IGES® Intermountain GeoEnvironmental Services, Inc.
4153 Commerce Drive
Salt Lake City, Utah 84107 Ph: 801-270-9400 Fax: 801-270-9401

SW089
Div of Waste Management
and Radiation Control

FEB 22 2017

February 21, 2017

Mr. Scott T. Anderson, Director
Utah Division of Waste Management & Radiation Control
Department of Environmental Quality
State of Utah
195 North 1950 West
P.O. Box 144880
Salt Lake City, Utah 84114-4880

DSHW-2017-001553

RE: Beaver County Class I Landfill – Alternate Final Cover

Dear Mr. Anderson,

IGES has been retained by Beaver County Special Service District #5 to evaluate the possibility of utilizing select site soils in an alternative final cover for the Beaver County Class I landfill. The document included with this letter includes laboratory test results, climate data and an analysis of the alternate cover proposed.

Prior to the final analysis of the alternate cover system, the preliminary data and analysis we discussed with Mr. Roy Van Os and Mr. Rob Powers on October 25th of 2016. The attached document has reflected additional comments received from Department staff concerning reduction in evaporation and the proposed soil covers sensitivity to higher than average precipitation.

Based on the conversations with your staff and the demonstration contained in the attached document, Beaver County Special Service District #5 requests that the GCL currently included in the final cover system be eliminated. The final cover system proposed would include the 12" foundation layer with a 24" layer of select site soils installed over the foundation layer.

If you or members of your staff have any questions regarding this request for the use of an alternate final cover for the Beaver County Class I Landfill, please call at your earliest convenience.

Respectfully submitted,

Brett Mickelson

Brett Mickelson P.E.
IGES, Inc

Cc: Mike Neilsen, Beaver County Landfill

IGES® Intermountain GeoEnvironmental Services, Inc.
4153 Commerce Drive
Salt Lake City, Utah 84107 Ph: 801-270-9400 Fax: 801-270-9401

February 21, 2017

Mr. Mike Neilsen
Beaver County Landfill Manger
7300 South 800 East, P.O. Box 278
Milford, Utah 84751-0278

RE: Beaver County Landfill Alternate Final Cover Analysis
Beaver County, Utah

Dear Mr. Neilsen,

INTRODUCTION

The following presents IGES's evaluation of the soil cover proposed to be utilized at the Beaver County Class I Landfill. Design of the final cover for the Beaver County Landfill has required a two-step process which first assesed the site soil characteristics and climate data to see if an Evapotranspiration (ET) final cover was feasible. Our analysis utilizes previously generated geotechnical data with available climate data to estimate the site water balance. The soil characteristics and climatological data did indicate that an ET cover would likely be an effective final cover. The following sections present the soil testing results, the climatological data and the soil moisture analysis for the ET landfill cover.

SITE SOIL TESTING

IGES personel visited the Beaver County Landfill to observe site conditions and collect soil samples for analysis. The site soils were tested for moisture density relationship and soil moisture characteristics. Appendix A contains the results of the laboratory testing.

Two soil samples were collected with laboratory testing indicating that the site soils tested to be utilized for the final cover consisted primarily of silts and clay type materials.

Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (ASTM D698) determines the relationship between molding water content and dry unit weight. The moisture density relationship of the soil is utilized in preparing the soil for the capillary-moisture testing. The maximum dry density and optimum moisture content was 92.7 pcf at 25.3% moisture for sample #1, and 100.2 pcf at 22.7% moisture for sample #2 respectively.

Capillary-Moisture Relationship by Pressure-Membrane Apparatus (ASTM D3152) presents the moisture content relationship at varying negative pressures as expressed as height above water table in feet. The soil moisture suction relationships help to define

the Wilting Point and Field Capacity of the site soils which in turn predict how much moisture the soil can store.

Wilting Point (θ_{wp}) is defined as the amount of moisture (percent) that plants can typically recover from soil. The Wilting Point is further defined as the water content of soil at a negative 15 bars (negative 217.5 psi) of suction. Field Capacity (θ_{fc}) is the amount of moisture present in soil (percent) at which the soil can not absorb more free water. Field Capacity is further defined as the water content of soil at a negative 0.33 bars (negative 4.78 psi) of suction. The difference between the Field Capacity and the Wiliting Point for any soil represents that soils' ability to store water.

The Wilting Point and Field Capacity calculated for the soils tested from the Beaver County Landfill were 24% and 45% for sample #1 and 19% and 37.5% for sample #2 respectively. The relatively large difference between the Wilting Point and Field Capacity (18.5 to 21%) indicates that the soil, in sufficient thickness combined with favorable precipitation and evaporation rates will perform well as an ET cover.

REGIONAL CLIMATOLOGICAL DATA

The Beaver County Landfill is located northwest of Beaver Utah on the west side of I-15. Precipitation data from the Western Regional Climate Center for Beaver is included in Appendix B.

Evaporation data for the area around the Beaver County Landfill is sparse; the nearest representative data is from the Milford, Utah area. Appendix B contains the Western Regional Climate Center evaporation data for Milford.

EVAPORATIVE / TRANSPIRATION COVER MODELING

IGES has utilized the site-specific soil data (Wilting Point, Field Capacity, and existing field moisture content) presented in Appendix A and the general climatological data (precipitation and evaporation) presented in Appendix B as the basis to establish a numerical model representative of the proposed final cover soil performance. The final cover thickness and the amount of runoff was varied to demonstrate an acceptable factor of safety. Additional modeling of the proposed soil cover system was performed to assess the cover performance with precipitation amounts above average.

The numerical model uses the Wilting Point, Field Capacity, monthly precipitation, net evaporation (Pan evaporation decreased for anticipated field conditions), cover soil thickness, initial moisture of the soil, and estimated runoff as the input parameters. Wilting Point, Field Capacity, precipitation, and evaporation data are from sources described above. IGES has run the numerical model multiple times changing the remaining variables to determine the critical case.

The critical case (worst case) of the alternate final cover analysis of the Beaver County Landfill final cover, as expected, occurs when the thickness of the cover is the smallest and the runoff is the least.

Regulatory requirements for final cover thickness in this type of landfill application are a minimum of 18" of site soils. In IGES's experience, due to the nature of solid wastes, it is necessary to apply an additional 6" of soils to account for site grading anomolies and to allow for loss of soil into the 12" base soil layer that will be over the waste.

To demonstrate an adequate factor of safety, IGES ran the numerical model by utilizing the following data:

- Use of net evaporation data rather than pan evaporation data. Since pan evaporation data is consistently greater than the free water evaporation, the pan data is reduced by 30%. The 30% reduction is a typical value for the pan evaporation coefficient.
- The IGES model conservatively reduces evaporation by another 40% to take into account other variables that aren't practical to measure like mean daily temperature, mean daily solar radiation, wind speed, and psychrometric constant required to calculate actual evaporation. Wilson et al. (1996) have shown that the ratio of actual evaporation to potential evaporation varies with suction pressure. The reduction in potential evaporation to estimate actual evaporation makes allowance for the changes in vapor pressure associated with partially saturated soil surfaces.
- Soil thickness varied from 18" to 24" in thickness
- The drainage system design for the Beaver County Landfill utilized a soil group D that resulted in a run-off curve number of 84 – indicating a soil with high runoff potential. Runoff was varied from 0 to 50%.
- Initial moisture content is equal to the moisture content of the soil samples utilized in the testing for Field Capacity and Wilting Point.
- IGES began the infiltration model at the start of the calendar year coincident with the months with the lowest evaporation.

RESULTS

The water balance of the final cover for the Beaver County Landfill varied with the soil changes in soil properties, thickness of soil, and the amount of runoff was changed. Appendix C contains the final eight iterations of the data utilized in the alternate cover analysis. The models included four for the soil type #1:

- ***Soil Type #1 – 18-inches of soil and no runoff***. This model utilized the soil characteristics of soil sample #1 (Wilting Point of 24%, Field Capacity of 45%,

and initial moisture content of 25.3%), 18-inch thick soil cover and no runoff. This scenario is the critical case where the soil layer is the thinnest with the assumption that there is no runoff.

- ***Soil Type #1 – 24-inches of soil and no runoff***. This model utilized the soil characteristics of soil sample #1 (Wilting Point of 24%, Field Capacity of 45%, and initial moisture content of 25.3%), 24-inch thick soil cover and no runoff.
- ***Soil Type #1 – 24-inches of soil, 50% runoff***. This model utilized the soil characteristics of soil sample #1 (Wilting Point of 24%, Field Capacity of 45%, and initial moisture content of 25.3%), 24-inch thick soil cover and 50% runoff.

The soil type #1 showed the lowest amount of storage capacity remaining (month of March) was 0.77 inches for 18" cover with no runoff. That increased to 1.95 inches of remaining storage capacity with the 24" of soil with no runoff. The remaining storage capacity of 3.34 inches was indicated utilizing the 24-inch thick cover soil with a 50% runoff.

An additional analysis was made on the most conservative soil cover modeled above to see how the proposed cover performed with precipitation above normal.

