coal combustion products will reduce the thickness of the geocomposite. Published values for creep are used where available, otherwise a value of 1.8 was assumed. Creep was not considered an influence for gravel.
>
> Chemical clogging occurs when dissolved substances form a precipitate that deposits in the drainage layer. Most of the coal combustion products are expected to have low solubilities in water. A value of 1.8 was assigned to reduce transmissivity by 55% for both the gravel and the geocomposite.
>
> Geotextile intrusion occurs when the geotextile is forced into the geonet. For bonded geotextile-geonet-geotextile composites, this intrusion is considered. A factor of 2 has been assigned to account for geotextile intrusion into the geonet. For the 12 inch gravel layer, geotextile intrusion is not expected to be a significant problem.
>
> Particle clogging from infiltration occurs when particles fill in the openings in the geotextile. In a similar way to a coffee filter protecting the drain in a coffee pot from

plugging, the geotextile serves to protect the geonet or gravel from plugging. Koerner handles particle clogging as a filtration problem. To be consistent with this analysis, the transmissivity was reduced by a factor of 1.8 to account for particle clogging. Dawson provides analysis of local materials to be used to prevent particle clogging.

Koerner also suggests biological clogging. This clogging of the geonet or gravel occurs when microbes have a supply of organic nutrients and water. The disposal of coal combustion products is not anticipated to supply organic nutrients to the extent that a sanitary landfill might. Therefore, it is assumed that biological clogging will not affect the drainage layer and the factor is set at 1.

Taken together, these reductions on the hydraulic conductivity result in a more-than ten-fold reduction in the published values for the geocomposite materials.

The cases modeled include initial, operating and closed conditions. The H.E.L.P. model runs are identified by the conditions modeled and the material used in the leachate collection layer. The case identification numbering system is also explained below:

Condition

- Initial condition is identified by "I" and models the initial phase of construction with waste still below the top of berm. This condition is modeled for a period of seven years (7 yr.).
    - AM signifies aggregate materials used for the leachate drainage layer and is layered (top down) as;
        - Coal Combustion Products. (vertical percolation)
        - A protective layer of graded aggregate to keep fly ash from migrating into the leachate collection layer. (vertical percolation)
        - Geotextile separator between the protective layer and the aggregate materials of the leachate collection layer. (not included in H.E.L.P model)
        - Aggregate materials are clean aggregate with a minimum hydraulic conductivity. (lateral drainage or leachate collection layer)
        - A geomembrane liner (primary liner) is next. (synthetic barrier)
        - Finally, a layer of 2-foot thick compacted clay soil (secondary liner) in contact with the geomembrane to form the composite liner. (soil barrier)
            - Case Identification Numbers 1, 2 and 3 indicate modeling of the 1% floor of the cell, the 33% inner side slope of the cell and the Schroeder approximation of the floor and side slope of the cell. Schroeder's approximation is used to approximate the longest length to the leachate collection pipe in order to accurately estimate head on the liner. It was used for the Initial and Operational cases to model the combined effects of the

33% sidewall and 1% floor of the bottom liner. The equation for Schroeder's Approximation (L') is: length of the bottom slope * (volume of water from the bottom + volume of water at sidewall) / volume of water from the bottom {L'=Lb*(Vb+Vs)/Vb}. Schroeder's approximation was not used on the final, closed condition case. Dr. Paul Schroeder of the USCOE, provided this approximation to the Missouri Department of Natural Resources in response to a question about a very long side slope at another landfill. It is used here to make sure no extreme flows are being missed.

- The designation like R003, is reserved for the use of revisions to any particular run using the format of Rxxx, where xxx is the run number.

- GE signifies geocomposites used in the leachate collection layer and is layered (top down) as:
  - Coal Combustion Products. (vertical percolation)
  - A protective layer of graded aggregate to keep fly ash from migrating into the leachate collection layer. (vertical percolation)
  - The geocomposite is manufactured as a composition of geotextile fabric-geonet-geotextile fabric. (lateral drainage or leachate collection layer)
  - A geomembrane liner (primary liner) is next. (synthetic barrier)
  - Finally, a layer of 2-foot thick compacted clay soil (secondary liner) in contact with the geomembrane to form the composite liner. (soil barrier)

- Operating condition models the placement of coal combustion products above the top of the perimeter berm and having an additional layer of soil placed as an intermediate cover for the cell. The intermediate cover is used for both the aggregate material and the geocomposite leachate models. The operating conditions were modeled for a period of 25 years.
- Closed condition models the placement of a final cap over the top of landfill. For both aggregate materials and geocomposite leachate collection it is modeled as:
  - A vegetative soil layer to support grasses. (vertical percolation)
  - A geotextile used as a cushion and drainage layer. (lateral drainage)
  - A geomembrane liner is used as a primary liner to prevent water from getting to the coal combustion products. (vertical barrier)
  - Layering below follows the pattern in the operating and initial conditions.

The operating condition is found to be the case that produces the most leachate. The precipitation falling on the initial layer of CCP has little chance for storage in the CCP column. It is more quickly transported to the leachate drainage layer and geomembrane

liner. The hydraulic head forces this water to flow into the leachate collection system. If the maximum hydraulic head can be maintained below the regulatory limit under the case of initial CCP placement, placement of additional CCP allows for more storage of water within the CCP mass and may lower the maximum hydraulic head on the geomembrane liner.

The H.E.L.P. model cases are sensitive to the length of the flow path of leachate in the drainage layer. As proposed, Phase 1/Cell 1 has the longest flow path present in any of the phases of the UWL. Cell 1 is also the cell that is opened first. The longest distance of 541 feet was scaled from the toe of slope to the leachate collection system perpendicular to contours. The side slope was also modeled and the impact on flow was incorporated using the Schroeder approximation.

As proposed, Phase 3/Cell 3 is expected to have the maximum leachate flow present in any of the phases of the UWL due to size (57 acres). The largest leachate collection zone in Cell 3 is smaller than the largest collection zone in Cell 1. The longest distance of 400 feet (as scaled from the dividing break-line in the leachate collection zone perpendicular to the leachate collection line contours) is significantly shorter than Cell 1. Therefore, Cell 1 represents the worst case scenario.

Critical cases presented indicate that the design parameters proposed will meet the regulatory standards for effectively collecting leachate while not allowing a hydraulic head on the liner that exceeds the regulatory limit of 12-inches. These cases are summarized on Table O-1 with H.E.L.P. results in Appendices O-2 through O-13.

The H.E.L.P. model results indicate that the leachate collection, liner and cover systems meet regulatory requirements. The model results also indicate that peak leachate flows and maximum hydraulic head on the bottom liner occurs during the intermediate operation of each cell when there is an average 20-foot thickness of CCP over the liner and leachate collection system, and intermediate cover is in place. Therefore, the worst case is expected to be short-lived and the performance of the liner and leachate collections system is expected to improve as additional CCP is placed in the disposal cell. After closure, the leachate generation rates drop substantially.

TABLES

Ameren Missouri
Labadie Energy Center Utility Waste Landfill
Franklin, County Missouri

TABLE O-1: SUMMARY OF HELP MODEL RESULTS & INPUT PARAMETERS
for Cell 1

Sub Appendix	Case No.	Acres	Case Modeled	Drainage Layer Material	Drainage Length (ft)	Maximum Head on Liner (in)	Peak Daily Leachate Volume		Average Annual Leachate Volume		Rainfall	
							(ft^3/day)	Flow GPM (GPAD) See Notes 5 & 6	(ft^3/year)	Flow GPM (GPAD) See Notes 5 & 6	Average Annual (ft^3/year)	Peak Daily (ft^3/day)
Initial Waste Placement Condition - Modeled at 7 Years - 7 ft of Waste - No Intermediate Cover												
O-2	IAM1R003	28.1	Cell 1 using Aggregate Material in the leachate collection system for the 1% bottom slope of the landfill.	Aggregate Material	541	0.540	746	NA	91,489	NA	NA	NA
O-3	IAM3R003	31.4	Cell 1 using Aggregate Materials in the leachate collection system. Use Schroeder's approximation for drainage length (See Note 3).	Aggregate Material	725	0.7	812	4.2 (193.4)	108,533	1.5 (70.8)	3,869,852	296,354
O-4	IGE1R003	28.1	Cell 1 using Geocomposite in the leachate collection system for the 1% bottom slope of the landfill.	Geocomposite	541	0.114	803	NA	91,742	NA	NA	NA
O-5	IGE2R003	3.3	Cell 1 using Geocomposites in the leachate collection system for the 33% side slopes of the landfill.	Geocomposite	60	0.012	253	NA	20,904	NA	NA	NA
O-6	IGE3R003	31.4	Cell 1 using Geocomposites in the leachate collection system. Use Schroeder's approximation for drainage length (See Note 3).	Geocomposite	712	0.149	887	4.6 (211.3)	108,979	1.6 (71.1)	3,869,852	296,354

Notes located on Page 3 of 3

Ameren Missouri
Labadie Energy Center Utility Waste Landfill
Franklin, County Missouri

TABLE O-1: SUMMARY OF HELP MODEL RESULTS & INPUT PARAMETERS
for Cell 1

Sub Appendix	Case No.	Acres	Case Modeled	Drainage Layer Material	Drainage Length (ft)	Maximum Head on Liner (in)	Peak Daily Leachate Volume		Average Annual Leachate Volume		Rainfall	
							(ft^3/day)	Flow GPM (GPAD) See Notes 5 & 6	(ft^3/year)	Flow GPM (GPAD) See Notes 5 & 6	Average Annual (ft^3/year)	Peak Daily (ft^3/day)
Intermediate Operating Condition - Modeled at 25 Years - 20 ft of Waste - Intermediate Cover												
O-7	OAM1R003	28.1	Cell 1 Operating Condition with Intermediate Cover using Aggregate Materials in the leachate collection system for the 1% bottom slope of the landfill.	Aggregate Material	541	1.437	2,060	NA	287,168	NA	3,411,430	350,891
O-8	OAM3R003	31.4	Cell 1 Operating Condition with Intermediate Cover using Aggregate Materials in the leachate collection system. Use Schroeder's approximation for drainage length (See Note 3).	Aggregate Material	637	1.66	2,254	11.7 (536.9)	320,708	4.6 (209.3)	3,812,060	392,099
O-9	OGE1R003	28.1	Cell 1 Operating Condition with Intermediate Cover using Geocomposites in in the leachate collection system for the 1% bottom slope of the landfill.	Geocomposite	541	0.336	2,368	NA	287,681	NA	3,411,430	350,891
O-10	OGE2R003	3.3	Cell 1 Operating Condition for 33% side slopes with Intermediate Cover using Geocomposites in the leachate collection system.	Geocomposite	60	0.016	375	NA	36,856	NA	400,631	41,208
O-11	OGE3R003	31.4	Cell 1 Operating Condition with Intermediate Cover using Geocomposites in the leachate collection system. Use Schroeder's approximation for drainage length (See Note 3).	Geocomposite	627	0.4	2,571	13.4 (612.5)	321,394	4.6 (209.8)	3,812,060	392,099

Notes located on Page 3 of 3

Ameren Missouri
Labadie Energy Center Utility Waste Landfill
Franklin, County Missouri

TABLE O-1: SUMMARY OF HELP MODEL RESULTS & INPUT PARAMETERS
for Cell 1

Sub Appendix	Case No.	Acres	Case Modeled	Drainage Layer Material	Drainage Length (ft)	Maximum Head on Liner (in)	Peak Daily Leachate Volume		Average Annual Leachate Volume		Rainfall	
							(ft^3/day)	Flow GPM (GPAD) See Notes 5 & 6	(ft^3/year)	Flow GPM (GPAD) See Notes 5 & 6	Average Annual (ft^3/year)	Peak Daily (ft^3/day)
Closed Condition - Modeled at 30 Years - ~58 ft of Waste - Final Cover												
O-12	CAM1R002	31.4	Cell 1 Closed Condition with Final Cover using Aggregate Materials in the leachate collection system for the 1% bottom slope of the landfill.	Aggregate Material	541	1.322	211	1.1 (50.3)	22,376	0.3 (14.6)	3,785,646	392,099
O-13	CGE1R003	31.4	Cell 1 Closed Condition with Final Cover using Geocomposites in the leachate collection system for the 1% bottom slope of the landfill.	Geocomposite	541	0.044	346	1.8 (82.4)	23,252	0.3 (15.2)	3,785,646	392,099

Notes:

1 Leaf Area Index (LAI) values for the Initial & Operational cases were set at 0.5 to assume bare ground conditions. LAI values for the Closed condition were set at 2.0 to assume average ground conditions. LAI values ranges for the Labadie area are from 0 to 4.5.

2 Geotextile layers at the bottom of the leachate collection protective cover and at the bottom of the Aggregate Material layer are not included in the HELP model cases. The k values of these layers are similar to their adjacent layers and their relatively small thickness make their affect negligible.

3 Schroeder's approximation is used to approximate the longest length to the leachate collection in order to accurately estimate head on the liner. It was used for the Initial and Operational cases to model the combined effects of the sidewall and floor of the bottom liner. The equation for Schroeder's Approximation (L') is: length of the bottom slope * (volume of water from the bottom + volume of water at sidewall) / volume of water from the bottom {L'=Lb*(Vb+Vs)/Vb}. Schroeder's approximation was not used on the closed condition.

4 Depth of waste placement on side slope cases are an average height of waste over/under slope.

5 Gallons per minute (GPM) is calculated from the reported peak and average daily volume in cubic feet per day and cubic feet per year, respectively, within the HELP model cases.

6 Gallons per acre per day (GPAD) is calculated from the reported peak amd average daily volume in cubic feet per day and cubic feet per year, respectively, within the HELP model cases.

7 Schroeder's Approximation was not used for Closed condition cases since no leachate was generated.

8 Vegetative soil modeled as Silt Loam (ML).

9 Initial moisture content was user specified in all cases. All layers (where applicable) were modeled at field capacity except for Fly Ash, which was modeled at 0.22 vol/vol (from R&J).

