

REPORT

ON

**HYDROLOGIC EVALUATION OF LANDFILL
PERFORMANCE (HELP) MODELING REPORT**

FOR

CUSHING REMEDIAL DESIGN

Prepared For



MARCH 1994



**FLUOR DANIEL
WILLIAMS BROTHERS**

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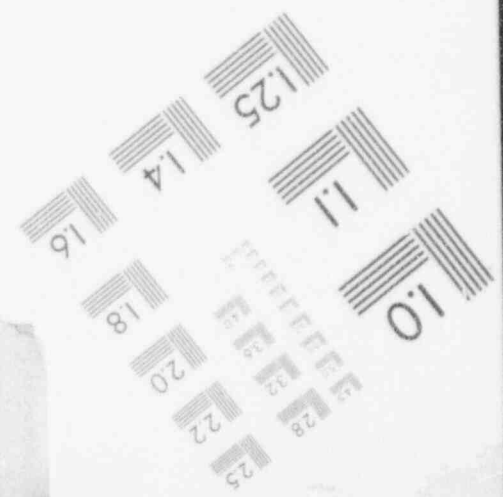
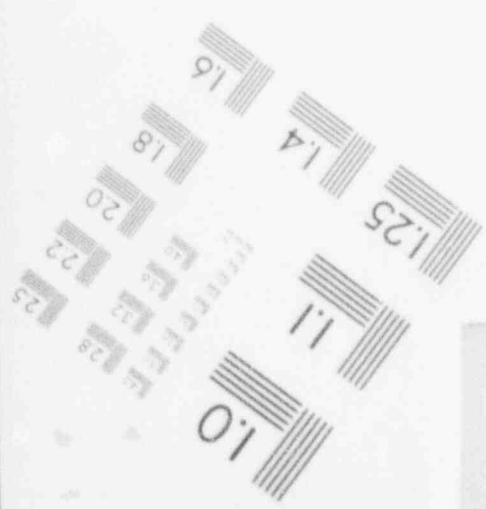
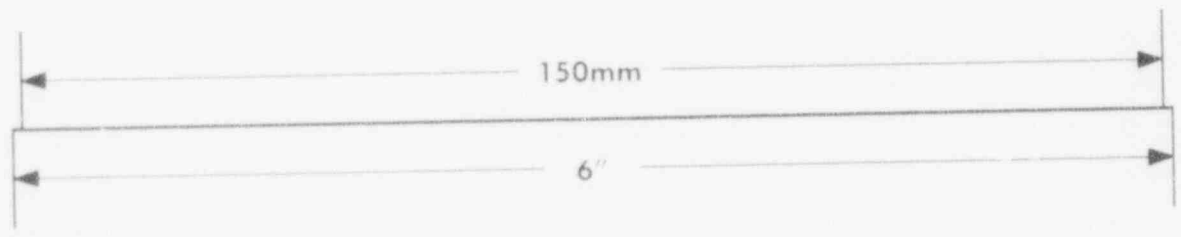
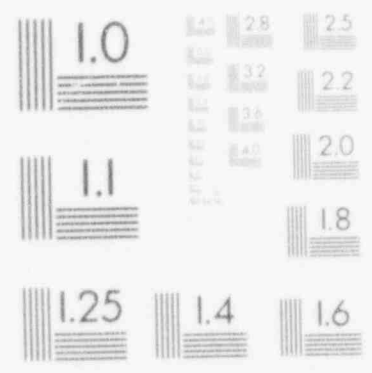
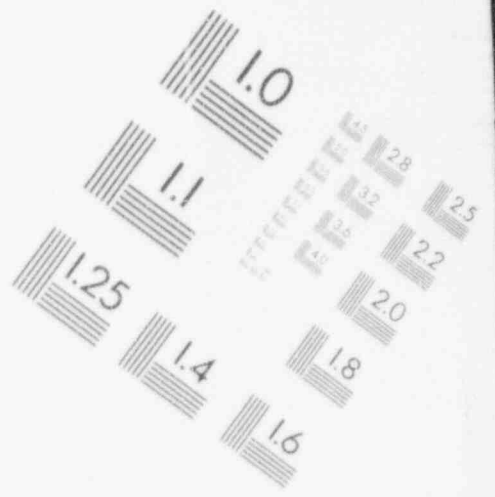