- ***Soil Type #1 – 24-inches of soil, no runoff, increased precipitation***. This model utilized the soil characteristics of soil sample #1 (Wilting Point of 24%, Field Capacity of 45%, and initial moisture content of 25.3%), 24-inch thick soil cover, no runoff and precipitation increased to 170% of normal.

The 170% of normal precipitation is the largest increase in precipitation where the cover system shows no breakthrough in infiltration. This model also assumes that there is no increased runoff associated with the increased precipitation.

The four models for the soil type #2:

- ***Soil Type #2 – 18-inches of soil, no runoff***. This model utilized the soil characteristics of soil sample #1 (Wilting Point of 19%, Field Capacity of 37.5%, and initial moisture content of 19.4%), 18-inch thick soil cover and no runoff. This scenario is the critical case where the soil layer is the thinnest with the assumption that there is no runoff.
- ***Soil Type #2 – 24-inches of soil, no runoff***. This model utilized the soil characteristics of soil sample #1 (Wilting Point of 19%, Field Capacity of 37.5%, and initial moisture content of 19.4%), 24-inch thick soil cover and no runoff.
- ***Soil Type #2 – 24-inches of soil, 50% runoff***. This model utilized the soil characteristics of soil sample #1 (Wilting Point of 19%, Field Capacity of 37.5%, and initial moisture content of 19.4%), 24-inch thick soil cover and 50% runoff.

The soil type #2 showed the lowest amount of storage capacity remaining (month of March) was 0.48 inches for 18" cover with no runoff. That increased to 1.57 inches of remaining storage capacity with the 24" of soil with no runoff. The remaining storage capacity of 2.96 inches was indicated utilizing the 24-inch thick cover soil with a 50% runoff.

An additional analysis was made on the most conservative soil cover modeled above to see how the proposed cover performed with precipitation above normal.

- ***Soil Type #2 – 24-inches of soil, no runoff, increased precipitation***. This model utilized the soil characteristics of soil sample #1 (Wilting Point of 19%, Field Capacity of 37.5%, and initial moisture content of 19.4%), 24-inch thick soil cover, no runoff and precipitation increase to 155% of normal.

The 155% of normal precipitation is the largest increase in precipitation where the cover system shows no breakthrough in infiltration. This model also assumes that there is no increased runoff associated with the increased precipitation.

CONCLUSIONS

The results of the modeling show that utilizing either soil for the final cover at an 18-inch thickness with no runoff would result in no infiltration through the 18 inches of soil. The addition of an additional 6" of soil for a final soil cover thickness of 24" increase the storage capacity of the final cover for an increased factor of safety.

The modeling with increase precipitation illustrated that the proposed cover had the ability to store 50% more precipitation than normal without infiltration to the base soil layer. The base soil layer of the proposed final cover is 12" of site soils. The reason that the base soil layer was not included in the modeling is that the soils utilized for the base layer might use other site soils and not come from the soil stockpile that was tested for the final cover. The 12" of base soils provide another level of protection from infiltration of storm water to solid waste. Additionally, runoff was set to zero to provide a more conservative final cover design.

References:

Wilson, G.W., Fredlund, D.G., and Barbour, S.L. 1996. The effect of soil suction on evaporative fluxes from soil surfaces. Canadian Geotechnical Journal, February 1997.

RECOMMENDATIONS

IGES recommends that the alternate final cover for the Beaver County Landfill be a 24-inch thick soil cover utilizing soils similar to those sampled and tested for this analysis. We recommend that the final 24"-inch thick soil layer be placed over a 12" base soil layer. The construction of the final cover for the Beaver County Landfill as described above will result in a final cover which will prevent precipitation from infiltrating into the landfill. The performance of the final cover will depend on the quality of cover construction. The final cover construction will require the development and implementation of a Utah Division of Waste Management and Radiation Control (UDWMRC) approved QA/QC plan to control and document construction.

oOo

If you have any questions regarding this analysis or any other aspects of your final cover construction, please call.

Respectfully submitted,

Brett D. Mickelson, P.E.
Principal

BDM/

Attachments:
- Appendix A – Laboratory Data
- Appendix B – Climatological Data
- Appendix C – Water Balance

APPENDIX A

(Laboratory Data)

Laboratory Compaction Characteristics of Soil

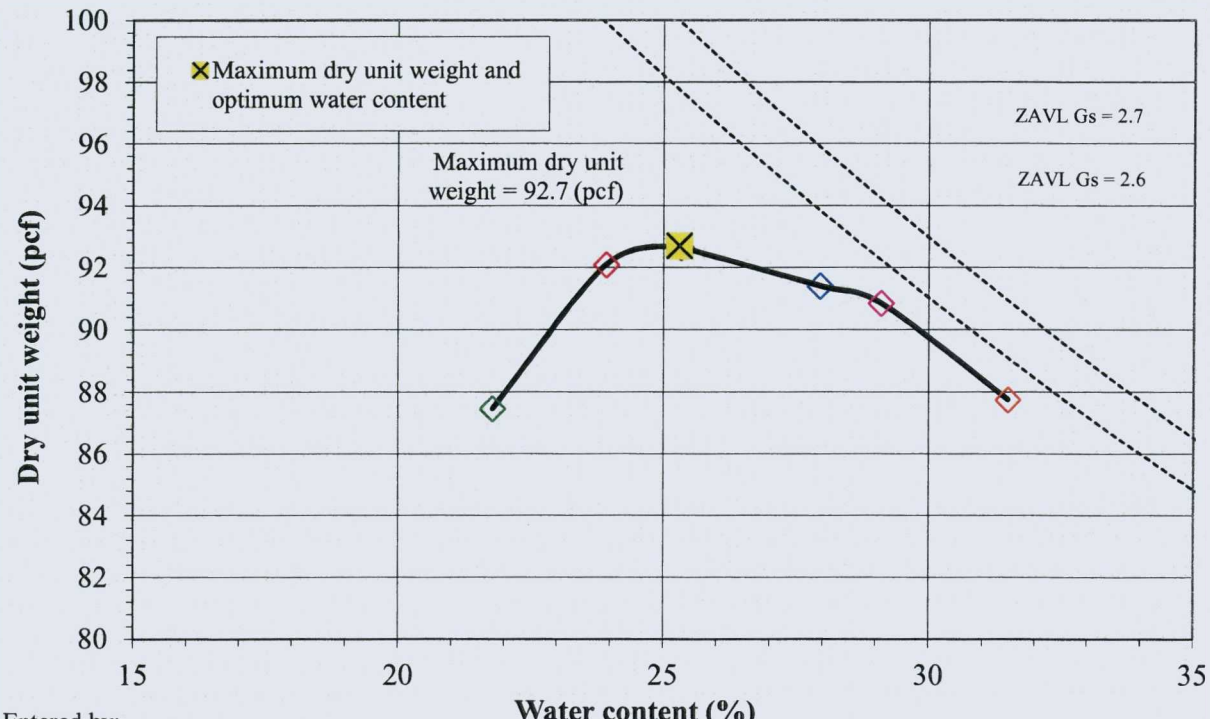
(ASTM D698 / D1557)

Project: Beaver County Landfill
No: 00639-005
Location: Beaver County, UT
Date: 7/15/2016
By: BSS

Boring No.:
Sample: #1
Depth:
Sample Description: Brown Clay
Engineering Classification: Not requested
As-received water content (%): Not requested
Method: ASTM D698 A
Preparation method: Moist
Mold Id. Inc 1
Rammer: Mechanical-circular face
Mold volume (ft^3): 0.0332
Rock Correction: No

Optimum water content (%): 25.3
Maximum dry unit weight (pcf): 92.7

Point Number	As Is	-2%	-4%	+2%	+4%	+1%		
Wt. Sample + Mold (g)	5984.0	5953.9	5839.5	6001.6	5973.0	5996.5		
Wt. of Mold (g)	4237	4237	4237	4237	4237	4237		
Wet Unit Wt., γ_m (pcf)	116.1	114.1	106.5	117.3	115.4	117.0		
Wet Soil + Tare (g)	1130.89	972.76	1039.84	1082.10	1125.83	1089.96		
Dry Soil + Tare (g)	945.78	828.11	924.15	926.35	934.73	900.36		
Tare (g)	215.00	223.51	393.03	391.13	327.90	222.04		
Water Content, w (%)	**25.3**	**23.9**	**21.8**	**29.1**	**31.5**	**28.0**		
Dry Unit Wt., γ_d (pcf)	**92.7**	**92.1**	**87.5**	**90.9**	**87.8**	**91.4**		



Entered by:_____

Reviewed:_____

Z:\PROJECTS\00639_Beaver_County_UT\005_Beaver_County_Landfill\[PROCTORv3.xlsm]1

Determination of the Soil Water Characteristic Curve for Desorption Using Pressure Extractor

(In general accordance with ASTM D6836)

Project: Beaver County Landfill
No: 00639-005
Location: Beaver County, UT
Date: 8/18/2016
By: NB

Specific gravity, Gs: 2.700 Assumed

Boring No.:
Sample: #1
Depth:
Description: Reddish brown clay
Sample type: Laboratory compacted
Dry unit weight 83.4 pcf
at 25.3 (%) w
Compaction specifications: 90% of ASTM D698A