10 SCS curve numbers were determined by the HELP model in all cases.

11 HELP Model Case No. Description:
Character 1: Denotes the landfill condition modeled. I - initial waste placement, O - intermediate operating, C - closed
Characters 2 - 3: Denote the type of leachate collection system modeled. GE - geocomposite, AM - aggregate material.
Character 4: Denotes the location along the bottom liner that was modeled. 1 - floor (bottom at 1%), 2 - side slope at 33%, 3 - Schroeder's Approximation
Characters 5 - 8: Reserved for the use of revisions to any particular run using the format of Rxxx, where xxx is the run number.

12 NA - Not applicable values in the sum of leachate flow or precipitation.

Ameren Missouri
Labadie Energy Center Utility Waste Landfill
Franklin County, Missouri

EFFECT OF REDUCTION FACTORS ON HYDRAULIC CONDUCTIVITY

For geonet with two sided geotextile

Reduction Factors assumed by Koerner in Designing with Geosynthetics, 5th Ed. 2005

Table O-2

GEONET WITH GEOTEXTILE INTRUSION	GEONET					REDUCTION FACTORS				
MANUFACTURER / MODEL NUMBER	THICKNESS MILS	THICKNESS CM	[1]TRANSMISSIVITY M^2/SEC	TRANSMISSIVITY CM^2/SEC	HYDRAULIC CONDUCTIVITY CM/SEC	CREEP FACTOR	CHEMICAL CLOGGING FACTOR	GEOTEXTILE INTRUSION FACTOR	PARTICLE CLOGGING FACTOR	RESULTANT HYDRAULIC CONDUCTIVITY CM/SEC
GSE PermaNet TRx (8oz/yd^2)	300	0.76	2.2E-03	22	28.9	1.80	1.80	2	1.80	2.5
GSE PermaNet HL (10oz/yd^2)	270	0.69	1.0E-03	10	14.6	1.80	1.80	2	1.80	1.3
GSE PermaNet UL (10oz/yd^2)	300	0.76	1.0E-03	10	13.1	1.80	1.80	2	1.80	1.1

NOTES:

1. Transmissivity as reported for various geocomposites from manufacturer's product data sheets.

APPENDICES

Appendix O-1

1505 E. High Street
Jefferson City, Missouri 65101
Telephone No. (573) 659-9078
Fax No. (573) 659-9079

GREDELL Engineering Resources, Inc.

Memo

To: Rick Roberts, P.E.

From: Bruce Dawson, P.E.

CC: Tom Gredell, P.E.

Date: 6/22/2012

Re: Reitz & Jens:Labadie UWL/Protective Cover Specification Development

---

Proposed Specification Language:
Protective cover shall consist of a well-graded aggregate with a particle size between 9.5 mm and 0.075 mm, with 0 to 10 percent passing the No. 100 U.S. Sieve, a d_{50} particle size of (approximately) 0.5 to 0.9 mm, and a d_{15} particle size of (approximately) 0.2 to 0.4 mm.

Background:
MoDOT concrete sand (Missouri Standard Specifications for Highway Construction Section 1005):

% Passing 3/8" (9.5mm):	100
% Passing No. 4 (4.75 mm):	95-100
% Passing No. 8 (2.38 mm):	70-100
% Passing No. 16 (1.20 mm):	45-90
% Passing No. 30 (0.599 mm):	15-65
% Passing No. 50 (0.297 mm):	5-30
% Passing No. 100 (0.152 mm):	1-10

Estimated Coefficient of Permeability per Eq. 2.4, Peck Hanson Thornburn, p. 40:
$k=CD_{10}^2$, where C=100/cm-sec and D_{10} is expressed in centimeters
for the above gradation, D_{10} will be between 0.0297 and 0.0152 centimeters;
k is therefore estimated to be between 0.023 cm/sec and 0.088 cm/sec

Filter criteria per Table 2.2, Peck Hanson Thornburn, p. 49:
Non-uniform, sub-rounded particles: R50 between 12 and 58; R15 between 12 and 40
Fly ash (from Reitz & Jens Fig 3-1, Labadie): d_{50} approx. 0.027 mm, d_{15} approx. 0.02 mm
Missouri River Sand (from examination of select sieve results from Washington Sand Co.):
D_{50} approx. 0.5 to 0.9 mm, d_{15} approx. 0.2 to 0.35 mm
Resultant ratios: R_{50} between 19 and 33, R_{15} between 10 and 18.

Conclusion:

"Typical" Missouri river sand dredged for concrete sand will protect Fly ash, per PHT Table 2.2 criteria.

Notes:

Develop "Note 5" in Detail Drawings to address Protective Cover Material requirements. Compare to similar material requirements note for non-carbonate aggregate drainage material and provide similar, parallel language.

PRODUCT DATA SHEET

GSE Nonwoven Geotextiles

GSE Nonwoven Geotextiles are a family of staple fiber needlepunched geotextiles. The geotextiles are manufactured using an advanced manufacturing and quality system to produce the most uniform and consistent nonwoven needlepunched geotextile currently available in the industry. GSE combines a fiber selection and approval system with an in-line quality control and a state-of-the-art laboratory to ensure that every roll shipped meets customer specifications.

AT THE CORE:

A family of geotextiles used for separation, filtration, protection and drainage applications.

Product Specifications

These product specifications meet GRI GT12, GRI GT13 and AASHTO M288

Property[1]	Test Method	Frequency	Minimum Average Roll Value					
			NW4	NW6	NW8	NW10	NW12	NW16
AASHTO M288 Class			3	2	1	>1	>>1	>>>1
Mass per Unit Area, oz/yd²	ASTM D 5261	90,000 ft²	4	6	8	10	12	16
Grab Tensile Strength, lb	ASTM D 4632	90,000 ft²	120	160	220	260	320	390
Grab Elongation, %	ASTM D 4632	90,000 ft²	50	50	50	50	50	50
Puncture Strength, lb	ASTM D 4833	90,000 ft²	60	90	120	165	190	240
Trapezoidal Tear Strength, lb	ASTM D 4533	90,000 ft²	50	65	90	100	125	150
Apparent Opening Size, Sieve No. (mm)	ASTM D 4751	540,000 ft²	70 (0.212)	70 (0.212)	80 (0.180)	100 (0.150)	100 (0.150)	100 (0.150)
Permittivity, sec⁻¹	ASTM D 4491	540,000 ft²	1.80	1.50	1.30	1.00	0.80	0.60
Water Flow Rate, gpm/ft²	ASTM D 4491	540,000 ft²	135	110	95	75	60	45
UV Resistance % retained after 500 hours	ASTM D 4355	per formulation		70	70	70	70	70
TYPICAL ROLL DIMENSIONS								
Roll Length[2], ft			850	850	600	500	400	300
Roll Width[3], ft			15	15	15	15	15	15
Roll Area, ft²			12,750	12,750	9,000	7,500	6,000	4,500

NOTES

- [1] The property values listed are MARV (or typical) per ASTM D 4759. All values listed are Minimum Average Roll Values except apparent opening size (max), and UV resistance (typical). Conforms to AASHTO M288 Minimum Average Roll Value. UV is a typical value.
- [2] [3] Roll lengths and widths have a tolerance of ±1%.

GSE is a leading manufacturer and marketer of geosynthetic lining products and services. We've built a reputation of reliability through our dedication to providing consistency of product, price and protection to our global customers.

Our commitment to innovation, our focus on quality and our industry expertise allow us the flexibility to collaborate with our clients to develop a custom, purpose-fit solution.

DURABILITY RUNS DEEP

For more information on this product and others, please visit us at GSEworld.com, call 800.435.2008 or contact your local sales office.

GSE ENVIRONMENTAL®

PRODUCT DATA SHEET

GSE PermaNet HL Geocomposite

GSE PermaNet HL (High Load) geocomposite is manufactured with a GSE PermaNet HL geonet heat-bonded on one or both sides with a GSE nonwoven needle-punched geotextile. The geotextile is available in mass per unit area range of 6 oz/yd² to 16 oz/yd². The creep resistant structure of the product ensures continuous flow performance over a broad range of conditions and long durations. The geocomposite works as an efficient drainage medium and is ideal for extremely high compressive stress applications.

[*]

AT THE CORE:

A high load geocomposite with a creep-resistant structure that ensures continuous flow performance and is ideal for extremely high compressive stress applications.

Product Specifications

Tested Property	Test Method	Frequency	Minimum Average Value		
Geocomposite			**6 oz/yd²**	**8 oz/yd²**	**10 oz/yd²**
Transmissivity[1], gal/min/ft (m^2/sec) Double-Sided Composite Single-Sided Composite	ASTM D 4716	1/540,000 ft²	4.8 (1×10^{-3}) 6.2 (1.3×10^{-3})	4.8 (1×10^{-3}) 6.2 (1.3×10^{-3})	4.8 (1×10^{-3}) 6.2 (1.3×10^{-3})
Ply Adhesion, lb/in	ASTM D 7005	1/50,000 ft²	1.0	1.0	1.0
Geonet Core – GSE PermaNet HL (prior to lamination)[2]					
Transmissivity[1], gal/min/ft (m^2/sec)	ASTM D 4716		19 (4×10^{-3})	19 (4×10^{-3})	19 (4×10^{-3})
Compressive Strength, lbs/ft²	ASTM D 6364	1/540,000 ft²	40,000	40,000	40,000
Creep Reduction Factor	ASTM D 7406/7361	per formulation	1.2 @15,000 psf	1.2 @15,000 psf	1.2 @15,000 psf
Density, g/cm³	ASTM D 1505	1/50,000 ft²	0.94	0.94	0.94
Tensile Strength (MD), lb/in	ASTM D 5035/7179	1/50,000 ft²	100	100	100
Carbon Black Content, %	ASTM D 1603 [4]/4216	1/50,000 ft²	2.0	2.0	2.0
Geotextile (prior to lamination)[2]					
Mass per Unit Area, oz/yd²	ASTM D 5261	1/90,000 ft²	6	8	10
Grab Tensile, lb	ASTM D 4632	1/90,000 ft²	160	220	260
Puncture Strength, lb	ASTM D 4833	1/90,000 ft²	90	120	165
AOS US Sieve (mm)	ASTM D 4751	1/540,000 ft²	70 (0.212)	80 (0.180)	100 (0.150)
Permittivity, sec⁻¹	ASTM D 4491	1/540,000 ft²	1.5	1.3	1.0
Flow Rate, gpm/ft²	ASTM D 4491	1/540,000 ft²	110	95	75
UV Resistance, % Retained	ASTM D 4355 (after 500 hours)	once per formulation	70	70	70
NOMINAL ROLL DIMENSIONS					
Geonet Core Thickness, mil	ASTM D 5199	1/50,000 ft²	270	270	270
Roll Width[3], ft			15	15	15
Roll Length[3], ft	Double-Sided Composite Single-Sided Composite		210 240	200 230	180 220
Roll Area, ft²	Double-Sided Composite Single-Sided Composite		3,150 3,600	3,000 3,450	2,700 3,300

[Product specifications continued on back]

[*]

AT THE CORE:
A high load geocomposite with a creep-resistant structure that ensures continuous flow performance and is ideal for extremely high compressive stress applications.

Product Specifications [continued]

NOTES:

- [illegible] is an index transmissivity value measured at stress = 15,000 psf, gradient = 0.1, time = 15 minutes, boundary conditions = between plates. Contact GSE for performance transmissivity value for use in design.
- All geotextile properties are minimum average roll values except AOS which is a maximum average roll value, and UV resistance which is a typical value.
- Roll widths and lengths have a tolerance of ±1%.
- Modified.

PRODUCT DATA SHEET

GSE PermaNet UL Geocomposite

GSE PermaNet UL (Ultra Load) geocomposite is manufactured with a GSE PermaNet UL geonet heat-bonded on one or both sides with a GSE nonwoven needle-punched geotextile. The geotextile is available in mass per unit area range of 6 oz/yd² to 16 oz/yd². The creep resistant structure of this product ensures continous flow performance over a broad range of conditions and long durations. The geocomposite works as an efficient drainage medium and is ideal for extremely high compressive stress applications.

[*]

AT THE CORE:
A very high compressive strength geocomposite with a creep-resistant structure that ensures continuous flow performance over a broad range of conditions and long durations.

Product Specifications

Tested Property	Test Method	Frequency	Minimum Average Roll Value		
Geocomposite			**6 oz/yd²**	**8 oz/yd²**	**10 oz/yd²**
Transmissivity[1], gal/min/ft (m²/sec) Double-Sided Composite Single-Sided Composite	ASTM D 4716	1/540,000 ft²	4.8 (1×10^{-3}) 6.2 (1.3×10^{-3})	4.8 (1×10^{-3}) 6.2 (1.3×10^{-3})	4.8 (1×10^{-3}) 6.2 (1.3×10^{-3})
Ply Adhesion, lb/in	ASTM D 7005	1/50,000 ft²	1.0	1.0	1.0
Geonet Core - GSE PermaNet UL (prior to lamination)[2]					
Transmissivity[1], gal/min/ft (m²/sec)	ASTM D 4716		24 (5×10^{-3})	24 (5×10^{-3})	24 (5×10^{-3})
Compression Strength, lb/ft²	ASTM D 6364	1/540,000 ft²	40,000	40,000	40,000
Creep Reduction Factor	ASTM D 7406/7361	per formulation	1.3 @ 20,000 psf	1.3 @ 20,000 psf	1.3 @ 20,000 psf
Density, g/cm³	ASTM D 1505	1/50,000 ft²	0.94	0.94	0.94
Tensile Strength (MD), lb/in	ASTM D 5035/7179	1/50,000 ft²	100	100	100
Carbon Black Content, %	ASTM D 1603[4]/4218	1/50,000 ft²	2.0	2.0	2.0
Geotextile (prior to lamination)[2]					
Mass per Unit Area, oz/yd²	ASTM D 5261	1/90,000 ft²	6	8	10
Grab Tensile, lb	ASTM D 4632	1/90,000 ft²	160	220	260
Puncture Strength, lb	ASTM D 4833	1/90,000 ft²	90	120	165
AOS, US Sieve (mm)	ASTM D 4751	1/540,000 ft²	70	80	100
Permittivity, sec⁻¹	ASTM D 4491	1/540,000 ft²	1.5	1.3	1.0
Flow Rate, gpm/ft²	ASTM D 4491	1/540,000 ft²	110	95	75
UV Resistance, % Retained	ASTM D 4355 (after 500 hours)	per formulation	70	70	70
NOMINAL ROLL DIMENSIONS					
Geonet Core Thickness, mil	ASTM D 5199	1/50,000 ft²	300	300	300
Roll Width[3], ft			15	15	15
Roll Length[3], ft	Double-Sided Composite Single-Sided Composite		190 200	180 200	150 190
Roll Area, ft²	Double-Sided Composite Single-Sided Composite		2,850 3,000	2,700 3,000	2,250 2,850

[Product specifications continued on back]

PRODUCT DATA SHEET

[*]

AT THE CORE:
A very high compressive strength geocomposite with a creep-resistant structure that ensures continuous flow performance over a broad range of conditions and long durations.