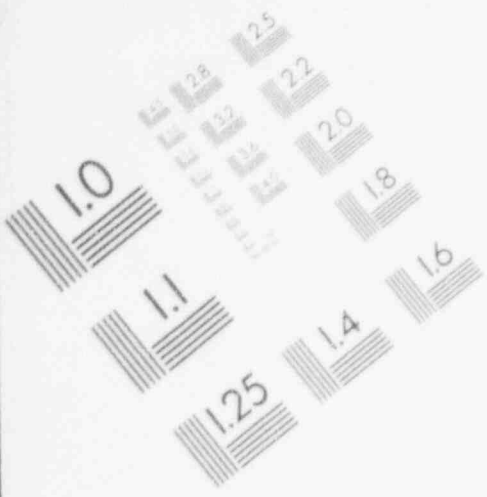
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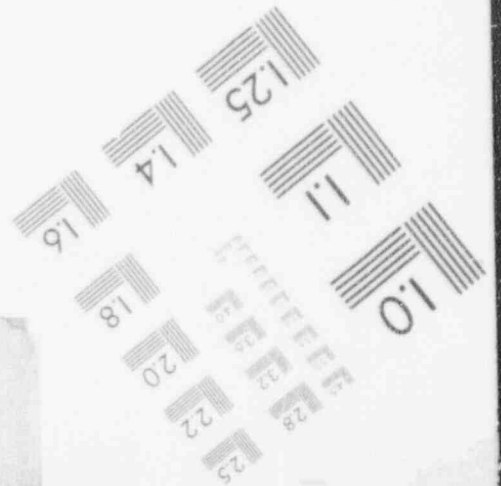
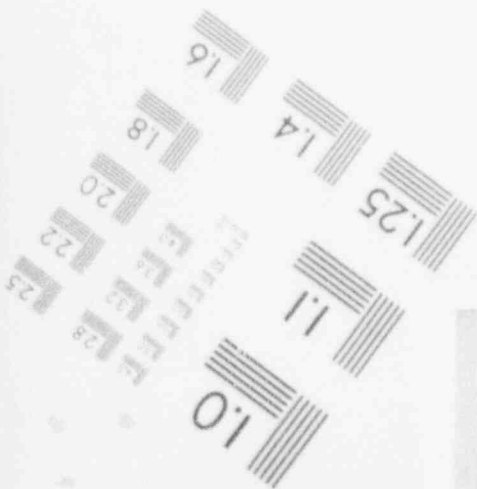
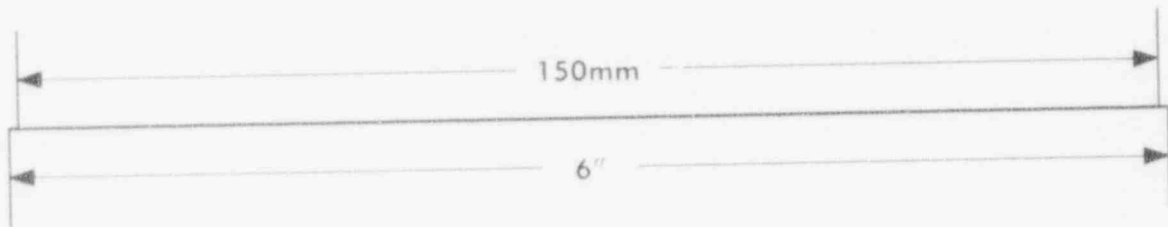
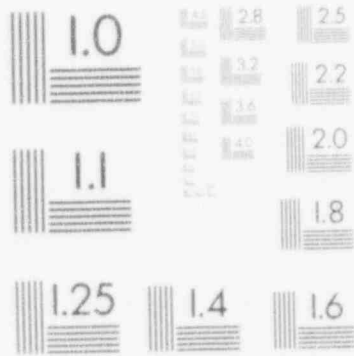
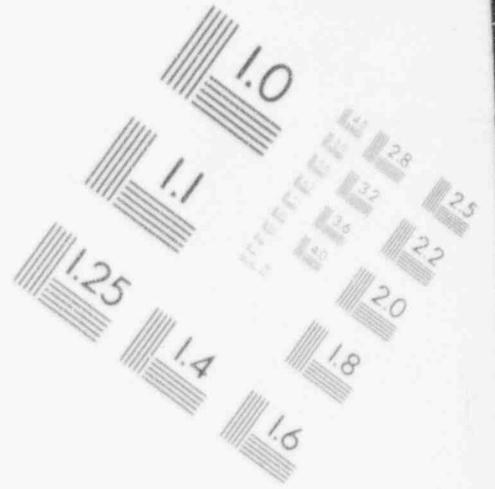
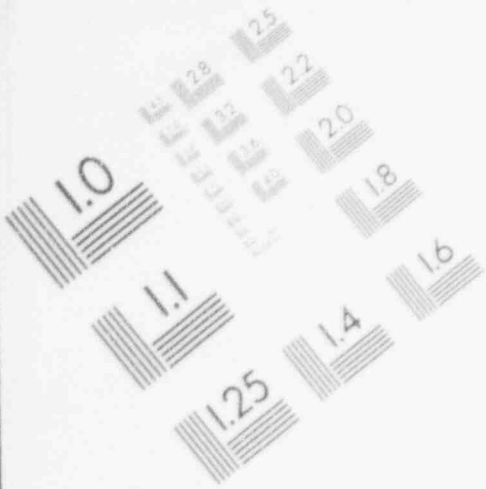
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IMAGE EVALUATION TEST TARGET (MT-3)