		Test No.	1	2	3	4	5	6	7*	8*
		Tension (psi)	0.5	1.0	2.0	6.0	18.0	72.0	4248.16	6697.84
Sample A	Initial Condition	Sample height, H (in)	0.4870	0.4870	0.4870	0.4870	0.4870	0.4870	0.1873	0.1877
		Sample diameter, D (in)	2.416	2.416	2.416	2.416	2.416	2.416	1.4722	1.4715
		Sample Volume (ft^3)	0.001	0.001	0.001	0.001	0.001	0.001	0.0002	0.0002
		Wt. rings/cup + wet soil (g)	103.05	103.05	103.05	103.05	103.05	103.05	34.092	33.802
		Wt. rings/cup (g)	41.72	41.72	41.72	41.72	41.72	41.72	25.715	25.691
		Moist soil, Ws (g)	61.33	61.33	61.33	61.33	61.33	61.33	8.377	8.111
		Dry soil (g)	48.72	48.72	48.72	48.72	48.72	48.72	6.972	6.971
		Moist unit wt., γ_m (pcf)	104.65	104.65	104.65	104.65	104.65	104.65	100.09	96.80
		Wet soil + tare (g)	252.71	252.71	252.71	252.71	252.71	252.71	34.092	33.802
		Dry soil + tare (g)	227.05	227.05	227.05	227.05	227.05	227.05	32.687	32.662
		Tare (g)	127.87	127.87	127.87	127.87	127.87	127.87	25.715	25.691
		Moisture Content, w (%)	25.9	25.9	25.9	25.9	25.9	25.9	20.15	16.35
		Dry Unit Wt., γ_d (pcf)	83.14	83.14	83.14	83.14	83.14	83.14	83.31	83.20
	Final Condition	Wet soil + ring/cup (g)	110.57	109.78	109.25	106.76	103.55	102.86	33.390	33.253
		Dry soil + ring/cup (g)	92.05	92.05	92.05	92.05	92.05	92.05	32.687	32.662
		Ring/cup (g)	43.33	43.33	43.33	43.33	43.33	43.33	25.715	25.691
		Dry soil (g)	48.72	48.72	48.72	48.72	48.72	48.72	6.972	6.971
		Moisture Content, w (%)	38.00	36.38	35.29	30.18	23.59	22.18	10.08	8.48
		Volumetric Water Content, θ	0.506	0.485	0.470	0.402	0.314	0.295	0.135	0.113
Sample B	Initial Condition	Sample height, H (in)	0.4870	0.4870	0.4870	0.4870	0.4870	0.4870		
		Sample diameter, D (in)	2.416	2.416	2.416	2.416	2.416	2.416		
		Sample Volume (ft^3)	0.001	0.001	0.001	0.001	0.001	0.001		
		Wt. rings/cup + wet soil (g)	106.75	106.75	106.75	106.75	106.75	106.75		
		Wt. rings/cup (g)	45.43	45.43	45.43	45.43	45.43	45.43		
		Moist unit wt., γ_m (pcf)	104.63	104.63	104.63	104.63	104.63	104.63		
		Wet soil + tare (g)	252.71	252.71	252.71	252.71	252.71	252.71		
		Dry soil + tare (g)	227.05	227.05	227.05	227.05	227.05	227.05		
		Tare (g)	127.87	127.87	127.87	127.87	127.87	127.87		
		Moisture Content, w (%)	25.9	25.9	25.9	25.9	25.9	25.9		
		Dry Unit Wt., γ_d (pcf)	83.13	83.13	83.13	83.13	83.13	83.13		
	Final Condition	Wet soil + ring/cup (g)	114.59	113.63	113.14	110.58	107.63	107.01		
		Dry soil + ring/cup (g)	94.15	94.15	94.15	94.15	94.15	94.15		
		Ring/cup (g)	45.43	45.43	45.43	45.43	45.43	45.43		
		Dry soil (g)	48.72	48.72	48.72	48.72	48.72	48.72		
		Moisture Content, w (%)	41.97	39.99	38.99	33.73	27.68	26.41		
		Volumetric Water Content, θ	0.559	0.533	0.519	0.449	0.369	0.352		
		Average Volumetric Moisture:	**0.533**	**0.509**	**0.495**	**0.426**	**0.342**	**0.324**	0.135	**0.113**

Comments:
*Points 7 and 8 were performed on a Chilled Mirror Hygrometer

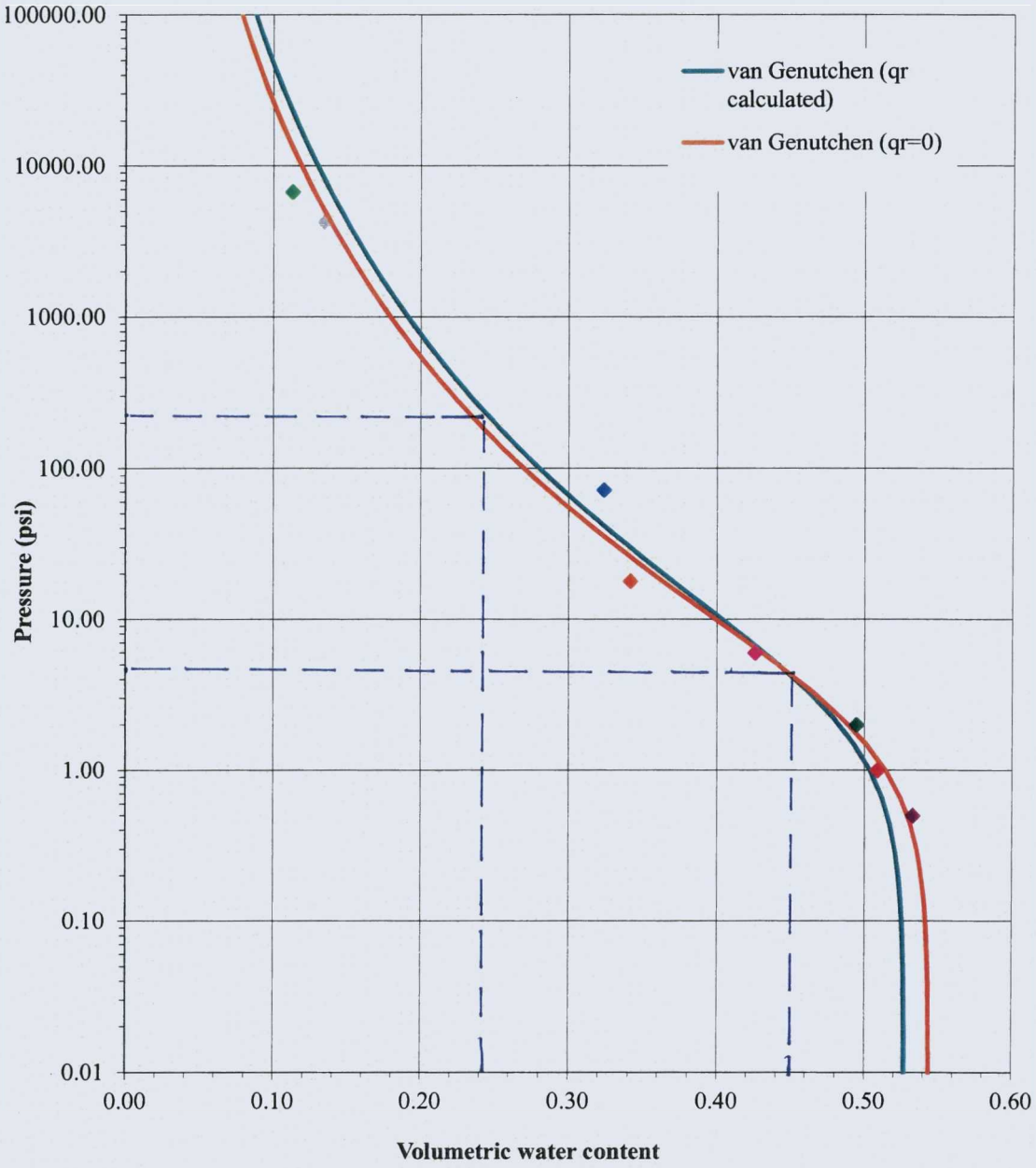
Entered by:_____
Reviewed:_____

Determination of the Soil Water Characteristic Curve for Desorption Using Pressure Extractor

(In general accordance with ASTM D6836)

Project: Beaver County Landfill
No: 00639-005
Location: Beaver County, UT
Date: 8/18/2016

Boring No.:
Sample: #1
Depth:
Description: Reddish brown clay



van Genuchten fitting parameters (using SWRC fit, Seki, K. (2007)):

θ_r calculated		Setting θ_r =0	
θ_s	0.5271	θ_s	0.5439
θ_r	8.7421E-06	θ_r	0
α	0.4268	α	0.5036
n	1.1676	n	1.1783
m	0.1435	m	0.1513
R^2	0.9843	R^2	0.9883

Laboratory Compaction Characteristics of Soil

(ASTM D698 / D1557)