Product Specifications [continued]

NOTES

- [illegible] index transmissivity value measured at [illegible] 20,000 psf, gradient [illegible], time [illegible] minutes, boundary conditions [illegible] between plates. Contact GSE for performance transmissivity value for use in design.
- All geotextile properties are minimum average roll values except AOS (in mm) which is a maximum average roll value and UV resistance which is a typical value.
- Roll widths and lengths have a tolerance of [illegible]
- [illegible] Modified

GSE is a leading manufacturer and marketer of geosynthetic lining products and services. We've built a reputation of reliability through our dedication to providing consistency of product, price and protection to our global customers.

Our commitment to innovation, our focus on quality and our industry expertise allow us the flexibility to collaborate with our clients to develop a custom, purpose-fit solution.

[DURABILITY RUNS DEEP] For more information on this product and others, please visit us at GSEworld.com, call 800.435.2008 or contact your local sales office.

GSE ENVIRONMENTAL

GSE FabriNet TRx Geocomposite

GSE HyperNet TRx geonet is produced with a unique one step process that coextrudes creep resistant columns to an intrusion resistant roof. The resulting triaxial geonet is then laminated to a nonwoven geotextile filtration media. This product achieves high in-situ transmissivity from optimally oriented flow channels that maintain porosity because of the intrusion and creep resistant nature of the triaxial structure. The geocomposite provides continuous performance over a broad range of conditions. It is well suited for use in surface water collection and removal systems, gas venting, and landfill drainage applications.

[*]

AT THE CORE:
A high flow geocomposite that achieves high in-situ transmissivity from optimally oriented flow channels that maintain porosity.

Product Specifications

Tested Property	Test Method	Frequency	Minimum Average Roll Value		
Geocomposite			**4 oz/yd²**	**6 oz/yd²**	**8 oz/yd²**
Transmissivity(1), gal/min/ft (m^2/sec) Double-Sided Composite Single-Sided Composite	ASTM D 4716	1/540,000 ft²	 12.1 (2.5×10^{-3}) 15.7 (3.2×10^{-3})	 12.1 (2.5×10^{-4}) 15.7 (3.2×10^{-3})	 10.1 (2.2×10^{-3}) 13.8 (2.9×10^{-3})
Ply Adhesion, lb/in	ASTM D 7005	1/50,000 ft²	1.0	1.0	1.0
Geonet Core – GSE HyperNet TRx (prior to lamination)(2)					
Transmissivity(1), gal/min/ft (m^2/sec)	ASTM D 4716		43.5 (9×10^{-3})	43.5 (9×10^{-3})	43.5 (9×10^{-3})
Density, g/cm³	ASTM D 1505	1/50,000 ft²	0.94	0.94	0.94
Tensile Strength(2), lb/in	ASTM D 5035/7179	1/50,000 ft²	75	75	75
Carbon Black Content, %	ASTM D 1603(1)/4218	1/50,000 ft²	2.0	2.0	2.0
Geotextile (prior to lamination)(3)					
Mass per Unit Area, oz/yd²	ASTM D 5261	1/90,000 ft²	4	6	8
Grab Tensile, lb	ASTM D 4632	1/90,000 ft²	120	160	220
Puncture Strength, lb	ASTM D 4833	1/90,000 ft²	60	90	120
AOS, US sieve (mm)	ASTM D 4751	1/540,000 ft²	70 (0.212)	70 (0.212)	80 (0.180)
Permittivity, sec⁻¹	ASTM D 4491	1/540,000 ft²	1.8	1.5	1.3
Flow Rate, gpm/ft²	ASTM D 4491	1/540,000 ft²	135	110	95
UV Resistance, % retained	ASTM D 4355 (after 500 hours)	per formulation	70	70	70
NOMINAL ROLL DIMENSIONS					
Geonet Core Thickness, mil	ASTM D 5199	1/50,000 ft²	300	300	300
Roll Width(4), ft			15	15	15
Roll Length(4), ft	Double-Sided Composite Single-Sided Composite		160 180	160 170	150 170
Roll Area, ft²	Double-Sided Composite Single-Sided Composite		2,400 2,700	2,400 2,550	2,250 2,550

[Product specifications continued on back]

[*]

AT THE CORE:
A high flow geocomposite that achieves high in-situ transmissivity from optimally oriented flow channels that maintain porosity.

Product Specifications [continued]

Notes:

- [illegible] 1000 psf, gradient = 0.1 [illegible] boundary conditions [illegible] between plates. Contact GSE for [illegible]
- [illegible] Tested in machine direction (MD).
- All properties are minimum average roll values except [illegible] which is a maximum average roll value and UV resistance which is a typical value.
- Roll widths and lengths have a tolerance of ±1%.
- [illegible]

Appendix O-2

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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:\HELP\ALPPR612.D4
TEMPERATURE DATA FILE:       C:\HELP\ALPTE612.D7
SOLAR RADIATION DATA FILE:   C:\HELP\ALPSR612.D13
EVAPOTRANSPIRATION DATA:     C:\HELP\ALPEV612.D11
SOIL AND DESIGN DATA FILE:   C:\HELP\INPUTS\IAM1R003.D10
OUTPUT DATA FILE:            C:\HELP\OUT\IAM1R003.OUT

TIME:  18:23     DATE:  10/30/2012

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

     TITLE:  Ameren Missouri Labadie Proposed Utility Waste Landfill

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

     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  30
          THICKNESS                    =     84.00   INCHES
          POROSITY                     =      0.5410 VOL/VOL
          FIELD CAPACITY               =      0.1870 VOL/VOL
          WILTING POINT                =      0.0470 VOL/VOL
          INITIAL SOIL WATER CONTENT   =      0.1935 VOL/VOL
          EFFECTIVE SAT. HYD. COND.    =  0.499999987000E-04 CM/SEC
        NOTE:  SATURATED HYDRAULIC CONDUCTIVITY IS MULTIPLIED BY  1.34
                 FOR ROOT CHANNELS IN TOP HALF OF EVAPORATIVE ZONE.
```

LAYER 2

TYPE 1 - VERTICAL PERCOLATION LAYER
MATERIAL TEXTURE NUMBER 0

THICKNESS	=	12.00	INCHES
POROSITY	=	0.4170	VOL/VOL
FIELD CAPACITY	=	0.0450	VOL/VOL
WILTING POINT	=	0.0180	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0513	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.500000007000E-01	CM/SEC

LAYER 3

TYPE 2 - LATERAL DRAINAGE LAYER
MATERIAL TEXTURE NUMBER 0

THICKNESS	=	12.00	INCHES
POROSITY	=	0.3970	VOL/VOL
FIELD CAPACITY	=	0.0320	VOL/VOL
WILTING POINT	=	0.0130	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0322	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.250000000000	CM/SEC
SLOPE	=	1.00	PERCENT
DRAINAGE LENGTH	=	541.0	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	=	2.00	HOLES/ACRE
FML INSTALLATION DEFECTS	=	2.00	HOLES/ACRE
FML PLACEMENT QUALITY	=	3 - GOOD	

LAYER 5

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

GENERAL DESIGN AND EVAPORATIVE ZONE DATA

NOTE: SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT SOIL DATA BASE USING SOIL TEXTURE #30 WITH BARE GROUND CONDITIONS, A SURFACE SLOPE OF 1.% AND A SLOPE LENGTH OF 541. FEET.

SCS RUNOFF CURVE NUMBER	=	96.70	
FRACTION OF AREA ALLOWING RUNOFF	=	100.0	PERCENT
AREA PROJECTED ON HORIZONTAL PLANE	=	28.100	ACRES
EVAPORATIVE ZONE DEPTH	=	12.0	INCHES
INITIAL WATER IN EVAPORATIVE ZONE	=	2.751	INCHES
UPPER LIMIT OF EVAPORATIVE STORAGE	=	6.492	INCHES
LOWER LIMIT OF EVAPORATIVE STORAGE	=	0.564	INCHES
INITIAL SNOW WATER	=	0.000	INCHES
INITIAL WATER IN LAYER MATERIALS	=	27.505	INCHES
TOTAL INITIAL WATER	=	27.505	INCHES
TOTAL SUBSURFACE INFLOW	=	0.00	INCHES/YEAR

EVAPOTRANSPIRATION AND WEATHER DATA

NOTE: EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
ST. LOUIS MISSOURI

STATION LATITUDE	=	38.70	DEGREES
MAXIMUM LEAF AREA INDEX	=	0.50	
START OF GROWING SEASON (JULIAN DATE)	=	98	
END OF GROWING SEASON (JULIAN DATE)	=	300	
EVAPORATIVE ZONE DEPTH	=	12.0	INCHES
AVERAGE ANNUAL WIND SPEED	=	10.40	MPH
AVERAGE 1ST QUARTER RELATIVE HUMIDITY	=	73.00	%
AVERAGE 2ND QUARTER RELATIVE HUMIDITY	=	67.00	%
AVERAGE 3RD QUARTER RELATIVE HUMIDITY	=	71.00	%
AVERAGE 4TH QUARTER RELATIVE HUMIDITY	=	74.00	%

NOTE: PRECIPITATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR ST. LOUIS MISSOURI

NORMAL MEAN MONTHLY PRECIPITATION (INCHES)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
1.72	2.14	3.28	3.55	3.54	3.73
3.63	2.55	2.70	2.32	2.53	2.22

NOTE: TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR ST. LOUIS MISSOURI

NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
28.60	33.80	43.20	56.10	65.60	74.80
78.90	77.00	69.70	57.90	44.60	34.20

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR ST. LOUIS MISSOURI
AND STATION LATITUDE = 38.70 DEGREES

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AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1 THROUGH 7

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	1.71	2.08	3.24	3.42	3.42	5.13
	3.06	2.47	2.32	2.38	2.97	1.75
STD. DEVIATIONS	0.89	1.36	0.81	1.50	1.81	1.30
	1.58	1.66	1.35	1.37	1.62	1.07
RUNOFF						
TOTALS	0.497	0.870	1.175	0.942	1.125	1.829
	1.003	0.656	0.709	0.709	1.119	0.290
STD. DEVIATIONS	0.245	0.749	0.885	0.695	1.168	0.610
	0.757	0.592	0.583	0.721	0.845	0.351

EVAPOTRANSPIRATION

TOTALS	0.462	0.941	2.235	3.028	2.582	3.234
	2.493	1.993	1.446	1.278	1.318	0.780
STD. DEVIATIONS	0.169	0.484	0.287	0.647	0.931	0.966
	0.645	0.994	0.901	0.536	0.214	0.214

LATERAL DRAINAGE COLLECTED FROM LAYER 3

TOTALS	0.0850	0.0745	0.0800	0.0959	0.1163	0.0949
	0.0621	0.0318	0.0310	0.0575	0.0759	0.0920
STD. DEVIATIONS	0.0801	0.0690	0.0768	0.0839	0.0793	0.0517
	0.0357	0.0257	0.0182	0.0510	0.0689	0.0740

PERCOLATION/LEAKAGE THROUGH LAYER 5

TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	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 4

AVERAGES	0.1046	0.1005	0.0985	0.1221	0.1432	0.1207
	0.0765	0.0391	0.0395	0.0708	0.0966	0.1133
STD. DEVIATIONS	0.0986	0.0926	0.0946	0.1067	0.0977	0.0658
	0.0440	0.0316	0.0232	0.0628	0.0876	0.0911

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AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1 THROUGH 7

	INCHES		CU. FEET	PERCENT
PRECIPITATION	33.95	(3.610)	3463147.5	100.00
RUNOFF	10.923	(2.5198)	1114135.75	32.171
EVAPOTRANSPIRATION	21.792	(2.0850)	2222852.00	64.186
LATERAL DRAINAGE COLLECTED FROM LAYER 3	0.89692	(0.59928)	91488.367	2.64177

PERCOLATION/LEAKAGE THROUGH LAYER 5	0.00008 (0.00005)	8.339	0.00024
AVERAGE HEAD ON TOP OF LAYER 4	0.094 (0.063)		
CHANGE IN WATER STORAGE	0.340 (1.3845)	34663.22	1.001

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PEAK DAILY VALUES FOR YEARS 1 THROUGH 7

	(INCHES)	(CU. FT.)
PRECIPITATION	2.60	265207.781
RUNOFF	1.896	193392.5780
DRAINAGE COLLECTED FROM LAYER 3	0.00731	745.62543
PERCOLATION/LEAKAGE THROUGH LAYER 5	0.000001	0.06296
AVERAGE HEAD ON TOP OF LAYER 4	0.279	
MAXIMUM HEAD ON TOP OF LAYER 4	0.540	
LOCATION OF MAXIMUM HEAD IN LAYER 3 (DISTANCE FROM DRAIN)	17.6 FEET	
SNOW WATER	1.38	140819.5620

MAXIMUM VEG. SOIL WATER (VOL/VOL)	0.3792
MINIMUM VEG. SOIL WATER (VOL/VOL)	0.0470

*** 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 7

LAYER	(INCHES)	(VOL/VOL)
1	18.3273	0.2182
2	0.8886	0.0741
3	0.4199	0.0350
4	0.0000	0.0000
5	10.2480	0.4270
SNOW WATER	0.000	

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Appendix O-3

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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:\HELP\ALPPR612.D4
TEMPERATURE DATA FILE:       C:\HELP\ALPTE612.D7
SOLAR RADIATION DATA FILE:   C:\HELP\ALPSR612.D13
EVAPOTRANSPIRATION DATA:     C:\HELP\ALPEV612.D11
SOIL AND DESIGN DATA FILE:   C:\HELP\INPUTS\IAM3R003.D10
OUTPUT DATA FILE:            C:\HELP\OUT\IAM3R003.OUT

TIME:  18:36     DATE:  10/30/2012

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

     TITLE:  Ameren Missouri Labadie Proposed Utility Waste Landfill

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

     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  30
          THICKNESS                    =     84.00   INCHES
          POROSITY                     =      0.5410 VOL/VOL
          FIELD CAPACITY               =      0.1870 VOL/VOL
          WILTING POINT                =      0.0470 VOL/VOL
          INITIAL SOIL WATER CONTENT   =      0.1945 VOL/VOL
          EFFECTIVE SAT. HYD. COND.    =  0.499999987000E-04 CM/SEC
        NOTE:  SATURATED HYDRAULIC CONDUCTIVITY IS MULTIPLIED BY  1.34
                 FOR ROOT CHANNELS IN TOP HALF OF EVAPORATIVE ZONE.
```