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IMAGE EVALUATION TEST TARGET (MT-3)



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IMAGE EVALUATION TEST TARGET (MT-3)

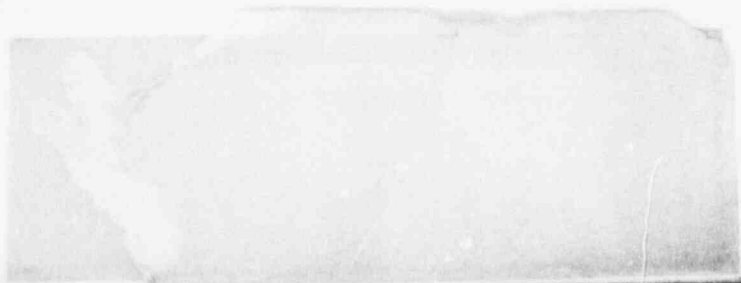
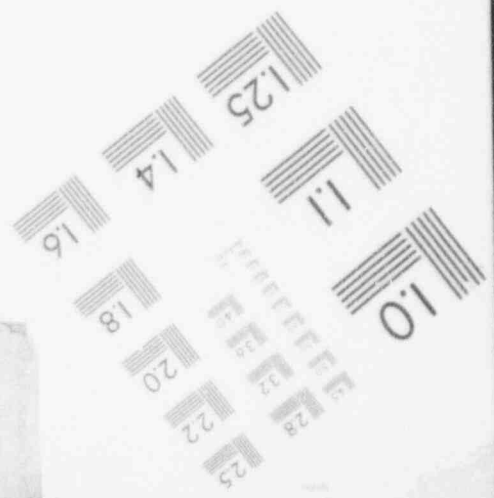
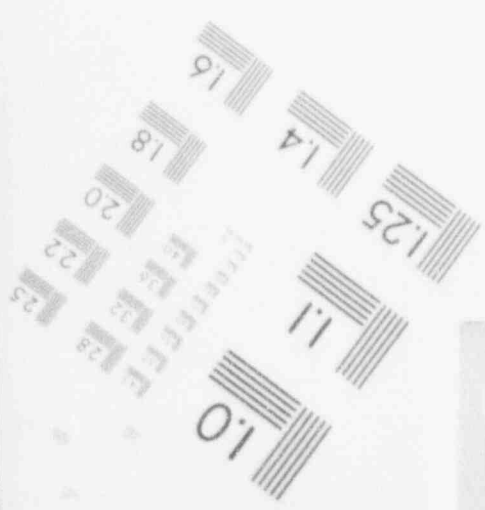
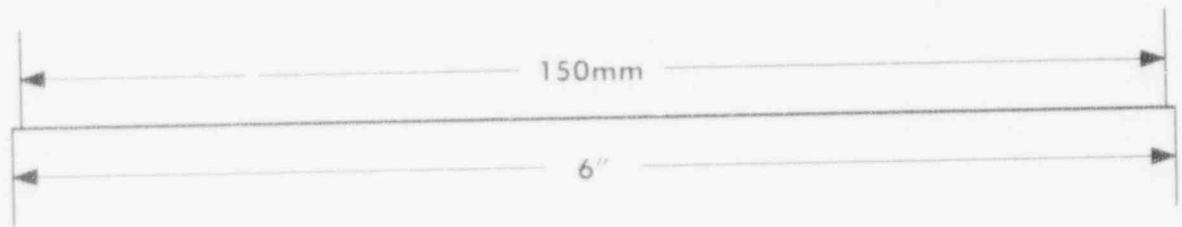
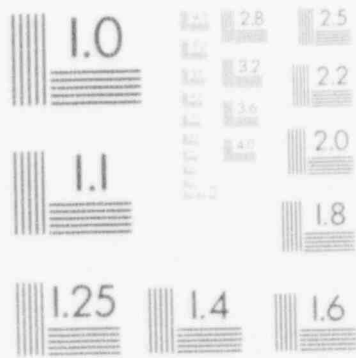
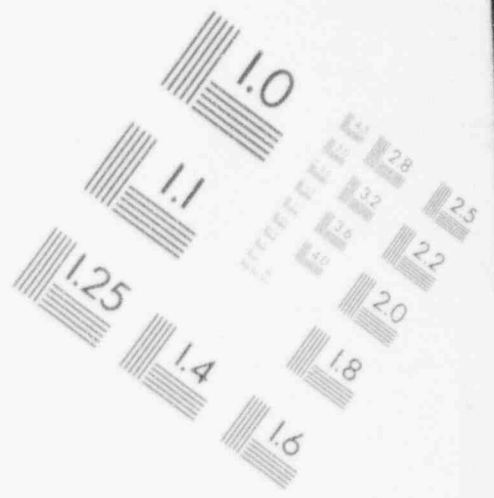
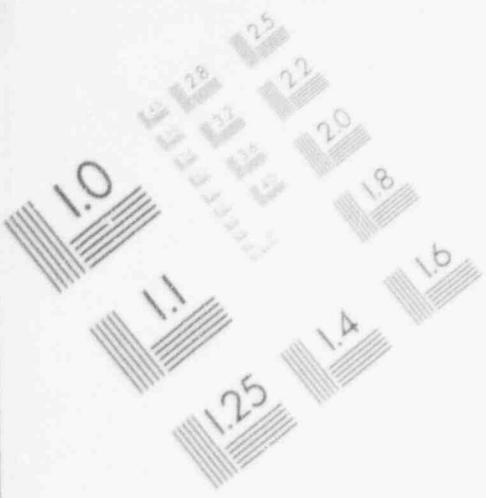