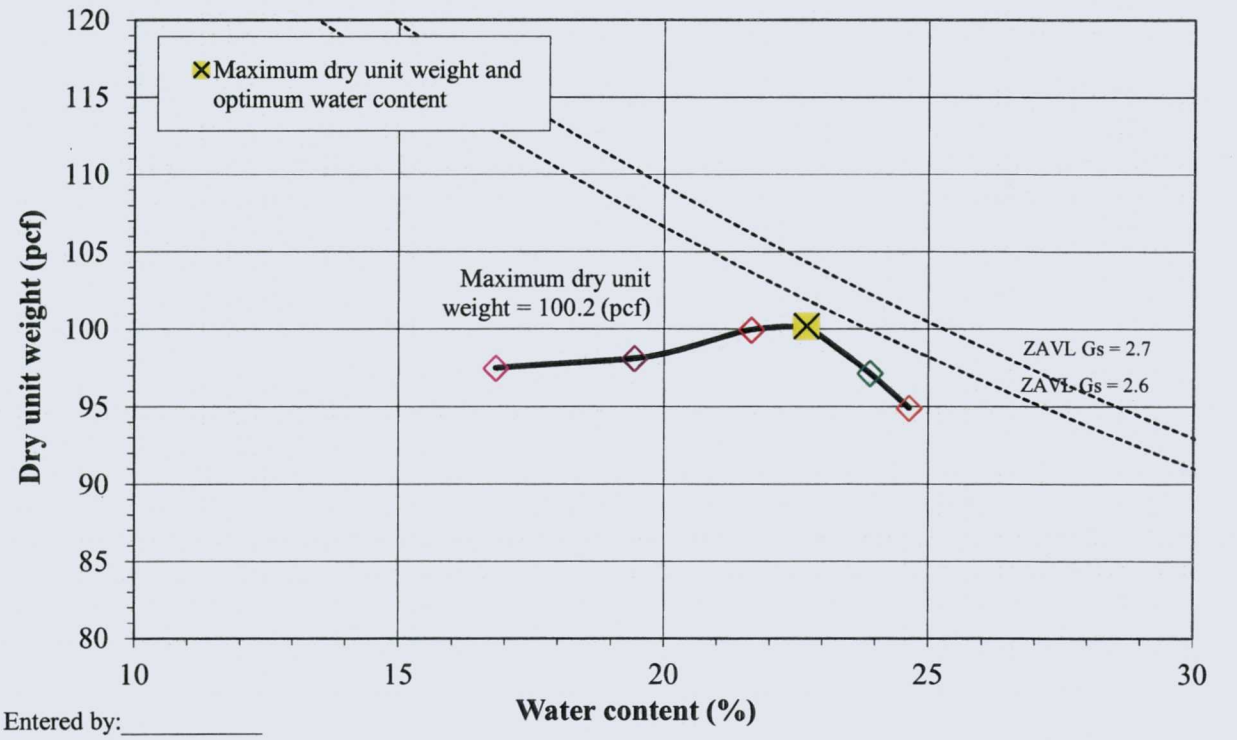
Project: Beaver County Landfill
No: 00639-005
Location: Beaver County, UT
Date: 7/14/2016
By: DKS

Method: ASTM D698 A
Mold Id. Inc 3
Mold volume (ft^3): 0.0331

Boring No.:
Sample: #2
Depth:
Sample Description: Brown silt
Engineering Classification: Not requested
As-received water content (%): Not requested
Preparation method: Moist
Rammer: Mechanical-circular face
Rock Correction: No

Optimum water content (%): 22.7
Maximum dry unit weight (pcf): 100.2

Point Number	As Is	+2%	+4%	-2%	+6%			
Wt. Sample + Mold (g)	5920.9	5987.7	5968.9	5871.7	5937.9			
Wt. of Mold (g)	4160.3	4160.3	4160.3	4160.3	4160.3			
Wet Unit Wt., γ_m (pcf)	117.2	121.6	120.4	113.9	118.3			
Wet Soil + Tare (g)	1085.43	1037.12	1275.17	1118.02	1020.02			
Dry Soil + Tare (g)	935.93	883.13	1072.03	988.05	852.20			
Tare (g)	167.09	172.21	222.25	215.41	171.24			
Water Content, w (%)	**19.4**	**21.7**	**23.9**	**16.8**	**24.6**			
Dry Unit Wt., γ_d (pcf)	**98.1**	**100.0**	**97.1**	**97.5**	**94.9**			



Entered by:_____

Reviewed:_____

Determination of the Soil Water Characteristic Curve for Desorption

Using Pressure Extractor

(In general accordance with ASTM D6836)

Project: Beaver County Landfill
No: 00639-005
Location: Beaver County, UT
Date: 8/18/2016
By: NB

Specific gravity, Gs: 2.700 Assumed

Boring No.:
Sample: #2
Depth:
Description: Brown silt
Sample type: Laboratory compacted
Dry unit weight 90.2 pcf
at 22.7 (%) w
Compaction specifications: 90% of ASTM D698A

		Test No.	1	2	3	4	5	6	7*	8*
		Tension (psi)	0.5	1.0	2.0	6.0	18.0	72.0	5953.80	11201.26
Sample A	Initial Condition	Sample height, H (in)	0.4870	0.4870	0.4870	0.4870	0.4870	0.4870	0.1890	0.1882
		Sample diameter, D (in)	2.416	2.416	2.416	2.416	2.416	2.416	1.4718	1.4722
		Sample Volume (ft^3)	0.001	0.001	0.001	0.001	0.001	0.001	0.0002	0.0002
		Wt. rings/cup + wet soil (g)	109.92	109.92	109.92	109.92	109.92	109.92	34.582	33.928
		Wt. rings/cup (g)	45.01	45.01	45.01	45.01	45.01	45.01	25.884	25.485
		Moist soil, Ws (g)	64.91	64.91	64.91	64.91	64.91	64.91	8.698	8.443
		Dry soil (g)	52.91	52.91	52.91	52.91	52.91	52.91	7.597	7.595
		Moist unit wt., γ_m (pcf)	110.76	110.76	110.76	110.76	110.76	110.76	103.05	100.40
		Wet soil + tare (g)	294.22	294.22	294.22	294.22	294.22	294.22	34.582	33.928
		Dry soil + tare (g)	263.62	263.62	263.62	263.62	263.62	263.62	33.481	33.080
		Tare (g)	128.75	128.75	128.75	128.75	128.75	128.75	25.884	25.485
		Moisture Content, w (%)	22.7	22.7	22.7	22.7	22.7	22.7	14.49	11.17
		Dry Unit Wt., γ_d (pcf)	90.28	90.28	90.28	90.28	90.28	90.28	90.01	90.32
	Final Condition	Wet soil + ring/cup (g)	114.16	113.07	112.53	110.45	107.69	106.39	34.005	33.503
		Dry soil + ring/cup (g)	96.24	96.24	96.24	96.24	96.24	96.24	33.481	33.080
		Ring/cup (g)	43.33	43.33	43.33	43.33	43.33	43.33	25.884	25.485
		Dry soil (g)	52.91	52.91	52.91	52.91	52.91	52.91	7.597	7.595
		Moisture Content, w (%)	33.88	31.82	30.80	26.87	21.65	19.19	6.90	5.57
		Volumetric Water Content, θ	0.490	0.460	0.446	0.389	0.313	0.278	0.099	0.081
Sample B	Initial Condition	Sample height, H (in)	0.4870	0.4870	0.4870	0.4870	0.4870	0.4870		
		Sample diameter, D (in)	2.416	2.416	2.416	2.416	2.416	2.416		
		Sample Volume (ft^3)	0.001	0.001	0.001	0.001	0.001	0.001		
		Wt. rings/cup + wet soil (g)	106.90	106.90	106.90	106.90	106.90	106.90		
		Wt. rings/cup (g)	41.98	41.98	41.98	41.98	41.98	41.98		
		Moist unit wt., γ_m (pcf)	110.78	110.78	110.78	110.78	110.78	110.78		
		Wet soil + tare (g)	294.22	294.22	294.22	294.22	294.22	294.22		
		Dry soil + tare (g)	263.62	263.62	263.62	263.62	263.62	263.62		
		Tare (g)	128.75	128.75	128.75	128.75	128.75	128.75		
		Moisture Content, w (%)	22.7	22.7	22.7	22.7	22.7	22.7		
		Dry Unit Wt., γ_d (pcf)	90.29	90.29	90.29	90.29	90.29	90.29		
	Final Condition	Wet soil + ring/cup (g)	111.22	110.18	109.57	107.53	104.47	103.93		
		Dry soil + ring/cup (g)	94.89	94.89	94.89	94.89	94.89	94.89		
		Ring/cup (g)	41.98	41.98	41.98	41.98	41.98	41.98		
		Dry soil (g)	52.91	52.91	52.91	52.91	52.91	52.91		
		Moisture Content, w (%)	30.85	28.89	27.73	23.88	18.10	17.08		
		Volumetric Water Content, θ	0.446	0.418	0.401	0.346	0.262	0.247		
		Average Volumetric Moisture:	**0.468**	**0.439**	**0.423**	**0.367**	**0.288**	**0.262**	0.099	**0.081**