LAYER 2

TYPE 1 - VERTICAL PERCOLATION LAYER
MATERIAL TEXTURE NUMBER 0

THICKNESS	=	12.00	INCHES
POROSITY	=	0.4170	VOL/VOL
FIELD CAPACITY	=	0.0450	VOL/VOL
WILTING POINT	=	0.0180	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0498	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.500000007000E-01	CM/SEC

LAYER 3

TYPE 2 - LATERAL DRAINAGE LAYER
MATERIAL TEXTURE NUMBER 0

THICKNESS	=	12.00	INCHES
POROSITY	=	0.3970	VOL/VOL
FIELD CAPACITY	=	0.0320	VOL/VOL
WILTING POINT	=	0.0130	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0322	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.250000000000	CM/SEC
SLOPE	=	1.00	PERCENT
DRAINAGE LENGTH	=	725.0	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	=	2.00	HOLES/ACRE
FML INSTALLATION DEFECTS	=	2.00	HOLES/ACRE
FML PLACEMENT QUALITY	=	3 - GOOD	

LAYER 5

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

GENERAL DESIGN AND EVAPORATIVE ZONE DATA

NOTE: SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT SOIL DATA BASE USING SOIL TEXTURE #30 WITH BARE GROUND CONDITIONS, A SURFACE SLOPE OF 1.% AND A SLOPE LENGTH OF 725. FEET.

SCS RUNOFF CURVE NUMBER	=	96.60	
FRACTION OF AREA ALLOWING RUNOFF	=	100.0	PERCENT
AREA PROJECTED ON HORIZONTAL PLANE	=	31.400	ACRES
EVAPORATIVE ZONE DEPTH	=	12.0	INCHES
INITIAL WATER IN EVAPORATIVE ZONE	=	2.864	INCHES
UPPER LIMIT OF EVAPORATIVE STORAGE	=	6.492	INCHES
LOWER LIMIT OF EVAPORATIVE STORAGE	=	0.564	INCHES
INITIAL SNOW WATER	=	0.000	INCHES
INITIAL WATER IN LAYER MATERIALS	=	27.572	INCHES
TOTAL INITIAL WATER	=	27.572	INCHES
TOTAL SUBSURFACE INFLOW	=	0.00	INCHES/YEAR

EVAPOTRANSPIRATION AND WEATHER DATA

NOTE: EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
ST. LOUIS MISSOURI

STATION LATITUDE	=	38.70	DEGREES
MAXIMUM LEAF AREA INDEX	=	0.50	
START OF GROWING SEASON (JULIAN DATE)	=	98	
END OF GROWING SEASON (JULIAN DATE)	=	300	
EVAPORATIVE ZONE DEPTH	=	12.0	INCHES
AVERAGE ANNUAL WIND SPEED	=	10.40	MPH
AVERAGE 1ST QUARTER RELATIVE HUMIDITY	=	73.00	%
AVERAGE 2ND QUARTER RELATIVE HUMIDITY	=	67.00	%
AVERAGE 3RD QUARTER RELATIVE HUMIDITY	=	71.00	%
AVERAGE 4TH QUARTER RELATIVE HUMIDITY	=	74.00	%

NOTE: PRECIPITATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR ST. LOUIS MISSOURI

NORMAL MEAN MONTHLY PRECIPITATION (INCHES)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
1.72	2.14	3.28	3.55	3.54	3.73
3.63	2.55	2.70	2.32	2.53	2.22

NOTE: TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR ST. LOUIS MISSOURI

NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
28.60	33.80	43.20	56.10	65.60	74.80
78.90	77.00	69.70	57.90	44.60	34.20

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR ST. LOUIS MISSOURI
AND STATION LATITUDE = 38.70 DEGREES

****

AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1 THROUGH 7

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	1.71	2.08	3.24	3.42	3.42	5.13
	3.06	2.47	2.32	2.38	2.97	1.75
STD. DEVIATIONS	0.89	1.36	0.81	1.50	1.81	1.30
	1.58	1.66	1.35	1.37	1.62	1.07
RUNOFF						
TOTALS	0.495	0.864	1.152	0.915	1.095	1.790
	0.968	0.641	0.689	0.706	1.099	0.283
STD. DEVIATIONS	0.241	0.742	0.889	0.683	1.148	0.601
	0.729	0.577	0.572	0.739	0.831	0.342

EVAPOTRANSPIRATION

TOTALS	0.465	0.954	2.257	3.008	2.619	3.299
	2.410	2.152	1.455	1.242	1.312	0.784
STD. DEVIATIONS	0.171	0.495	0.292	0.675	1.015	0.980
	0.814	1.029	0.930	0.508	0.268	0.209

LATERAL DRAINAGE COLLECTED FROM LAYER 3

TOTALS	0.0910	0.0802	0.0855	0.1013	0.1152	0.0928
	0.0644	0.0345	0.0358	0.0665	0.0848	0.1003
STD. DEVIATIONS	0.0845	0.0751	0.0805	0.0853	0.0843	0.0607
	0.0376	0.0249	0.0165	0.0593	0.0744	0.0785

PERCOLATION/LEAKAGE THROUGH LAYER 5

TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	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 4

AVERAGES	0.1501	0.1449	0.1411	0.1728	0.1901	0.1583
	0.1063	0.0570	0.0611	0.1097	0.1445	0.1655
STD. DEVIATIONS	0.1394	0.1353	0.1328	0.1454	0.1391	0.1034
	0.0620	0.0411	0.0282	0.0978	0.1268	0.1296

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AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1 THROUGH 7

	INCHES		CU. FEET	PERCENT
PRECIPITATION	33.95	(3.610)	3869851.5	100.00
RUNOFF	10.697	(2.5448)	1219280.12	31.507
EVAPOTRANSPIRATION	21.957	(2.0606)	2502747.50	64.673
LATERAL DRAINAGE COLLECTED FROM LAYER 3	0.95219	(0.63655)	108532.078	2.80455

PERCOLATION/LEAKAGE THROUGH LAYER 5	0.00011 (0.00007)	12.764	0.00033
AVERAGE HEAD ON TOP OF LAYER 4	0.133 (0.089)		
CHANGE IN WATER STORAGE	0.345 (1.3618)	39279.45	1.015

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PEAK DAILY VALUES FOR YEARS 1 THROUGH 7

	(INCHES)	(CU. FT.)
PRECIPITATION	2.60	296353.187
RUNOFF	1.874	213547.0620
DRAINAGE COLLECTED FROM LAYER 3	0.00712	811.63214
PERCOLATION/LEAKAGE THROUGH LAYER 5	0.000001	0.08958
AVERAGE HEAD ON TOP OF LAYER 4	0.364	
MAXIMUM HEAD ON TOP OF LAYER 4	0.705	
LOCATION OF MAXIMUM HEAD IN LAYER 3 (DISTANCE FROM DRAIN)	23.2 FEET	
SNOW WATER	1.38	157357.0940

MAXIMUM VEG. SOIL WATER (VOL/VOL)	0.3778
MINIMUM VEG. SOIL WATER (VOL/VOL)	0.0470

*** 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 7

LAYER	(INCHES)	(VOL/VOL)
1	18.3947	0.2190
2	0.9023	0.0752
3	0.4397	0.0366
4	0.0000	0.0000
5	10.2480	0.4270
SNOW WATER	0.000	

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Appendix O-4

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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:\HELP\ALPPR612.D4
TEMPERATURE DATA FILE:       C:\HELP\ALPTE612.D7
SOLAR RADIATION DATA FILE:   C:\HELP\ALPSR612.D13
EVAPOTRANSPIRATION DATA:     C:\HELP\ALPEV612.D11
SOIL AND DESIGN DATA FILE:   C:\HELP\INPUTS\IGE1R003.D10
OUTPUT DATA FILE:            C:\HELP\OUT\IGE1R003.OUT

TIME:  15:22     DATE:  10/30/2012

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

     TITLE:  Ameren Missouri Labadie Proposed Utility Waste Landfill

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

     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  30
          THICKNESS                    =     84.00   INCHES
          POROSITY                     =      0.5410 VOL/VOL
          FIELD CAPACITY               =      0.1870 VOL/VOL
          WILTING POINT                =      0.0470 VOL/VOL
          INITIAL SOIL WATER CONTENT   =      0.1935 VOL/VOL
          EFFECTIVE SAT. HYD. COND.    =  0.499999987000E-04 CM/SEC
        NOTE:  SATURATED HYDRAULIC CONDUCTIVITY IS MULTIPLIED BY  1.34
                FOR ROOT CHANNELS IN TOP HALF OF EVAPORATIVE ZONE.
```

LAYER 2

TYPE 1 - VERTICAL PERCOLATION LAYER
MATERIAL TEXTURE NUMBER 0

THICKNESS	=	12.00	INCHES
POROSITY	=	0.4170	VOL/VOL
FIELD CAPACITY	=	0.0450	VOL/VOL
WILTING POINT	=	0.0180	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0513	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.500000007000E-01	CM/SEC

LAYER 3

TYPE 2 - LATERAL DRAINAGE LAYER
MATERIAL TEXTURE NUMBER 0

THICKNESS	=	0.69	INCHES
POROSITY	=	0.8500	VOL/VOL
FIELD CAPACITY	=	0.0100	VOL/VOL
WILTING POINT	=	0.0050	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0114	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	1.29999995000	CM/SEC
SLOPE	=	1.00	PERCENT
DRAINAGE LENGTH	=	541.0	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	=	2.00	HOLES/ACRE
FML INSTALLATION DEFECTS	=	2.00	HOLES/ACRE
FML PLACEMENT QUALITY	=	3 - GOOD	

LAYER 5

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

GENERAL DESIGN AND EVAPORATIVE ZONE DATA

NOTE: SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT SOIL DATA BASE USING SOIL TEXTURE #30 WITH BARE GROUND CONDITIONS, A SURFACE SLOPE OF 1.% AND A SLOPE LENGTH OF 541. FEET.

SCS RUNOFF CURVE NUMBER	=	96.70	
FRACTION OF AREA ALLOWING RUNOFF	=	100.0	PERCENT
AREA PROJECTED ON HORIZONTAL PLANE	=	28.100	ACRES
EVAPORATIVE ZONE DEPTH	=	12.0	INCHES
INITIAL WATER IN EVAPORATIVE ZONE	=	2.751	INCHES
UPPER LIMIT OF EVAPORATIVE STORAGE	=	6.492	INCHES
LOWER LIMIT OF EVAPORATIVE STORAGE	=	0.564	INCHES
INITIAL SNOW WATER	=	0.000	INCHES
INITIAL WATER IN LAYER MATERIALS	=	27.127	INCHES
TOTAL INITIAL WATER	=	27.127	INCHES
TOTAL SUBSURFACE INFLOW	=	0.00	INCHES/YEAR

EVAPOTRANSPIRATION AND WEATHER DATA

NOTE: EVAPOTRANSPIRATION DATA WAS OBTAINED FROM ST. LOUIS MISSOURI

STATION LATITUDE	=	38.70	DEGREES
MAXIMUM LEAF AREA INDEX	=	0.50	
START OF GROWING SEASON (JULIAN DATE)	=	98	
END OF GROWING SEASON (JULIAN DATE)	=	300	
EVAPORATIVE ZONE DEPTH	=	12.0	INCHES
AVERAGE ANNUAL WIND SPEED	=	10.40	MPH
AVERAGE 1ST QUARTER RELATIVE HUMIDITY	=	73.00	%
AVERAGE 2ND QUARTER RELATIVE HUMIDITY	=	67.00	%
AVERAGE 3RD QUARTER RELATIVE HUMIDITY	=	71.00	%
AVERAGE 4TH QUARTER RELATIVE HUMIDITY	=	74.00	%

NOTE: PRECIPITATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR ST. LOUIS MISSOURI

NORMAL MEAN MONTHLY PRECIPITATION (INCHES)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
1.72	2.14	3.28	3.55	3.54	3.73
3.63	2.55	2.70	2.32	2.53	2.22

NOTE: TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR ST. LOUIS MISSOURI

NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
28.60	33.80	43.20	56.10	65.60	74.80
78.90	77.00	69.70	57.90	44.60	34.20

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR ST. LOUIS MISSOURI
AND STATION LATITUDE = 38.70 DEGREES

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AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1 THROUGH 7

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	1.71	2.08	3.24	3.42	3.42	5.13
	3.06	2.47	2.32	2.38	2.97	1.75
STD. DEVIATIONS	0.89	1.36	0.81	1.50	1.81	1.30
	1.58	1.66	1.35	1.37	1.62	1.07
RUNOFF						
TOTALS	0.497	0.870	1.175	0.942	1.125	1.829
	1.003	0.656	0.709	0.709	1.119	0.290
STD. DEVIATIONS	0.245	0.749	0.885	0.695	1.168	0.610
	0.757	0.592	0.583	0.721	0.845	0.351

EVAPOTRANSPIRATION

TOTALS	0.462	0.941	2.235	3.028	2.582	3.234
	2.493	1.993	1.446	1.278	1.318	0.780
STD. DEVIATIONS	0.169	0.484	0.287	0.647	0.931	0.966
	0.645	0.994	0.901	0.536	0.214	0.214

LATERAL DRAINAGE COLLECTED FROM LAYER 3

TOTALS	0.0846	0.0737	0.0799	0.1030	0.1179	0.0878
	0.0533	0.0256	0.0338	0.0642	0.0804	0.0953
STD. DEVIATIONS	0.0789	0.0691	0.0769	0.0874	0.0751	0.0459
	0.0333	0.0234	0.0220	0.0612	0.0717	0.0749

PERCOLATION/LEAKAGE THROUGH LAYER 5

TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	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 4

AVERAGES	0.0200	0.0191	0.0189	0.0252	0.0279	0.0215
	0.0126	0.0061	0.0083	0.0152	0.0197	0.0226
STD. DEVIATIONS	0.0187	0.0178	0.0182	0.0214	0.0178	0.0112
	0.0079	0.0056	0.0054	0.0145	0.0175	0.0177

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AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1 THROUGH 7

	INCHES	CU. FEET	PERCENT
PRECIPITATION	33.95 (3.610)	3463147.5	100.00
RUNOFF	10.923 (2.5198)	1114135.75	32.171
EVAPOTRANSPIRATION	21.792 (2.0850)	2222852.00	64.186
LATERAL DRAINAGE COLLECTED FROM LAYER 3	0.89941 (0.59344)	91742.234	2.64910

PERCOLATION/LEAKAGE THROUGH LAYER 5	0.00002 (0.00001)	2.038	0.00006
AVERAGE HEAD ON TOP OF LAYER 4	0.018 (0.012)		
CHANGE IN WATER STORAGE	0.337 (1.3648)	34415.69	0.994

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PEAK DAILY VALUES FOR YEARS 1 THROUGH 7

	(INCHES)	(CU. FT.)
PRECIPITATION	2.60	265207.781
RUNOFF	1.896	193392.5780
DRAINAGE COLLECTED FROM LAYER 3	0.00787	802.88251
PERCOLATION/LEAKAGE THROUGH LAYER 5	0.000000	0.01516
AVERAGE HEAD ON TOP OF LAYER 4	0.058	
MAXIMUM HEAD ON TOP OF LAYER 4	0.114	
LOCATION OF MAXIMUM HEAD IN LAYER 3 (DISTANCE FROM DRAIN)	5.0 FEET	
SNOW WATER	1.38	140819.5620

MAXIMUM VEG. SOIL WATER (VOL/VOL)	0.3792
MINIMUM VEG. SOIL WATER (VOL/VOL)	0.0470

*** 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 7

LAYER	(INCHES)	(VOL/VOL)
1	18.3273	0.2182
2	0.8886	0.0741
3	0.0246	0.0357
4	0.0000	0.0000
5	10.2480	0.4270
SNOW WATER	0.000	

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Appendix O-5

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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:\HELP\ALPPR612.D4
TEMPERATURE DATA FILE:       C:\HELP\ALPTE612.D7
SOLAR RADIATION DATA FILE:   C:\HELP\ALPSR612.D13
EVAPOTRANSPIRATION DATA:     C:\HELP\ALPEV612.D11
SOIL AND DESIGN DATA FILE:   C:\HELP\INPUTS\IGE2R003.D10
OUTPUT DATA FILE:            C:\HELP\OUT\IGE2R003.OUT

TIME:  18: 4     DATE:  10/30/2012

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

     TITLE:  Ameren Missouri Labadie Proposed Utility Waste Landfill

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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  30
          THICKNESS                    =     42.00   INCHES
          POROSITY                     =      0.5410 VOL/VOL
          FIELD CAPACITY               =      0.1870 VOL/VOL
          WILTING POINT                =      0.0470 VOL/VOL
          INITIAL SOIL WATER CONTENT   =      0.2199 VOL/VOL
          EFFECTIVE SAT. HYD. COND.    =  0.499999987000E-04 CM/SEC
        NOTE:  SATURATED HYDRAULIC CONDUCTIVITY IS MULTIPLIED BY  1.34
               FOR ROOT CHANNELS IN TOP HALF OF EVAPORATIVE ZONE.
```