Comments:
*Points 7 and 8 were performed on a Chilled Mirror Hygrometer

Entered by:_____
Reviewed:_____

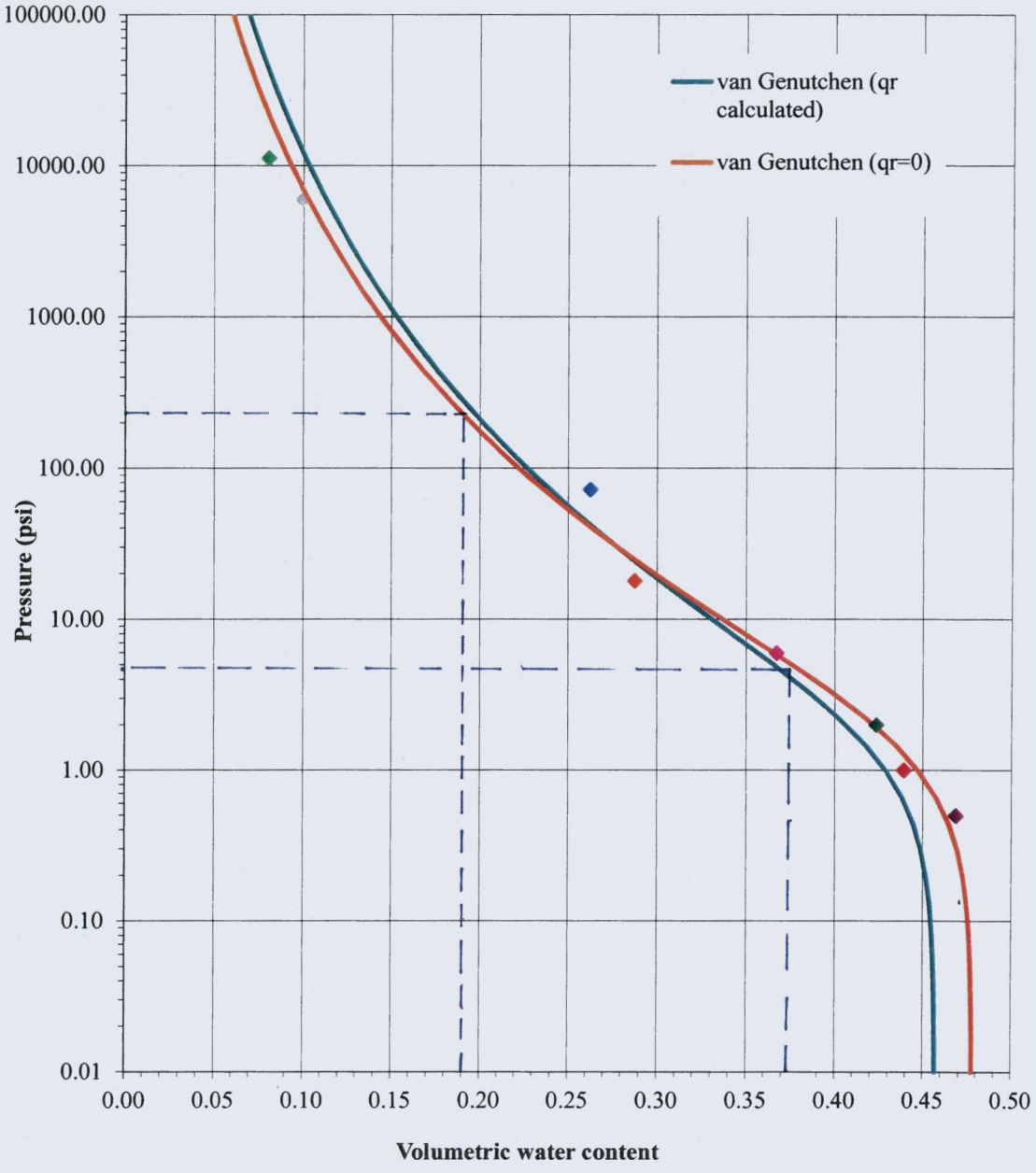
Determination of the Soil Water Characteristic Curve for Desorption

Using Pressure Extractor

(In general accordance with ASTM D6836)

Project: Beaver County Landfill
No: 00639-005
Location: Beaver County, UT
Date: 8/18/2016

Boring No.:
Sample: #2
Depth:
Description: Brown silt



van Genuchten fitting parameters (using SWRC fit, Seki, K. (2007)):

θ_r calculated		Setting θ_r =0	
θ_s	0.4570	θ_s	0.4778
θ_r	3.1876E-06	θ_r	0
α	0.6002	α	0.5781
n	1.1710	n	1.1886
m	0.1460	m	0.1587
R^2	0.9881	R^2	0.9924

APPENDIX B

(Climatological Data)

BEAVER, UTAH (420519)

Period of Record Monthly Climate Summary

Period of Record : 1/ 1/1890 to 5/31/1990

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Average Max. Temperature (F)	41.6	45.1	52.0	61.3	70.8	80.9	87.4	85.1	77.8	66.3	52.7	43.3	63.7
Average Min. Temperature (F)	13.4	18.3	23.5	29.4	36.3	43.2	50.8	49.6	40.7	30.7	21.2	15.2	31.0
Average Total Precipitation (in.)	0.78	0.94	1.06	1.05	0.97	0.58	1.15	1.48	0.96	0.87	0.70	0.79	11.33
Average Total SnowFall (in.)	8.8	6.6	5.0	2.6	0.9	0.1	0.0	0.0	0.1	0.7	4.0	5.3	34.0
Average Snow Depth (in.)	1	1	0	0	0	0	0	0	0	0	0	0	0

Percent of possible observations for period of record.
Max. Temp.: 81.1% Min. Temp.: 81.3% Precipitation: 69.1% Snowfall: 54.4% Snow Depth: 48.8%
Check Station Metadata or Metadata graphics for more detail about data completeness.

Western Regional Climate Center, wrcc@dri.edu

Evaporation Stations

Standard daily pan evaporation is measured using the four-foot diameter Class A evaporation pan. The pan water level reading is adjusted when precipitation is measure to obtain the actual evaporation. Most Class A pans are installed above ground, allowing effects such as radiation on the side walls and heat exchnges with the pan material. These effects tend to increase the evaporation totals. The amounts can then be adjusted by multiplying the totals b 0.70 or 0.80 to more closely estimate the evaporation from naturally existing surfaces such as a shallow lake, wet soil or other moist natural surfaces.

Many stations do not measure pan evaportation during winter months. A "0.00" total indicates no measuement is taken.
Stations marked with an asterisk (*) have estimated totals computed from meteorological measurements using a form of the Penman equation.

UTAH

MONTHLY AVERAGE PAN EVAPORATION (INCHES)

	PERIOD OF RECORD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	YEAR
ARCHES NATL PARK HQ	1980-2005	0.00	0.00	0.00	7.44	9.81	12.33	12.94	11.15	8.16	4.73	0.00	0.00	66.56
BEAR RIVER BAY	1969-1996	0.00	0.00	0.00	6.27	10.17	12.59	13.86	12.29	7.83	4.89	0.00	0.00	67.90
BEAR RIVER REFUGE	1948-1984	0.00	0.00	0.00	4.80	7.21	8.66	10.46	9.30	6.13	3.27	1.27	0.00	51.10
BRYCE CANYON NAT'L PRK	1971-1978	0.00	0.00	0.00	0.00	6.86	7.86	8.07	7.21	5.30	0.00	0.00	0.00	35.30
FARMINGTON USU FLD STN	1948-2005	0.00	0.00	0.00	0.00	7.33	6.35	9.25	8.62	4.63	2.97	0.00	0.00	39.15
FERRON	1948-2005	0.00	0.00	0.00	5.20	5.66	8.06	6.58	6.39	5.49	3.53	0.00	0.00	40.91
FISH SPRINGS REFUGE	1960-2005	0.00	0.00	0.00	7.02	10.70	12.90	15.92	13.58	9.92	5.84	0.00	0.00	75.88
FLAMING GORGE	1957-2005	0.00	0.00	0.00	0.00	6.23	8.74	9.71	8.62	5.76	3.94	0.00	0.00	43.00
FORT DUCHESNE	1894-2005	0.00	0.00	0.00	5.16	7.41	8.61	9.06	7.98	5.57	3.25	0.00	0.00	47.04
GREEN RIVER AVIATION	1893-2005	0.00	0.00	0.00	6.07	8.07	9.29	9.49	7.97	5.74	3.52	1.60	0.00	51.75
GUNNISON	1956-1990	0.00	0.00	0.00	5.10	7.23	8.70	9.65	8.26	6.03	3.81	0.00	0.00	48.78
HITE	1949-1962	0.00	0.00	0.00	7.84	11.74	14.14	14.01	12.44	8.34	4.86	1.94	0.00	75.31
LOGAN USU EXP STN	1950-1978	0.00	0.00	0.00	4.01	5.98	7.05	8.37	7.50	5.02	2.92	0.00	0.00	40.85
LOGAN 5 SW EXP FARM	1969-2005	0.00	0.00	3.30	4.57	6.57	8.48	10.05	8.93	5.88	3.51	0.00	0.00	51.29
MANILA	1952-2005	0.00	0.00	0.00	0.00	7.31	8.66	9.83	8.37	6.50	4.63	0.00	0.00	45.30
MEXICAN HAT	1948-2005	0.00	0.00	6.31	8.45	11.99	14.42	14.87	12.48	9.37	5.52	2.25	0.00	85.66
MILFORD	1906-2005	0.00	0.00	0.00	7.47	10.22	13.54	15.47	13.24	9.88	6.16	2.32	0.00	78.30
MOAB	1889-2005	0.00	0.00	4.19	7.29	10.41	12.03	12.72	10.75	7.66	4.25	2.26	0.00	71.56
MORGAN	1948-2005	0.00	0.00	0.00	4.94	6.96	7.30	9.07	8.01	6.15	3.74	0.00	0.00	46.17
PIUTE DAM	1948-1971	0.00	0.00	0.00	0.00	7.91	9.98	10.13	8.40	6.98	4.60	0.00	0.00	48.00
PROVO AIRPORT	1948-1953	0.00	0.00	2.91	6.03	6.83	8.62	8.88	8.36	6.09	3.41	0.00	0.00	51.13
PROVO BYU	1980-2005	0.00	0.00	2.59	4.71	6.81	8.77	9.85	8.70	5.59	2.92	0.00	0.00	49.94
PROVO RADIO KAYK	1952-1977	0.00	0.00	0.00	4.38	5.94	7.53	8.32	7.58	5.40	3.21	1.53	0.00	43.89
ST GEORGE	1862-2005	0.00	0.00	4.57	7.36	10.08	12.22	13.17	11.55	8.22	4.83	2.68	0.00	74.68
SALTAIR SALT PLANT	1956-1991	0.00	0.00	3.66	6.20	9.19	11.88	14.40	12.67	8.58	4.86	2.32	0.00	73.76
SCOFIELD DAM	1948-1991	0.00	0.00	0.00	0.00	5.52	7.84	8.29	6.94	5.13	3.90	0.00	0.00	37.62
SEVIER DRY LAKE	1987-1993	0.00	0.00	2.93	6.33	13.52	16.06	18.32	0.00	0.00	0.00	0.00	0.00	57.16
STRAWBERRY RESERVOIR EA	1956-1977	0.00	0.00	0.00	0.00	5.82	7.28	7.87	7.31	5.08	3.02	0.00	0.00	36.38
UTAH LAKE LEHI	1928-2003	0.00	0.00	2.77	5.19	7.11	8.80	9.61	8.58	6.10	3.81	1.42	0.00	53.39
VERNAL ARPT	1928-2005	0.00	0.00	0.00	5.07	6.41	7.48	6.64	6.34	4.89	2.92	0.00	0.00	39.75
WANSHIP DAM	1955-2005	0.00	0.00	0.00	0.00	6.09	6.79	7.41	6.59	4.79	3.19	0.00	0.00	34.86

APPENDIX C

(Water Balance)

Annual cycle of precipation-evapotranspiration-storage for Beaver County Landfill
(Soil Type # 1 - 18" of soil, no runoff)

Annual ave Precip total =	**11.33**	inches (average annual over last 100 years)
Annual Evapo-Transpiration =	**54.8**	inches (70% of 78.3 inches) Pan Evaporaton = 78.3
Field Capacity of Cover Soil =	**45**	% (Moisture Content in Percent of Volume)
Wilting Point of Soil =	**24**	% (Moisture Content in Percent of Volume)
Runoff =	**0**	% (Percent of Precipation)
Initial Moisture Content of Cover Soil =	**25.3**	% (Percent of Volume)
Thickness of Cover Soil =	**18**	inches
Penman-Wilson ET Reduction =	**0.6**	(fraction of total potential evapo-transpiration expressed as actual soil evaporation)
Maximum Storage Capacity of Cover Soil =	**3.78**	inches [(field capacity - wilting point) x layer thickness]
Initial Storage Capacity =	**3.55**	inches

	6.86%	**8.30%**	**9.36%**	**9.27%**	**8.56%**	**5.12%**	**10.15%**	**13.07%**	**8.48%**	**7.68%**	**6.18%**	**6.97%**
MONTH OF YEAR	**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUNE**	**JULY**	**AUG**	**SEPT**	**OCT**	**NOV**	**DEC**
percentage of annual precip by month	6.86%	8.30%	9.36%	9.27%	8.56%	5.12%	10.15%	13.07%	8.48%	7.68%	6.18%	6.97%
percentage of annual ET by month	0.00%	0.00%	0.00%	9.54%	13.05%	17.29%	19.76%	16.91%	12.62%	7.87%	2.96%	0.00%
days per month	31	28	31	30	31	30	31	31	30	31	30	31
Beginning Available Storage Capacity (in.)	3.55	2.77	1.83	0.77	2.86	3.78	3.78	3.78	3.78	3.78	3.78	3.78
Monthly Precipitation (inches)	0.78	0.94	1.06	1.05	0.97	0.58	1.15	1.48	0.96	0.87	0.70	0.79
Monthlry Infiltration = precip-runoff (in.)	0.78	0.94	1.06	1.05	0.97	0.58	1.15	1.48	0.96	0.87	0.70	0.79
Monthly ET Loss (inches)	0.00	0.00	0.00	3.14	4.29	5.69	6.50	5.56	4.15	2.59	0.97	0.00
Change in Storage Capacity (in.)	-0.78	-0.94	-1.06	2.09	3.32	5.11	5.35	4.08	3.19	1.72	0.27	-0.79
Ending Storage Capacity (in.)	2.77	1.83	0.77	2.86	3.78	3.78	3.78	3.78	3.78	3.78	3.78	2.99
Amount of Percolation (in.)	**none**	**none**	**none**	**none**	**none**	**none**	**none**	**none**	**none**	**none**	**none**	**none**
storage consumed	0.78	0.94	1.06	-2.09	-0.92	0.00	0.00	0.00	0.00	0.00	0.00	0.79

Annual cycle of precipation-evapotranspiration-storage for Beaver County Landfill
(Soil Type # 1 - 24" of soil, no runoff)

Annual ave Precip total =	**11.33**	inches (average annual over last 100 years)
Annual Evapo-Transpiration =	**54.8**	inches (70% of 78.3 inches) Pan Evaporaton = 78.3
Field Capacity of Cover Soil =	**45**	% (Moisture Content in Percent of Volume)
Wilting Point of Soil =	**24**	% (Moisture Content in Percent of Volume)
Runoff =	**0**	% (Percent of Precipation)
Initial Moisture Content of Cover Soil =	**25.3**	% (Percent of Volume)
Thickness of Cover Soil =	**24**	inches
Penman-Wilson ET Reduction =	**0.6**	(fraction of total potential evapo-transpiration expressed as actual soil evaporation)
Maximum Storage Capacity of Cover Soil =	**5.04**	inches [(field capacity - wilting point) x layer thickness]
Initial Storage Capacity =	**4.73**	inches

	6.86%	**8.30%**	**9.36%**	**9.27%**	**8.56%**	**5.12%**	**10.15%**	**13.07%**	**8.48%**	**7.68%**	**6.18%**	**6.97%**
MONTH OF YEAR	**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUNE**	**JULY**	**AUG**	**SEPT**	**OCT**	**NOV**	**DEC**
percentage of annual precip by month	6.86%	8.30%	9.36%	9.27%	8.56%	5.12%	10.15%	13.07%	8.48%	7.68%	6.18%	6.97%
percentage of annual ET by month	0.00%	0.00%	0.00%	9.54%	13.05%	17.29%	19.76%	16.91%	12.62%	7.87%	2.96%	0.00%
days per month	31	28	31	30	31	30	31	31	30	31	30	31
Beginning Available Storage Capacity (in.)	4.73	3.95	3.01	1.95	4.04	5.04	5.04	5.04	5.04	5.04	5.04	5.04
Monthly Precipitation (inches)	0.78	0.94	1.06	1.05	0.97	0.58	1.15	1.48	0.96	0.87	0.70	0.79
Monthlry Infiltration = precip-runoff (in.)	0.78	0.94	1.06	1.05	0.97	0.58	1.15	1.48	0.96	0.87	0.70	0.79
Monthly ET Loss (inches)	0.00	0.00	0.00	3.14	4.29	5.69	6.50	5.56	4.15	2.59	0.97	0.00
Change in Storage Capacity (in.)	-0.78	-0.94	-1.06	2.09	3.32	5.11	5.35	4.08	3.19	1.72	0.27	-0.79
Ending Storage Capacity (in.)	3.95	3.01	1.95	4.04	5.04	5.04	5.04	5.04	5.04	5.04	5.04	4.25
Amount of Percolation (in.)	**none**	**none**	**none**	**none**	**none**	**none**	**none**	**none**	**none**	**none**	**none**	**none**
storage consumed	0.78	0.94	1.06	-2.09	-1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.79