LAYER 2

TYPE 1 - VERTICAL PERCOLATION LAYER
MATERIAL TEXTURE NUMBER 0

THICKNESS	=	12.00	INCHES
POROSITY	=	0.4170	VOL/VOL
FIELD CAPACITY	=	0.0450	VOL/VOL
WILTING POINT	=	0.0180	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0528	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.500000007000E-01	CM/SEC

LAYER 3

TYPE 2 - LATERAL DRAINAGE LAYER
MATERIAL TEXTURE NUMBER 0

THICKNESS	=	0.69	INCHES
POROSITY	=	0.8500	VOL/VOL
FIELD CAPACITY	=	0.0100	VOL/VOL
WILTING POINT	=	0.0050	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0100	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	1.29999995000	CM/SEC
SLOPE	=	33.33	PERCENT
DRAINAGE LENGTH	=	60.0	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	=	2.00	HOLES/ACRE
FML INSTALLATION DEFECTS	=	2.00	HOLES/ACRE
FML PLACEMENT QUALITY	=	3 - GOOD	

LAYER 5

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

GENERAL DESIGN AND EVAPORATIVE ZONE DATA

NOTE: SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT SOIL DATA BASE USING SOIL TEXTURE #30 WITH BARE GROUND CONDITIONS, A SURFACE SLOPE OF 1.% AND A SLOPE LENGTH OF 60. FEET.

SCS RUNOFF CURVE NUMBER	=	97.00	
FRACTION OF AREA ALLOWING RUNOFF	=	100.0	PERCENT
AREA PROJECTED ON HORIZONTAL PLANE	=	3.300	ACRES
EVAPORATIVE ZONE DEPTH	=	12.0	INCHES
INITIAL WATER IN EVAPORATIVE ZONE	=	2.962	INCHES
UPPER LIMIT OF EVAPORATIVE STORAGE	=	6.492	INCHES
LOWER LIMIT OF EVAPORATIVE STORAGE	=	0.564	INCHES
INITIAL SNOW WATER	=	0.000	INCHES
INITIAL WATER IN LAYER MATERIALS	=	20.124	INCHES
TOTAL INITIAL WATER	=	20.124	INCHES
TOTAL SUBSURFACE INFLOW	=	0.00	INCHES/YEAR

EVAPOTRANSPIRATION AND WEATHER DATA

NOTE: EVAPOTRANSPIRATION DATA WAS OBTAINED FROM ST. LOUIS MISSOURI

STATION LATITUDE	=	38.70	DEGREES
MAXIMUM LEAF AREA INDEX	=	0.50	
START OF GROWING SEASON (JULIAN DATE)	=	98	
END OF GROWING SEASON (JULIAN DATE)	=	300	
EVAPORATIVE ZONE DEPTH	=	12.0	INCHES
AVERAGE ANNUAL WIND SPEED	=	10.40	MPH
AVERAGE 1ST QUARTER RELATIVE HUMIDITY	=	73.00	%
AVERAGE 2ND QUARTER RELATIVE HUMIDITY	=	67.00	%
AVERAGE 3RD QUARTER RELATIVE HUMIDITY	=	71.00	%
AVERAGE 4TH QUARTER RELATIVE HUMIDITY	=	74.00	%

NOTE: PRECIPITATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR ST. LOUIS MISSOURI

NORMAL MEAN MONTHLY PRECIPITATION (INCHES)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
1.72	2.14	3.28	3.55	3.54	3.73
3.63	2.55	2.70	2.32	2.53	2.22

NOTE: TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR ST. LOUIS MISSOURI

NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
28.60	33.80	43.20	56.10	65.60	74.80
78.90	77.00	69.70	57.90	44.60	34.20

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR ST. LOUIS MISSOURI
AND STATION LATITUDE = 38.70 DEGREES

****

AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1 THROUGH 7

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	1.71	2.08	3.24	3.42	3.42	5.13
	3.06	2.47	2.32	2.38	2.97	1.75
STD. DEVIATIONS	0.89	1.36	0.81	1.50	1.81	1.30
	1.58	1.66	1.35	1.37	1.62	1.07
RUNOFF						
TOTALS	0.507	0.889	1.245	1.036	1.208	1.986
	1.093	0.720	0.766	0.767	1.194	0.312
STD. DEVIATIONS	0.257	0.773	0.878	0.747	1.195	0.629
	0.809	0.634	0.624	0.759	0.881	0.379

EVAPOTRANSPIRATION

TOTALS	0.462	0.938	2.218	2.882	2.536	3.000
	2.134	1.840	1.360	1.107	1.207	0.759
STD. DEVIATIONS	0.168	0.481	0.305	0.650	0.941	0.921
	0.606	0.836	0.814	0.498	0.251	0.207

LATERAL DRAINAGE COLLECTED FROM LAYER 3

TOTALS	0.1049	0.1204	0.1589	0.1257	0.1343	0.1955
	0.2012	0.1718	0.1394	0.1282	0.1346	0.1299
STD. DEVIATIONS	0.0509	0.0786	0.0829	0.0604	0.1909	0.1581
	0.0932	0.0726	0.0467	0.0489	0.0539	0.0408

PERCOLATION/LEAKAGE THROUGH LAYER 5

TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	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 4

AVERAGES	0.0002	0.0002	0.0003	0.0002	0.0002	0.0003
	0.0003	0.0003	0.0002	0.0002	0.0002	0.0002
STD. DEVIATIONS	0.0001	0.0001	0.0001	0.0001	0.0003	0.0003
	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001

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AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1 THROUGH 7

	INCHES		CU. FEET	PERCENT
PRECIPITATION	33.95	(3.610)	406704.2	100.00
RUNOFF	11.722	(2.5523)	140417.73	34.526
EVAPOTRANSPIRATION	20.443	(1.9893)	244887.45	60.213
LATERAL DRAINAGE COLLECTED FROM LAYER 3	1.74498	(0.72759)	20903.158	5.13965

PERCOLATION/LEAKAGE THROUGH LAYER 5	0.00000 (0.00000)	0.013	0.00000
AVERAGE HEAD ON TOP OF LAYER 4	0.000 (0.000)		
CHANGE IN WATER STORAGE	0.041 (1.0396)	495.82	0.122

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PEAK DAILY VALUES FOR YEARS 1 THROUGH 7

	(INCHES)	(CU. FT.)
PRECIPITATION	2.60	31145.398
RUNOFF	1.940	23245.0449
DRAINAGE COLLECTED FROM LAYER 3	0.02107	252.41109
PERCOLATION/LEAKAGE THROUGH LAYER 5	0.000000	0.00008
AVERAGE HEAD ON TOP OF LAYER 4	0.001	
MAXIMUM HEAD ON TOP OF LAYER 4	0.012	
LOCATION OF MAXIMUM HEAD IN LAYER 3 (DISTANCE FROM DRAIN)	0.0 FEET	
SNOW WATER	1.38	16537.5293

MAXIMUM VEG. SOIL WATER (VOL/VOL)	0.3556
MINIMUM VEG. SOIL WATER (VOL/VOL)	0.0470

*** 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 7

LAYER	(INCHES)	(VOL/VOL)
1	9.2876	0.2211
2	0.8712	0.0726
3	0.0072	0.0105
4	0.0000	0.0000
5	10.2480	0.4270
SNOW WATER	0.000	

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Appendix O-6

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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:\HELP\ALPPR612.D4
TEMPERATURE DATA FILE:       C:\HELP\ALPTE612.D7
SOLAR RADIATION DATA FILE:   C:\HELP\ALPSR612.D13
EVAPOTRANSPIRATION DATA:     C:\HELP\ALPEV612.D11
SOIL AND DESIGN DATA FILE:   C:\HELP\INPUTS\IGE3R003.D10
OUTPUT DATA FILE:            C:\HELP\OUT\IGE3R003.OUT


TIME:  18:17     DATE:  10/30/2012


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

     TITLE:  Ameren Missouri Labadie Proposed Utility Waste Landfill

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


     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  30
          THICKNESS                    =     84.00   INCHES
          POROSITY                     =      0.5410 VOL/VOL
          FIELD CAPACITY               =      0.1870 VOL/VOL
          WILTING POINT                =      0.0470 VOL/VOL
          INITIAL SOIL WATER CONTENT   =      0.1945 VOL/VOL
          EFFECTIVE SAT. HYD. COND.    =  0.499999987000E-04 CM/SEC
        NOTE:  SATURATED HYDRAULIC CONDUCTIVITY IS MULTIPLIED BY  1.34
                 FOR ROOT CHANNELS IN TOP HALF OF EVAPORATIVE ZONE.
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LAYER 2

TYPE 1 - VERTICAL PERCOLATION LAYER
MATERIAL TEXTURE NUMBER 0

THICKNESS	=	12.00	INCHES
POROSITY	=	0.4170	VOL/VOL
FIELD CAPACITY	=	0.0450	VOL/VOL
WILTING POINT	=	0.0180	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0498	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.500000007000E-01	CM/SEC

LAYER 3

TYPE 2 - LATERAL DRAINAGE LAYER
MATERIAL TEXTURE NUMBER 0

THICKNESS	=	0.69	INCHES
POROSITY	=	0.8500	VOL/VOL
FIELD CAPACITY	=	0.0100	VOL/VOL
WILTING POINT	=	0.0050	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0114	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	1.29999995000	CM/SEC
SLOPE	=	1.00	PERCENT
DRAINAGE LENGTH	=	712.0	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	=	2.00	HOLES/ACRE
FML INSTALLATION DEFECTS	=	2.00	HOLES/ACRE
FML PLACEMENT QUALITY	=	3 - GOOD	

LAYER 5

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

GENERAL DESIGN AND EVAPORATIVE ZONE DATA

NOTE: SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT SOIL DATA BASE USING SOIL TEXTURE #30 WITH BARE GROUND CONDITIONS, A SURFACE SLOPE OF 1.% AND A SLOPE LENGTH OF 712. FEET.