Annual cycle of precipation-evapotranspiration-storage for Beaver County Landfill
(Soil Type # 1 - 24" of soil, 50% runoff)

Annual ave Precip total =	**11.33**	inches (average annual over last 100 years)
Annual Evapo-Transpiration =	**54.8**	inches (70% of 78.3 inches) Pan Evaporaton = 78.3
Field Capacity of Cover Soil =	**45**	% (Moisture Content in Percent of Volume)
Wilting Point of Soil =	**24**	% (Moisture Content in Percent of Volume)
Runoff =	**50**	% (Percent of Precipation)
Initial Moisture Content of Cover Soil =	**25.3**	% (Percent of Volume)
Thickness of Cover Soil =	**24**	inches
Penman-Wilson ET Reduction =	**0.6**	(fraction of total potential evapo-transpiration expressed as actual soil evaporation)
Maximum Storage Capacity of Cover Soil =	**5.04**	inches [(field capacity - wilting point) x layer thickness]
Initial Storage Capacity =	**4.73**	inches

	6.86%	**8.30%**	**9.36%**	**9.27%**	**8.56%**	**5.12%**	**10.15%**	**13.07%**	**8.48%**	**7.68%**	**6.18%**	**6.97%**
MONTH OF YEAR	**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUNE**	**JULY**	**AUG**	**SEPT**	**OCT**	**NOV**	**DEC**
percentage of annual precip by month	6.86%	8.30%	9.36%	9.27%	8.56%	5.12%	10.15%	13.07%	8.48%	7.68%	6.18%	6.97%
percentage of annual ET by month	0.00%	0.00%	0.00%	9.54%	13.05%	17.29%	19.76%	16.91%	12.62%	7.87%	2.96%	0.00%
days per month	31	28	31	30	31	30	31	31	30	31	30	31
Beginning Available Storage Capacity (in.)	4.73	4.34	3.87	3.34	5.04	5.04	5.04	5.04	5.04	5.04	5.04	5.04
Monthly Precipitation (inches)	0.78	0.94	1.06	1.05	0.97	0.58	1.15	1.48	0.96	0.87	0.70	0.79
Monthlry Infiltration = precip-runoff (in.)	0.39	0.47	0.53	0.53	0.49	0.29	0.58	0.74	0.48	0.44	0.35	0.40
Monthly ET Loss (inches)	0.00	0.00	0.00	3.14	4.29	5.69	6.50	5.56	4.15	2.59	0.97	0.00
Change in Storage Capacity (in.)	-0.39	-0.47	-0.53	2.61	3.81	5.40	5.92	4.82	3.67	2.15	0.62	-0.40
Ending Storage Capacity (in.)	4.34	3.87	3.34	5.04	5.04	5.04	5.04	5.04	5.04	5.04	5.04	4.65
Amount of Percolation (in.)	**none**	**none**	**none**	**none**	**none**	**none**	**none**	**none**	**none**	**none**	**none**	**none**
storage consumed	0.39	0.47	0.53	-1.70	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.40

Annual cycle of precipation-evapotranspiration-storage for Beaver County Landfill
(Soil Type # 1 - 24" of soil, no runoff, increased precipitation)

170% of Annual ave Precip total =	**19.27**	inches (170% of average annual over last 100 years)	
Annual Evapo-Transpiration =	**54.8**	inches (70% of 78.3 inches)	Pan Evaporaton = 78.3
Field Capacity of Cover Soil =	**45**	% (Moisture Content in Percent of Volume)	
Wilting Point of Soil =	**24**	% (Moisture Content in Percent of Volume)	
Runoff =	**0**	% (Percent of Precipation)	
Initial Moisture Content of Cover Soil =	**25.3**	% (Percent of Volume)	
Thickness of Cover Soil =	**24**	inches	
Penman-Wilson ET Reduction =	**0.6**	(fraction of total potential evapo-transpiration expressed as actual soil evaporation)	
Maximum Storage Capacity of Cover Soil =	**5.04**	inches [(field capacity - wilting point) x layer thickness]	
Initial Storage Capacity =	**4.73**	inches	

	6.90%	**8.25%**	**9.34%**	**9.29%**	**8.56%**	**5.14%**	**10.17%**	**13.08%**	**8.46%**	**7.68%**	**6.18%**	**6.95%**
MONTH OF YEAR	**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUNE**	**JULY**	**AUG**	**SEPT**	**OCT**	**NOV**	**DEC**
percentage of annual precip by month	6.86%	8.25%	9.34%	9.29%	8.56%	5.14%	10.17%	13.08%	8.46%	7.68%	6.18%	6.95%
percentage of annual ET by month	0.00%	0.00%	0.00%	9.54%	13.05%	17.29%	19.76%	16.91%	12.62%	7.87%	2.96%	0.00%
days per month	31	28	31	30	31	30	31	31	30	31	30	31
Beginning Available Storage Capacity (in.)	4.73	3.40	1.81	0.01	1.35	4.00	5.04	5.04	5.04	5.04	5.04	4.82
Monthly Precipitation (inches)	1.33	1.59	1.80	1.79	1.65	0.99	1.96	2.52	1.63	1.48	1.19	1.34
Monthlry Infiltration = precip-runoff (in.)	1.33	1.59	1.80	1.79	1.65	0.99	1.96	2.52	1.63	1.48	1.19	1.34
Monthly ET Loss (inches)	0.00	0.00	0.00	3.14	4.29	5.69	6.50	5.56	4.15	2.59	0.97	0.00
Change in Storage Capacity (in.)	-1.33	-1.59	-1.80	1.35	2.64	4.70	4.54	3.04	2.52	1.11	-0.22	-1.34
Ending Storage Capacity (in.)	3.40	1.81	0.01	1.35	4.00	5.04	5.04	5.04	5.04	5.04	4.82	3.48
Amount of Percolation (in.)	**none**	**none**	**none**	**none**	**none**	**none**	**none**	**none**	**none**	**none**	**none**	**none**
storage consumed	1.33	1.59	1.80	-1.35	-2.64	-1.04	0.00	0.00	0.00	0.00	0.22	1.34

Annual cycle of precipation-evapotranspiration-storage for Beaver County Landfill
(Soil Type # 2 - 18" of soil, no runoff)

Average Annual Precip total =	**11.33**	inches (average annual over last 100 years)
Adjusted Annual Evapo-Transpiration =	**54.8**	inches (70% of 78.3 inches) Pan Evaporaton = 78.3
Field Capacity of Cover Soil =	**37.5**	% (Moisture Content in Percent of Volume)
Wilting Point of Soil =	**19**	% (Moisture Content in Percent of Volume)
Runoff =	**0**	% (Percent of Precipation)
Initial Moisture Content of Cover Soil =	**19.4**	% (Percent of Volume)
Thickness of Cover Soil =	**18**	inches
Penman-Wilson ET Reduction =	**0.6**	(fraction of total potential evapo-transpiration expressed as actual soil evaporation)
Maximum Storage Capacity of Cover Soil =	**3.33**	inches [(field capacity - wilting point) x layer thickness]
Initial Storage Capacity =	**3.26**	inches

	6.86%	**8.30%**	**9.36%**	**9.27%**	**8.56%**	**5.12%**	**10.15%**	**13.07%**	**8.48%**	**7.68%**	**6.18%**	**6.97%**
MONTH OF YEAR	**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUNE**	**JULY**	**AUG**	**SEPT**	**OCT**	**NOV**	**DEC**
percentage of annual precip by month	6.86%	8.30%	9.36%	9.27%	8.56%	5.12%	10.15%	13.07%	8.48%	7.68%	6.18%	6.97%
percentage of annual ET by month	0.00%	0.00%	0.00%	9.54%	13.05%	17.29%	19.76%	16.91%	12.62%	7.87%	2.96%	0.00%
days per month	31	28	31	30	31	30	31	31	30	31	30	31
Beginning Available Storage Capacity (in.)	3.26	2.48	1.54	0.48	2.57	3.33	3.33	3.33	3.33	3.33	3.33	3.33
Monthly Precipitation (inches)	0.78	0.94	1.06	1.05	0.97	0.58	1.15	1.48	0.96	0.87	0.70	0.79
Monthlry Infiltration = precip-runoff (in.)	0.78	0.94	1.06	1.05	0.97	0.58	1.15	1.48	0.96	0.87	0.70	0.79
Monthly ET Loss (inches)	0.00	0.00	0.00	3.14	4.29	5.69	6.50	5.56	4.15	2.59	0.97	0.00
Change in Storage Capacity (in.)	-0.78	-0.94	-1.06	2.09	3.32	5.11	5.35	4.08	3.19	1.72	0.27	-0.79
Ending Storage Capacity (in.)	2.48	1.54	0.48	2.57	3.33	3.33	3.33	3.33	3.33	3.33	3.33	2.54
Amount of Percolation (in.)	**none**	**none**	**none**	**none**	**none**	**none**	**none**	**none**	**none**	**none**	**none**	**none**
storage consumed	0.78	0.94	1.06	-2.09	-0.76	0.00	0.00	0.00	0.00	0.00	0.00	0.79