SCS RUNOFF CURVE NUMBER	=	96.60	
FRACTION OF AREA ALLOWING RUNOFF	=	100.0	PERCENT
AREA PROJECTED ON HORIZONTAL PLANE	=	31.400	ACRES
EVAPORATIVE ZONE DEPTH	=	12.0	INCHES
INITIAL WATER IN EVAPORATIVE ZONE	=	2.864	INCHES
UPPER LIMIT OF EVAPORATIVE STORAGE	=	6.492	INCHES
LOWER LIMIT OF EVAPORATIVE STORAGE	=	0.564	INCHES
INITIAL SNOW WATER	=	0.000	INCHES
INITIAL WATER IN LAYER MATERIALS	=	27.194	INCHES
TOTAL INITIAL WATER	=	27.194	INCHES
TOTAL SUBSURFACE INFLOW	=	0.00	INCHES/YEAR

EVAPOTRANSPIRATION AND WEATHER DATA

NOTE: EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
ST. LOUIS MISSOURI

STATION LATITUDE	=	38.70	DEGREES
MAXIMUM LEAF AREA INDEX	=	0.50	
START OF GROWING SEASON (JULIAN DATE)	=	98	
END OF GROWING SEASON (JULIAN DATE)	=	300	
EVAPORATIVE ZONE DEPTH	=	12.0	INCHES
AVERAGE ANNUAL WIND SPEED	=	10.40	MPH
AVERAGE 1ST QUARTER RELATIVE HUMIDITY	=	73.00	%
AVERAGE 2ND QUARTER RELATIVE HUMIDITY	=	67.00	%
AVERAGE 3RD QUARTER RELATIVE HUMIDITY	=	71.00	%
AVERAGE 4TH QUARTER RELATIVE HUMIDITY	=	74.00	%

NOTE: PRECIPITATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR ST. LOUIS MISSOURI

NORMAL MEAN MONTHLY PRECIPITATION (INCHES)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
1.72	2.14	3.28	3.55	3.54	3.73
3.63	2.55	2.70	2.32	2.53	2.22

NOTE: TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR ST. LOUIS MISSOURI

NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
28.60	33.80	43.20	56.10	65.60	74.80
78.90	77.00	69.70	57.90	44.60	34.20

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR ST. LOUIS MISSOURI
AND STATION LATITUDE = 38.70 DEGREES

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AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1 THROUGH 7

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	1.71	2.08	3.24	3.42	3.42	5.13
	3.06	2.47	2.32	2.38	2.97	1.75
STD. DEVIATIONS	0.89	1.36	0.81	1.50	1.81	1.30
	1.58	1.66	1.35	1.37	1.62	1.07
RUNOFF						
TOTALS	0.495	0.864	1.152	0.915	1.095	1.790
	0.968	0.641	0.689	0.706	1.099	0.283
STD. DEVIATIONS	0.241	0.742	0.889	0.683	1.148	0.601
	0.729	0.577	0.572	0.739	0.831	0.342

EVAPOTRANSPIRATION

TOTALS	0.465	0.954	2.257	3.008	2.619	3.299
	2.410	2.152	1.455	1.242	1.312	0.784
STD. DEVIATIONS	0.171	0.495	0.292	0.675	1.015	0.980
	0.814	1.029	0.930	0.508	0.268	0.209

LATERAL DRAINAGE COLLECTED FROM LAYER 3

TOTALS	0.0897	0.0802	0.0843	0.1100	0.1162	0.0843
	0.0532	0.0260	0.0403	0.0764	0.0909	0.1046
STD. DEVIATIONS	0.0829	0.0754	0.0793	0.0900	0.0818	0.0528
	0.0332	0.0216	0.0263	0.0730	0.0782	0.0795

PERCOLATION/LEAKAGE THROUGH LAYER 5

TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	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 4

AVERAGES	0.0279	0.0274	0.0263	0.0354	0.0362	0.0272
	0.0166	0.0081	0.0130	0.0238	0.0293	0.0326
STD. DEVIATIONS	0.0258	0.0256	0.0247	0.0290	0.0255	0.0170
	0.0104	0.0067	0.0085	0.0228	0.0252	0.0248

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AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1 THROUGH 7

	INCHES		CU. FEET	PERCENT
PRECIPITATION	33.95	(3.610)	3869851.5	100.00
RUNOFF	10.697	(2.5448)	1219280.12	31.507
EVAPOTRANSPIRATION	21.957	(2.0606)	2502747.50	64.673
LATERAL DRAINAGE COLLECTED FROM LAYER 3	0.95610	(0.63050)	108978.195	2.81608

PERCOLATION/LEAKAGE THROUGH LAYER 5	0.00003 (0.00002)	2.975	0.00008
AVERAGE HEAD ON TOP OF LAYER 4	0.025 (0.017)		
CHANGE IN WATER STORAGE	0.341 (1.3369)	38843.12	1.004

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PEAK DAILY VALUES FOR YEARS 1 THROUGH 7

	(INCHES)	(CU. FT.)
PRECIPITATION	2.60	296353.187
RUNOFF	1.874	213547.0620
DRAINAGE COLLECTED FROM LAYER 3	0.00777	886.12292
PERCOLATION/LEAKAGE THROUGH LAYER 5	0.000000	0.02144
AVERAGE HEAD ON TOP OF LAYER 4	0.075	
MAXIMUM HEAD ON TOP OF LAYER 4	0.149	
LOCATION OF MAXIMUM HEAD IN LAYER 3 (DISTANCE FROM DRAIN)	5.8 FEET	
SNOW WATER	1.38	157357.0940

MAXIMUM VEG. SOIL WATER (VOL/VOL)	0.3778
MINIMUM VEG. SOIL WATER (VOL/VOL)	0.0470

*** 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 7

LAYER	(INCHES)	(VOL/VOL)
1	18.3947	0.2190
2	0.9023	0.0752
3	0.0346	0.0502
4	0.0000	0.0000
5	10.2480	0.4270
SNOW WATER	0.000	

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Appendix O-7

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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:\HELP\ALPPR612.D4
TEMPERATURE DATA FILE:       C:\HELP\ALPTE612.D7
SOLAR RADIATION DATA FILE:   C:\HELP\ALPSR612.D13
EVAPOTRANSPIRATION DATA:     C:\HELP\ALPEV612.D11
SOIL AND DESIGN DATA FILE:   C:\HELP\INPUTS\OAM1R003.D10
OUTPUT DATA FILE:            C:\HELP\OUT\OAM1R003.OUT

TIME:  19:29     DATE:  10/30/2012

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

     TITLE:  Ameren Missouri Labadie Proposed Utility Waste Landfill

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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   9
          THICKNESS                    =     12.00   INCHES
          POROSITY                     =      0.5010 VOL/VOL
          FIELD CAPACITY               =      0.2840 VOL/VOL
          WILTING POINT                =      0.1350 VOL/VOL
          INITIAL SOIL WATER CONTENT   =      0.3062 VOL/VOL
          EFFECTIVE SAT. HYD. COND.    =  0.190000006000E-03 CM/SEC
        NOTE:  SATURATED HYDRAULIC CONDUCTIVITY IS MULTIPLIED BY  1.34
                 FOR ROOT CHANNELS IN TOP HALF OF EVAPORATIVE ZONE.
```

LAYER 2

TYPE 1 - VERTICAL PERCOLATION LAYER
MATERIAL TEXTURE NUMBER 30

THICKNESS	=	240.00	INCHES
POROSITY	=	0.5410	VOL/VOL
FIELD CAPACITY	=	0.1870	VOL/VOL
WILTING POINT	=	0.0470	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.1947	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.499999987000E-04	CM/SEC

LAYER 3

TYPE 1 - VERTICAL PERCOLATION LAYER
MATERIAL TEXTURE NUMBER 0

THICKNESS	=	12.00	INCHES
POROSITY	=	0.4170	VOL/VOL
FIELD CAPACITY	=	0.0450	VOL/VOL
WILTING POINT	=	0.0180	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0455	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.500000007000E-01	CM/SEC

LAYER 4

TYPE 2 - LATERAL DRAINAGE LAYER
MATERIAL TEXTURE NUMBER 0

THICKNESS	=	12.00	INCHES
POROSITY	=	0.3970	VOL/VOL
FIELD CAPACITY	=	0.0320	VOL/VOL
WILTING POINT	=	0.0130	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0321	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.250000000000	CM/SEC
SLOPE	=	1.00	PERCENT
DRAINAGE LENGTH	=	541.0	FEET

LAYER 5

TYPE 4 - FLEXIBLE MEMBRANE LINER
MATERIAL TEXTURE NUMBER 35

THICKNESS	=	0.06	INCHES
POROSITY	=	0.0000	VOL/VOL
FIELD CAPACITY	=	0.0000	VOL/VOL
WILTING POINT	=	0.0000	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0000	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.199999996000E-12	CM/SEC
FML PINHOLE DENSITY	=	2.00	HOLES/ACRE
FML INSTALLATION DEFECTS	=	2.00	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

GENERAL DESIGN AND EVAPORATIVE ZONE DATA

NOTE: SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT SOIL DATA BASE USING SOIL TEXTURE # 9 WITH BARE GROUND CONDITIONS, A SURFACE SLOPE OF 2.% AND A SLOPE LENGTH OF 720. FEET.

SCS RUNOFF CURVE NUMBER	=	91.30	
FRACTION OF AREA ALLOWING RUNOFF	=	100.0	PERCENT
AREA PROJECTED ON HORIZONTAL PLANE	=	28.100	ACRES
EVAPORATIVE ZONE DEPTH	=	12.0	INCHES
INITIAL WATER IN EVAPORATIVE ZONE	=	3.675	INCHES
UPPER LIMIT OF EVAPORATIVE STORAGE	=	6.012	INCHES
LOWER LIMIT OF EVAPORATIVE STORAGE	=	1.620	INCHES
INITIAL SNOW WATER	=	0.000	INCHES
INITIAL WATER IN LAYER MATERIALS	=	61.577	INCHES
TOTAL INITIAL WATER	=	61.577	INCHES
TOTAL SUBSURFACE INFLOW	=	0.00	INCHES/YEAR

EVAPOTRANSPIRATION AND WEATHER DATA

NOTE: EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
ST. LOUIS MISSOURI

STATION LATITUDE	=	38.70 DEGREES
MAXIMUM LEAF AREA INDEX	=	0.50
START OF GROWING SEASON (JULIAN DATE)	=	98
END OF GROWING SEASON (JULIAN DATE)	=	300
EVAPORATIVE ZONE DEPTH	=	12.0 INCHES
AVERAGE ANNUAL WIND SPEED	=	10.40 MPH
AVERAGE 1ST QUARTER RELATIVE HUMIDITY	=	73.00 %
AVERAGE 2ND QUARTER RELATIVE HUMIDITY	=	67.00 %
AVERAGE 3RD QUARTER RELATIVE HUMIDITY	=	71.00 %
AVERAGE 4TH QUARTER RELATIVE HUMIDITY	=	74.00 %

NOTE: PRECIPITATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR ST. LOUIS MISSOURI

NORMAL MEAN MONTHLY PRECIPITATION (INCHES)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
1.72	2.14	3.28	3.55	3.54	3.73
3.63	2.55	2.70	2.32	2.53	2.22

NOTE: TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR ST. LOUIS MISSOURI

NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
28.60	33.80	43.20	56.10	65.60	74.80
78.90	77.00	69.70	57.90	44.60	34.20

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR ST. LOUIS MISSOURI
AND STATION LATITUDE = 38.70 DEGREES

****

AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1 THROUGH 25

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	1.48	2.08	3.12	3.53	3.24	4.61
	3.36	2.45	2.96	2.30	2.13	2.18
STD. DEVIATIONS	0.86	1.11	0.97	1.36	1.58	2.13
	1.90	1.28	1.45	1.31	1.49	1.09
RUNOFF						
TOTALS	0.391	0.787	0.587	0.212	0.265	0.654
	0.392	0.109	0.234	0.151	0.218	0.161
STD. DEVIATIONS	0.452	0.654	0.824	0.222	0.351	0.754
	0.548	0.144	0.217	0.199	0.266	0.215
EVAPOTRANSPIRATION						
TOTALS	0.569	0.697	2.472	3.494	2.909	3.987
	3.079	2.410	2.233	1.795	1.364	0.859
STD. DEVIATIONS	0.318	0.474	0.492	0.953	1.133	1.415
	1.345	1.087	1.145	0.670	0.512	0.255
LATERAL DRAINAGE COLLECTED FROM LAYER 4						
TOTALS	0.2985	0.2211	0.2083	0.2099	0.1671	0.1134
	0.1469	0.2314	0.2721	0.3079	0.3115	0.3273
STD. DEVIATIONS	0.1400	0.1112	0.1310	0.1158	0.0888	0.0735
	0.1329	0.1607	0.1621	0.1665	0.1407	0.1348
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	0.3676	0.2981	0.2565	0.2670	0.2058	0.1443
	0.1808	0.2850	0.3462	0.3792	0.3963	0.4030
STD. DEVIATIONS	0.1725	0.1487	0.1613	0.1474	0.1093	0.0935
	0.1637	0.1979	0.2063	0.2051	0.1790	0.1660

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AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1 THROUGH 25

	INCHES	CU. FEET	PERCENT
PRECIPITATION	33.44 (4.389)	3411429.2	100.00
RUNOFF	4.161 (1.6271)	424391.19	12.440
EVAPOTRANSPIRATION	25.868 (3.1274)	2638658.00	77.348
LATERAL DRAINAGE COLLECTED FROM LAYER 4	2.81529 (1.21086)	287167.750	8.41781
PERCOLATION/LEAKAGE THROUGH LAYER 6	0.00023 (0.00009)	23.651	0.00069
AVERAGE HEAD ON TOP OF LAYER 5	0.294 (0.126)		
CHANGE IN WATER STORAGE	0.600 (2.1564)	61188.54	1.794

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PEAK DAILY VALUES FOR YEARS 1 THROUGH 25

	(INCHES)	(CU. FT.)
PRECIPITATION	3.44	350890.344
RUNOFF	1.975	201463.1090
DRAINAGE COLLECTED FROM LAYER 4	0.02019	2059.21289
PERCOLATION/LEAKAGE THROUGH LAYER 6	0.000002	0.15823
AVERAGE HEAD ON TOP OF LAYER 5	0.771	
MAXIMUM HEAD ON TOP OF LAYER 5	1.437	
LOCATION OF MAXIMUM HEAD IN LAYER 4 (DISTANCE FROM DRAIN)	36.4 FEET	
SNOW WATER	2.22	225988.4530

MAXIMUM VEG. SOIL WATER (VOL/VOL)	0.4152
MINIMUM VEG. SOIL WATER (VOL/VOL)	0.1350

*** 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 25

LAYER	(INCHES)	(VOL/VOL)
1	2.6733	0.2228
2	61.7891	0.2575
3	1.0614	0.0885
4	0.6015	0.0501
5	0.0000	0.0000
6	10.2480	0.4270
SNOW WATER	0.201	

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Appendix O-8

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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:\HELP\ALPPR612.D4
TEMPERATURE DATA FILE:       C:\HELP\ALPTE612.D7
SOLAR RADIATION DATA FILE:   C:\HELP\ALPSR612.D13
EVAPOTRANSPIRATION DATA:     C:\HELP\ALPEV612.D11
SOIL AND DESIGN DATA FILE:   C:\HELP\INPUTS\OAM3R003.D10
OUTPUT DATA FILE:            C:\HELP\OUT\OAM3R003.OUT

TIME:  11:18     DATE:  10/31/2012

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

     TITLE:  Ameren Missouri Labadie Proposed Utility Waste Landfill

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

     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   9
          THICKNESS                     =     12.00   INCHES
          POROSITY                      =      0.5010 VOL/VOL
          FIELD CAPACITY                =      0.2840 VOL/VOL
          WILTING POINT                 =      0.1350 VOL/VOL
          INITIAL SOIL WATER CONTENT    =      0.3062 VOL/VOL
          EFFECTIVE SAT. HYD. COND.     =  0.190000006000E-03 CM/SEC
        NOTE:  SATURATED HYDRAULIC CONDUCTIVITY IS MULTIPLIED BY  1.34
                 FOR ROOT CHANNELS IN TOP HALF OF EVAPORATIVE ZONE.
```