Annual cycle of precipation-evapotranspiration-storage for Beaver County Landfill
(Soil Type # 2 - 24" of soil, no runoff)

Average Annual Precip total =	**11.33**	inches (average annual over last 100 years)
Adjusted Annual Evapo-Transpiration =	**54.8**	inches (70% of 78.3 inches) Pan Evaporaton = 78.3
Field Capacity of Cover Soil =	**37.5**	% (Moisture Content in Percent of Volume)
Wilting Point of Soil =	**19**	% (Moisture Content in Percent of Volume)
Runoff =	**0**	% (Percent of Precipation)
Initial Moisture Content of Cover Soil =	**19.4**	% (Percent of Volume)
Thickness of Cover Soil =	**24**	inches
Penman-Wilson ET Reduction =	**0.6**	(fraction of total potential evapo-transpiration expressed as actual soil evaporation)
Maximum Storage Capacity of Cover Soil =	**4.44**	inches [(field capacity - wilting point) x layer thickness]
Initial Storage Capacity =	**4.34**	inches

	6.86%	**8.30%**	**9.36%**	**9.27%**	**8.56%**	**5.12%**	**10.15%**	**13.07%**	**8.48%**	**7.68%**	**6.18%**	**6.97%**
MONTH OF YEAR	**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUNE**	**JULY**	**AUG**	**SEPT**	**OCT**	**NOV**	**DEC**
percentage of annual precip by month	6.86%	8.30%	9.36%	9.27%	8.56%	5.12%	10.15%	13.07%	8.48%	7.68%	6.18%	6.97%
percentage of annual ET by month	0.00%	0.00%	0.00%	9.54%	13.05%	17.29%	19.76%	16.91%	12.62%	7.87%	2.96%	0.00%
days per month	31	28	31	30	31	30	31	31	30	31	30	31
Beginning Available Storage Capacity (in.)	4.34	3.57	2.63	1.57	3.65	4.44	4.44	4.44	4.44	4.44	4.44	4.44
Monthly Precipitation (inches)	0.78	0.94	1.06	1.05	0.97	0.58	1.15	1.48	0.96	0.87	0.70	0.79
Monthlry Infiltration = precip-runoff (in.)	0.78	0.94	1.06	1.05	0.97	0.58	1.15	1.48	0.96	0.87	0.70	0.79
Monthly ET Loss (inches)	0.00	0.00	0.00	3.14	4.29	5.69	6.50	5.56	4.15	2.59	0.97	0.00
Change in Storage Capacity (in.)	-0.78	-0.94	-1.06	2.09	3.32	5.11	5.35	4.08	3.19	1.72	0.27	-0.79
Ending Storage Capacity (in.)	3.57	2.63	1.57	3.65	4.44	4.44	4.44	4.44	4.44	4.44	4.44	3.65
Amount of Percolation (in.)	**none**	**none**	**none**	**none**	**none**	**none**	**none**	**none**	**none**	**none**	**none**	**none**
storage consumed	0.78	0.94	1.06	-2.09	-0.79	0.00	0.00	0.00	0.00	0.00	0.00	0.79

Annual cycle of precipation-evapotranspiration-storage for Beaver County Landfill
(Soil Type # 2 - 24" of soil, 50% runoff)

Average Annual Precip total =	**11.33**	inches (average annual over last 100 years)
Adjusted Annual Evapo-Transpiration =	**54.8**	inches (70% of 78.3 inches) Pan Evaporaton = 78.3
Field Capacity of Cover Soil =	**37.5**	% (Moisture Content in Percent of Volume)
Wilting Point of Soil =	**19**	% (Moisture Content in Percent of Volume)
Runoff =	**50**	% (Percent of Precipation)
Initial Moisture Content of Cover Soil =	**19.4**	% (Percent of Volume)
Thickness of Cover Soil =	**24**	inches
Penman-Wilson ET Reduction =	**0.6**	(fraction of total potential evapo-transpiration expressed as actual soil evaporation)
Maximum Storage Capacity of Cover Soil =	**4.44**	inches [(field capacity - wilting point) x layer thickness]
Initial Storage Capacity =	**4.34**	inches

	6.86%	**8.30%**	**9.36%**	**9.27%**	**8.56%**	**5.12%**	**10.15%**	**13.07%**	**8.48%**	**7.68%**	**6.18%**	**6.97%**
MONTH OF YEAR	**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUNE**	**JULY**	**AUG**	**SEPT**	**OCT**	**NOV**	**DEC**
percentage of annual precip by month	6.86%	8.30%	9.36%	9.27%	8.56%	5.12%	10.15%	13.07%	8.48%	7.68%	6.18%	6.97%
percentage of annual ET by month	0.00%	0.00%	0.00%	9.54%	13.05%	17.29%	19.76%	16.91%	12.62%	7.87%	2.96%	0.00%
days per month	31	28	31	30	31	30	31	31	30	31	30	31
Beginning Available Storage Capacity (in.)	4.34	3.96	3.49	2.96	4.44	4.44	4.44	4.44	4.44	4.44	4.44	4.44
Monthly Precipitation (inches)	0.78	0.94	1.06	1.05	0.97	0.58	1.15	1.48	0.96	0.87	0.70	0.79
Monthlry Infiltration = precip-runoff (in.)	0.39	0.47	0.53	0.53	0.49	0.29	0.58	0.74	0.48	0.44	0.35	0.40
Monthly ET Loss (inches)	0.00	0.00	0.00	3.14	4.29	5.69	6.50	5.56	4.15	2.59	0.97	0.00
Change in Storage Capacity (in.)	-0.39	-0.47	-0.53	2.61	3.81	5.40	5.92	4.82	3.67	2.15	0.62	-0.40
Ending Storage Capacity (in.)	3.96	3.49	2.96	4.44	4.44	4.44	4.44	4.44	4.44	4.44	4.44	4.05
Amount of Percolation (in.)	**none**	**none**	**none**	**none**	**none**	**none**	**none**	**none**	**none**	**none**	**none**	**none**
storage consumed	0.39	0.47	0.53	-1.48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.40

Annual cycle of precipation-evapotranspiration-storage for Beaver County Landfill
(Soil Type # 2 - 24" of soil, no runoff, increased precipitation)

155% of Average Annual Precip total =	**17.56**	inches (155% of average annual over last 100 years)	
Adjusted Annual Evapo-Transpiration =	**54.8**	inches (70% of 78.3 inches)	Pan Evaporaton = 78.3
Field Capacity of Cover Soil =	**37.5**	% (Moisture Content in Percent of Volume)	
Wilting Point of Soil =	**19**	% (Moisture Content in Percent of Volume)	
Runoff =	**0**	% (Percent of Precipation)	
Initial Moisture Content of Cover Soil =	**19.4**	% (Percent of Volume)	
Thickness of Cover Soil =	**24**	inches	
Penman-Wilson ET Reduction =	**0.6**	(fraction of total potential evapo-transpiration expressed as actual soil evaporation)	
Maximum Storage Capacity of Cover Soil =	**4.44**	inches [(field capacity - wilting point) x layer thickness]	
Initial Storage Capacity =	**4.34**	inches	

	6.89%	**8.31%**	**9.33%**	**9.28%**	**8.54%**	**5.12%**	**10.13%**	**13.09%**	**8.48%**	**7.68%**	**6.20%**	**6.94%**
MONTH OF YEAR	**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUNE**	**JULY**	**AUG**	**SEPT**	**OCT**	**NOV**	**DEC**
percentage of annual precip by month	6.86%	8.31%	9.33%	9.28%	8.54%	5.12%	10.13%	13.09%	8.48%	7.68%	6.20%	6.94%
percentage of annual ET by month	0.00%	0.00%	0.00%	9.54%	13.05%	17.29%	19.76%	16.91%	12.62%	7.87%	2.96%	0.00%
days per month	31	28	31	30	31	30	31	31	30	31	30	31
Beginning Available Storage Capacity (in.)	4.34	3.13	1.67	0.03	1.54	4.33	4.44	4.44	4.44	4.44	4.44	4.32
Monthly Precipitation (inches)	1.21	1.46	1.64	1.63	1.50	0.90	1.78	2.30	1.49	1.35	1.09	1.22
Monthlry Infiltration = precip-runoff (in.)	1.21	1.46	1.64	1.63	1.50	0.90	1.78	2.30	1.49	1.35	1.09	1.22
Monthly ET Loss (inches)	0.00	0.00	0.00	3.14	4.29	5.69	6.50	5.56	4.15	2.59	0.97	0.00
Change in Storage Capacity (in.)	-1.21	-1.46	-1.64	1.51	2.79	4.79	4.72	3.26	2.66	1.24	-0.12	-1.22
Ending Storage Capacity (in.)	3.13	1.67	0.03	1.54	4.33	4.44	4.44	4.44	4.44	4.44	4.32	3.10
Amount of Percolation (in.)	**none**	**none**	**none**	**none**	**none**	**none**	**none**	**none**	**none**	**none**	**none**	**none**
storage consumed	1.21	1.46	1.64	-1.51	-2.79	-0.11	0.00	0.00	0.00	0.00	0.12	1.22