LAYER 2

TYPE 1 - VERTICAL PERCOLATION LAYER
MATERIAL TEXTURE NUMBER 30

THICKNESS	=	240.00	INCHES
POROSITY	=	0.5410	VOL/VOL
FIELD CAPACITY	=	0.1870	VOL/VOL
WILTING POINT	=	0.0470	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.1947	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.499999987000E-04	CM/SEC

LAYER 3

TYPE 1 - VERTICAL PERCOLATION LAYER
MATERIAL TEXTURE NUMBER 0

THICKNESS	=	12.00	INCHES
POROSITY	=	0.4170	VOL/VOL
FIELD CAPACITY	=	0.0450	VOL/VOL
WILTING POINT	=	0.0180	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0455	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.500000007000E-01	CM/SEC

LAYER 4

TYPE 2 - LATERAL DRAINAGE LAYER
MATERIAL TEXTURE NUMBER 0

THICKNESS	=	12.00	INCHES
POROSITY	=	0.3970	VOL/VOL
FIELD CAPACITY	=	0.0320	VOL/VOL
WILTING POINT	=	0.0130	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0321	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.250000000000	CM/SEC
SLOPE	=	1.00	PERCENT
DRAINAGE LENGTH	=	637.0	FEET

LAYER 5

TYPE 4 - FLEXIBLE MEMBRANE LINER
MATERIAL TEXTURE NUMBER 35

THICKNESS	=	0.06	INCHES
POROSITY	=	0.0000	VOL/VOL
FIELD CAPACITY	=	0.0000	VOL/VOL
WILTING POINT	=	0.0000	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0000	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.199999996000E-12	CM/SEC
FML PINHOLE DENSITY	=	2.00	HOLES/ACRE
FML INSTALLATION DEFECTS	=	2.00	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

GENERAL DESIGN AND EVAPORATIVE ZONE DATA

NOTE: SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT SOIL DATA BASE USING SOIL TEXTURE # 9 WITH BARE GROUND CONDITIONS, A SURFACE SLOPE OF 2.% AND A SLOPE LENGTH OF 720. FEET.

SCS RUNOFF CURVE NUMBER	=	91.30	
FRACTION OF AREA ALLOWING RUNOFF	=	100.0	PERCENT
AREA PROJECTED ON HORIZONTAL PLANE	=	31.400	ACRES
EVAPORATIVE ZONE DEPTH	=	12.0	INCHES
INITIAL WATER IN EVAPORATIVE ZONE	=	3.675	INCHES
UPPER LIMIT OF EVAPORATIVE STORAGE	=	6.012	INCHES
LOWER LIMIT OF EVAPORATIVE STORAGE	=	1.620	INCHES
INITIAL SNOW WATER	=	0.000	INCHES
INITIAL WATER IN LAYER MATERIALS	=	61.577	INCHES
TOTAL INITIAL WATER	=	61.577	INCHES
TOTAL SUBSURFACE INFLOW	=	0.00	INCHES/YEAR

EVAPOTRANSPIRATION AND WEATHER DATA

NOTE: EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
ST. LOUIS MISSOURI

STATION LATITUDE	=	38.70	DEGREES
MAXIMUM LEAF AREA INDEX	=	0.50	
START OF GROWING SEASON (JULIAN DATE)	=	98	
END OF GROWING SEASON (JULIAN DATE)	=	300	
EVAPORATIVE ZONE DEPTH	=	12.0	INCHES
AVERAGE ANNUAL WIND SPEED	=	10.40	MPH
AVERAGE 1ST QUARTER RELATIVE HUMIDITY	=	73.00	%
AVERAGE 2ND QUARTER RELATIVE HUMIDITY	=	67.00	%
AVERAGE 3RD QUARTER RELATIVE HUMIDITY	=	71.00	%
AVERAGE 4TH QUARTER RELATIVE HUMIDITY	=	74.00	%

NOTE: PRECIPITATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR ST. LOUIS MISSOURI

NORMAL MEAN MONTHLY PRECIPITATION (INCHES)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
1.72	2.14	3.28	3.55	3.54	3.73
3.63	2.55	2.70	2.32	2.53	2.22

NOTE: TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR ST. LOUIS MISSOURI

NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
28.60	33.80	43.20	56.10	65.60	74.80
78.90	77.00	69.70	57.90	44.60	34.20

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR ST. LOUIS MISSOURI
AND STATION LATITUDE = 38.70 DEGREES

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AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1 THROUGH 25

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	1.48	2.08	3.12	3.53	3.24	4.61
	3.36	2.45	2.96	2.30	2.13	2.18
STD. DEVIATIONS	0.86	1.11	0.97	1.36	1.58	2.13
	1.90	1.28	1.45	1.31	1.49	1.09
RUNOFF						
TOTALS	0.391	0.787	0.587	0.212	0.265	0.654
	0.392	0.109	0.234	0.151	0.218	0.161
STD. DEVIATIONS	0.452	0.654	0.824	0.222	0.351	0.754
	0.548	0.144	0.217	0.199	0.266	0.215
EVAPOTRANSPIRATION						
TOTALS	0.569	0.697	2.472	3.494	2.909	3.987
	3.079	2.410	2.233	1.795	1.364	0.859
STD. DEVIATIONS	0.318	0.474	0.492	0.953	1.133	1.415
	1.345	1.087	1.145	0.670	0.512	0.255
LATERAL DRAINAGE COLLECTED FROM LAYER 4						
TOTALS	0.2996	0.2250	0.2109	0.2098	0.1710	0.1167
	0.1446	0.2252	0.2684	0.3054	0.3103	0.3268
STD. DEVIATIONS	0.1396	0.1117	0.1294	0.1155	0.0896	0.0728
	0.1266	0.1571	0.1604	0.1663	0.1416	0.1353
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	0.4344	0.3571	0.3057	0.3144	0.2480	0.1748
	0.2096	0.3265	0.4022	0.4429	0.4649	0.4739
STD. DEVIATIONS	0.2025	0.1759	0.1877	0.1730	0.1299	0.1091
	0.1836	0.2278	0.2403	0.2411	0.2122	0.1962

AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1 THROUGH 25

	INCHES	CU. FEET	PERCENT
PRECIPITATION	33.44 (4.389)	3812059.7	100.00
RUNOFF	4.161 (1.6271)	474230.69	12.440
EVAPOTRANSPIRATION	25.868 (3.1274)	2948536.00	77.348
LATERAL DRAINAGE COLLECTED FROM LAYER 4	2.81367 (1.21238)	320707.656	8.41298
PERCOLATION/LEAKAGE THROUGH LAYER 6	0.00027 (0.00011)	30.642	0.00080
AVERAGE HEAD ON TOP OF LAYER 5	0.346 (0.149)		
CHANGE IN WATER STORAGE	0.601 (2.1597)	68554.64	1.798

PEAK DAILY VALUES FOR YEARS 1 THROUGH 25

	(INCHES)	(CU. FT.)
PRECIPITATION	3.44	392098.094
RUNOFF	1.975	225122.4840
DRAINAGE COLLECTED FROM LAYER 4	0.01977	2253.52466
PERCOLATION/LEAKAGE THROUGH LAYER 6	0.000002	0.20126
AVERAGE HEAD ON TOP OF LAYER 5	0.889	
MAXIMUM HEAD ON TOP OF LAYER 5	1.659	
LOCATION OF MAXIMUM HEAD IN LAYER 4 (DISTANCE FROM DRAIN)	42.3 FEET	
SNOW WATER	2.22	252528.0310

MAXIMUM VEG. SOIL WATER (VOL/VOL)	0.4152
MINIMUM VEG. SOIL WATER (VOL/VOL)	0.1350

*** 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 25

LAYER	(INCHES)	(VOL/VOL)
1	2.6733	0.2228
2	61.7891	0.2575
3	1.0614	0.0885
4	0.6412	0.0534
5	0.0000	0.0000
6	10.2480	0.4270
SNOW WATER	0.201	

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Appendix O-9

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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:\HELP\ALPPR612.D4
TEMPERATURE DATA FILE:       C:\HELP\ALPTE612.D7
SOLAR RADIATION DATA FILE:   C:\HELP\ALPSR612.D13
EVAPOTRANSPIRATION DATA:     C:\HELP\ALPEV612.D11
SOIL AND DESIGN DATA FILE:   C:\HELP\INPUTS\OGE1R003.D10
OUTPUT DATA FILE:            C:\HELP\OUT\OGE1R003.OUT

TIME:  18:55     DATE:  10/30/2012

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

     TITLE:  Ameren Missouri Labadie Proposed Utility Waste Landfill

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

     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   9
          THICKNESS                     =     12.00   INCHES
          POROSITY                      =      0.5010 VOL/VOL
          FIELD CAPACITY                =      0.2840 VOL/VOL
          WILTING POINT                 =      0.1350 VOL/VOL
          INITIAL SOIL WATER CONTENT    =      0.3062 VOL/VOL
          EFFECTIVE SAT. HYD. COND.     =  0.190000006000E-03 CM/SEC
        NOTE:  SATURATED HYDRAULIC CONDUCTIVITY IS MULTIPLIED BY  1.34
                 FOR ROOT CHANNELS IN TOP HALF OF EVAPORATIVE ZONE.
```

LAYER 2

TYPE 1 - VERTICAL PERCOLATION LAYER
MATERIAL TEXTURE NUMBER 30

THICKNESS	=	240.00	INCHES
POROSITY	=	0.5410	VOL/VOL
FIELD CAPACITY	=	0.1870	VOL/VOL
WILTING POINT	=	0.0470	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.1947	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.499999987000E-04	CM/SEC

LAYER 3

TYPE 1 - VERTICAL PERCOLATION LAYER
MATERIAL TEXTURE NUMBER 0

THICKNESS	=	12.00	INCHES
POROSITY	=	0.4170	VOL/VOL
FIELD CAPACITY	=	0.0450	VOL/VOL
WILTING POINT	=	0.0180	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0455	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.500000007000E-01	CM/SEC

LAYER 4

TYPE 2 - LATERAL DRAINAGE LAYER
MATERIAL TEXTURE NUMBER 0

THICKNESS	=	0.69	INCHES
POROSITY	=	0.8500	VOL/VOL
FIELD CAPACITY	=	0.0100	VOL/VOL
WILTING POINT	=	0.0050	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0102	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	1.28999996000	CM/SEC
SLOPE	=	1.00	PERCENT
DRAINAGE LENGTH	=	541.0	FEET

LAYER 5

TYPE 4 - FLEXIBLE MEMBRANE LINER
MATERIAL TEXTURE NUMBER 35

THICKNESS	=	0.06	INCHES
POROSITY	=	0.0000	VOL/VOL
FIELD CAPACITY	=	0.0000	VOL/VOL
WILTING POINT	=	0.0000	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0000	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.199999996000E-12	CM/SEC
FML PINHOLE DENSITY	=	2.00	HOLES/ACRE
FML INSTALLATION DEFECTS	=	2.00	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

GENERAL DESIGN AND EVAPORATIVE ZONE DATA

NOTE: SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT SOIL DATA BASE USING SOIL TEXTURE # 9 WITH BARE GROUND CONDITIONS, A SURFACE SLOPE OF 2.% AND A SLOPE LENGTH OF 720. FEET.

SCS RUNOFF CURVE NUMBER	=	91.30	
FRACTION OF AREA ALLOWING RUNOFF	=	100.0	PERCENT
AREA PROJECTED ON HORIZONTAL PLANE	=	28.100	ACRES
EVAPORATIVE ZONE DEPTH	=	12.0	INCHES
INITIAL WATER IN EVAPORATIVE ZONE	=	3.675	INCHES
UPPER LIMIT OF EVAPORATIVE STORAGE	=	6.012	INCHES
LOWER LIMIT OF EVAPORATIVE STORAGE	=	1.620	INCHES
INITIAL SNOW WATER	=	0.000	INCHES
INITIAL WATER IN LAYER MATERIALS	=	61.200	INCHES
TOTAL INITIAL WATER	=	61.200	INCHES
TOTAL SUBSURFACE INFLOW	=	0.00	INCHES/YEAR

EVAPOTRANSPIRATION AND WEATHER DATA

NOTE: EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
ST. LOUIS MISSOURI

STATION LATITUDE	=	38.70 DEGREES
MAXIMUM LEAF AREA INDEX	=	0.50
START OF GROWING SEASON (JULIAN DATE)	=	98
END OF GROWING SEASON (JULIAN DATE)	=	300
EVAPORATIVE ZONE DEPTH	=	12.0 INCHES
AVERAGE ANNUAL WIND SPEED	=	10.40 MPH
AVERAGE 1ST QUARTER RELATIVE HUMIDITY	=	73.00 %
AVERAGE 2ND QUARTER RELATIVE HUMIDITY	=	67.00 %
AVERAGE 3RD QUARTER RELATIVE HUMIDITY	=	71.00 %
AVERAGE 4TH QUARTER RELATIVE HUMIDITY	=	74.00 %

NOTE: PRECIPITATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR ST. LOUIS MISSOURI

NORMAL MEAN MONTHLY PRECIPITATION (INCHES)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
1.72	2.14	3.28	3.55	3.54	3.73
3.63	2.55	2.70	2.32	2.53	2.22

NOTE: TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR ST. LOUIS MISSOURI

NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
28.60	33.80	43.20	56.10	65.60	74.80
78.90	77.00	69.70	57.90	44.60	34.20

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR ST. LOUIS MISSOURI
AND STATION LATITUDE = 38.70 DEGREES

****

AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1 THROUGH 25

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	1.48	2.08	3.12	3.53	3.24	4.61
	3.36	2.45	2.96	2.30	2.13	2.18
STD. DEVIATIONS	0.86	1.11	0.97	1.36	1.58	2.13
	1.90	1.28	1.45	1.31	1.49	1.09
RUNOFF						
TOTALS	0.391	0.787	0.587	0.212	0.265	0.654
	0.392	0.109	0.234	0.151	0.218	0.161
STD. DEVIATIONS	0.452	0.654	0.824	0.222	0.351	0.754
	0.548	0.144	0.217	0.199	0.266	0.215
EVAPOTRANSPIRATION						
TOTALS	0.569	0.697	2.472	3.494	2.909	3.987
	3.079	2.410	2.233	1.795	1.364	0.859
STD. DEVIATIONS	0.318	0.474	0.492	0.953	1.133	1.415
	1.345	1.087	1.145	0.670	0.512	0.255
LATERAL DRAINAGE COLLECTED FROM LAYER 4						
TOTALS	0.2922	0.2075	0.2035	0.2098	0.1508	0.1063
	0.1599	0.2529	0.2804	0.3148	0.3142	0.3278
STD. DEVIATIONS	0.1408	0.1104	0.1359	0.1175	0.0870	0.0816
	0.1536	0.1692	0.1658	0.1653	0.1374	0.1332
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	0.0697	0.0542	0.0486	0.0517	0.0360	0.0262
	0.0382	0.0604	0.0691	0.0751	0.0775	0.0782
STD. DEVIATIONS	0.0336	0.0287	0.0324	0.0290	0.0208	0.0201
	0.0367	0.0404	0.0409	0.0395	0.0339	0.0318

AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1 THROUGH 25

	INCHES	CU. FEET	PERCENT
PRECIPITATION	33.44 (4.389)	3411429.2	100.00
RUNOFF	4.161 (1.6271)	424391.19	12.440
EVAPOTRANSPIRATION	25.868 (3.1274)	2638658.00	77.348
LATERAL DRAINAGE COLLECTED FROM LAYER 4	2.82031 (1.20619)	287680.219	8.43284
PERCOLATION/LEAKAGE THROUGH LAYER 6	0.00005 (0.00002)	5.415	0.00016
AVERAGE HEAD ON TOP OF LAYER 5	0.057 (0.024)		
CHANGE IN WATER STORAGE	0.595 (2.1461)	60694.28	1.779

PEAK DAILY VALUES FOR YEARS 1 THROUGH 25

	(INCHES)	(CU. FT.)
PRECIPITATION	3.44	350890.344
RUNOFF	1.975	201463.1090
DRAINAGE COLLECTED FROM LAYER 4	0.02321	2367.64014
PERCOLATION/LEAKAGE THROUGH LAYER 6	0.000000	0.04056
AVERAGE HEAD ON TOP OF LAYER 5	0.172	
MAXIMUM HEAD ON TOP OF LAYER 5	0.336	
LOCATION OF MAXIMUM HEAD IN LAYER 4 (DISTANCE FROM DRAIN)	12.3 FEET	
SNOW WATER	2.22	225988.4530

MAXIMUM VEG. SOIL WATER (VOL/VOL)	0.4152
MINIMUM VEG. SOIL WATER (VOL/VOL)	0.1350

*** 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 25

LAYER	(INCHES)	(VOL/VOL)
1	2.6733	0.2228
2	61.7891	0.2575
3	1.0614	0.0885
4	0.1028	0.1490
5	0.0000	0.0000
6	10.2480	0.4270
SNOW WATER	0.201	

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Appendix O-10

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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:\HELP\ALPPR612.D4
TEMPERATURE DATA FILE:       C:\HELP\ALPTE612.D7
SOLAR RADIATION DATA FILE:   C:\HELP\ALPSR612.D13
EVAPOTRANSPIRATION DATA:     C:\HELP\ALPEV612.D11
SOIL AND DESIGN DATA FILE:   C:\HELP\INPUTS\OGE2R003.D10
OUTPUT DATA FILE:            C:\HELP\OUT\OGE2R003.OUT

TIME:  19: 9     DATE:  10/30/2012

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

     TITLE:  Ameren Missouri Labadie Proposed Utility Waste Landfill

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

     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   9
          THICKNESS                     =     12.00   INCHES
          POROSITY                      =      0.5010 VOL/VOL
          FIELD CAPACITY                =      0.2840 VOL/VOL
          WILTING POINT                 =      0.1350 VOL/VOL
          INITIAL SOIL WATER CONTENT    =      0.3111 VOL/VOL
          EFFECTIVE SAT. HYD. COND.     =  0.190000006000E-03 CM/SEC
        NOTE:  SATURATED HYDRAULIC CONDUCTIVITY IS MULTIPLIED BY  1.34
                 FOR ROOT CHANNELS IN TOP HALF OF EVAPORATIVE ZONE.
```

LAYER 2

TYPE 1 - VERTICAL PERCOLATION LAYER
MATERIAL TEXTURE NUMBER 30

THICKNESS	=	120.00	INCHES
POROSITY	=	0.5410	VOL/VOL
FIELD CAPACITY	=	0.1870	VOL/VOL
WILTING POINT	=	0.0470	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.2011	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.499999987000E-04	CM/SEC

LAYER 3

TYPE 1 - VERTICAL PERCOLATION LAYER
MATERIAL TEXTURE NUMBER 0

THICKNESS	=	12.00	INCHES
POROSITY	=	0.4170	VOL/VOL
FIELD CAPACITY	=	0.0450	VOL/VOL
WILTING POINT	=	0.0180	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0473	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.500000007000E-01	CM/SEC

LAYER 4

TYPE 2 - LATERAL DRAINAGE LAYER
MATERIAL TEXTURE NUMBER 0

THICKNESS	=	0.69	INCHES
POROSITY	=	0.8500	VOL/VOL
FIELD CAPACITY	=	0.0100	VOL/VOL
WILTING POINT	=	0.0050	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0100	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	1.28999996000	CM/SEC
SLOPE	=	33.33	PERCENT
DRAINAGE LENGTH	=	60.0	FEET

LAYER 5

TYPE 4 - FLEXIBLE MEMBRANE LINER
MATERIAL TEXTURE NUMBER 35

THICKNESS	=	0.06	INCHES
POROSITY	=	0.0000	VOL/VOL
FIELD CAPACITY	=	0.0000	VOL/VOL
WILTING POINT	=	0.0000	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0000	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.199999996000E-12	CM/SEC
FML PINHOLE DENSITY	=	2.00	HOLES/ACRE
FML INSTALLATION DEFECTS	=	2.00	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

GENERAL DESIGN AND EVAPORATIVE ZONE DATA

NOTE: SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT SOIL DATA BASE USING SOIL TEXTURE # 9 WITH BARE GROUND CONDITIONS, A SURFACE SLOPE OF 2.% AND A SLOPE LENGTH OF 720. FEET.

SCS RUNOFF CURVE NUMBER	=	91.30	
FRACTION OF AREA ALLOWING RUNOFF	=	100.0	PERCENT
AREA PROJECTED ON HORIZONTAL PLANE	=	3.300	ACRES
EVAPORATIVE ZONE DEPTH	=	12.0	INCHES
INITIAL WATER IN EVAPORATIVE ZONE	=	3.734	INCHES
UPPER LIMIT OF EVAPORATIVE STORAGE	=	6.012	INCHES
LOWER LIMIT OF EVAPORATIVE STORAGE	=	1.620	INCHES
INITIAL SNOW WATER	=	0.000	INCHES
INITIAL WATER IN LAYER MATERIALS	=	38.694	INCHES
TOTAL INITIAL WATER	=	38.694	INCHES
TOTAL SUBSURFACE INFLOW	=	0.00	INCHES/YEAR

EVAPOTRANSPIRATION AND WEATHER DATA

NOTE: EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
ST. LOUIS MISSOURI

STATION LATITUDE	=	38.70 DEGREES
MAXIMUM LEAF AREA INDEX	=	0.50
START OF GROWING SEASON (JULIAN DATE)	=	98
END OF GROWING SEASON (JULIAN DATE)	=	300
EVAPORATIVE ZONE DEPTH	=	12.0 INCHES
AVERAGE ANNUAL WIND SPEED	=	10.40 MPH
AVERAGE 1ST QUARTER RELATIVE HUMIDITY	=	73.00 %
AVERAGE 2ND QUARTER RELATIVE HUMIDITY	=	67.00 %
AVERAGE 3RD QUARTER RELATIVE HUMIDITY	=	71.00 %
AVERAGE 4TH QUARTER RELATIVE HUMIDITY	=	74.00 %

NOTE: PRECIPITATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR ST. LOUIS MISSOURI

NORMAL MEAN MONTHLY PRECIPITATION (INCHES)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
1.72	2.14	3.28	3.55	3.54	3.73
3.63	2.55	2.70	2.32	2.53	2.22

NOTE: TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR ST. LOUIS MISSOURI

NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
28.60	33.80	43.20	56.10	65.60	74.80
78.90	77.00	69.70	57.90	44.60	34.20

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR ST. LOUIS MISSOURI
AND STATION LATITUDE = 38.70 DEGREES

****

AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1 THROUGH 25

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	1.48	2.08	3.12	3.53	3.24	4.61
	3.36	2.45	2.96	2.30	2.13	2.18
STD. DEVIATIONS	0.86	1.11	0.97	1.36	1.58	2.13
	1.90	1.28	1.45	1.31	1.49	1.09
RUNOFF						
TOTALS	0.394	0.796	0.601	0.222	0.271	0.671
	0.404	0.112	0.243	0.153	0.222	0.167
STD. DEVIATIONS	0.455	0.656	0.824	0.237	0.357	0.769
	0.555	0.149	0.222	0.209	0.268	0.220
EVAPOTRANSPIRATION						
TOTALS	0.567	0.695	2.466	3.495	2.923	3.983
	3.074	2.428	2.243	1.783	1.378	0.857
STD. DEVIATIONS	0.317	0.472	0.489	0.934	1.114	1.409
	1.344	1.076	1.129	0.666	0.495	0.254
LATERAL DRAINAGE COLLECTED FROM LAYER 4						
TOTALS	0.2596	0.1940	0.1951	0.2016	0.1607	0.1715
	0.2941	0.3313	0.3130	0.3359	0.3121	0.3079
STD. DEVIATIONS	0.1270	0.0991	0.1028	0.1071	0.1131	0.1970
	0.2319	0.2140	0.1787	0.1565	0.1247	0.1157
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	0.0004	0.0003	0.0003	0.0003	0.0003	0.0003
	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005
STD. DEVIATIONS	0.0002	0.0002	0.0002	0.0002	0.0002	0.0003
	0.0004	0.0003	0.0003	0.0003	0.0002	0.0002

AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1 THROUGH 25

	INCHES	CU. FEET	PERCENT
PRECIPITATION	33.44 (4.389)	400630.5	100.00
RUNOFF	4.257 (1.6530)	50989.73	12.727
EVAPOTRANSPIRATION	25.892 (3.1254)	310166.03	77.419
LATERAL DRAINAGE COLLECTED FROM LAYER 4	3.07670 (1.26999)	36855.824	9.19946
PERCOLATION/LEAKAGE THROUGH LAYER 6	0.00000 (0.00000)	0.015	0.00000
AVERAGE HEAD ON TOP OF LAYER 5	0.000 (0.000)		
CHANGE IN WATER STORAGE	0.219 (1.7240)	2618.90	0.654

PEAK DAILY VALUES FOR YEARS 1 THROUGH 25

	(INCHES)	(CU. FT.)
PRECIPITATION	3.44	41207.762
RUNOFF	2.008	24057.4727
DRAINAGE COLLECTED FROM LAYER 4	0.03123	374.08154
PERCOLATION/LEAKAGE THROUGH LAYER 6	0.000000	0.00009
AVERAGE HEAD ON TOP OF LAYER 5	0.002	
MAXIMUM HEAD ON TOP OF LAYER 5	0.016	
LOCATION OF MAXIMUM HEAD IN LAYER 4 (DISTANCE FROM DRAIN)	0.0 FEET	
SNOW WATER	2.22	26539.5703

MAXIMUM VEG. SOIL WATER (VOL/VOL)	0.4162
MINIMUM VEG. SOIL WATER (VOL/VOL)	0.1350

*** 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 25

LAYER	(INCHES)	(VOL/VOL)
1	2.6890	0.2241
2	29.9731	0.2498
3	1.0424	0.0869
4	0.0069	0.0100
5	0.0000	0.0000
6	10.2480	0.4270
SNOW WATER	0.201	

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Appendix O-11