TABLE OF CONTENTS



TRANSMITTAL LETTER

EXECUTIVE SUMMARY

INTRODUCTION Section 1

MODEL INPUT REQUIREMENTS Section 2

- Climatological Data
- Design Data
- Soil Data

MODEL RESULTS Section 3

DISPOSAL CELL LINER COMPARISON AND CONCLUSION Section 4

- Disposal Cell Liner Comparison
- Conclusion

APPENDICES

- Appendix A HELP Modeling Data References
- Appendix B HELP Model Output Data
- Appendix C ODEQ HELP Model Memo
- Appendix D References

LIST OF TABLES

- Text
 - 3-1 Comparison of Model Results
- Appendix A
 - 1-2 Normal Daily Minimum Temperature - Selected Cities of the United States
 - 1-7 Normal Monthly Precipitation - Selected Cities of the United States
 - 4-4 Disposal Cell Size, Parameters, and Quantities



EXECUTIVE SUMMARY

The U.S. Army Corps of Engineers Hydrologic Evaluation of Landfill Performance (HELP) model was used to evaluate two design options for the Kerr-McGee Cushing, Oklahoma, Refinery Site disposal cells. Specifically, the HELP model was used to estimate the amount of leachate generated from disposal cells with two different liners. The evaluation was performed to support the final design of two disposal cells with 5-foot *in situ* clay liners with permeabilities of 10^{-8} cm/s. This design is more stringent than the State requirement of a 3-foot recompacted clay liner with a permeability of 10^{-7} cm/s.

Results from modeling a disposal cell having a 5-foot, *in situ* clay liner with 10^{-8} cm/s permeability were compared to results from modeling a disposal cell having a 3-foot, recompacted clay liner with 10^{-7} cm/s permeability. The results show that the disposal cells having 5-foot, 10^{-8} cm/s *in situ* clay liners will produce less leachate than the disposal cell having a 3-foot, 10^{-7} cm/s recompacted clay liner.

The projected leachate volume from a disposal cell modeled by Oklahoma Department of Environmental Quality (ODEQ) was compared to the leachate volume of the cells designed for this project having 5-foot *in situ* clay liners. The model results indicate that the disposal cells with 5-foot *in situ* clay liners will produce significantly less leachate than the disposal cell modeled by the ODEQ.

The 5-foot, *in situ* clay liner protects groundwater as effectively as the 3-foot, compacted clay liner, based on HELP model results for both average annual and peak daily percolation. In addition, the 5-foot, *in situ* clay liner can be considered adequate since the ODEQ concluded that a single, 3-foot, recompacted clay liner was adequate under ODEQ conditions where significantly more leachate was generated.

INTRODUCTION



The remedial design for the Kerr-McGee Cushing site includes two disposal cells, Cell A and Cell B, for the storage of neutralized refinery sludge. As part of the design process, the HELP model was used to evaluate liner and cover alternatives for several disposal cell construction options. This report presents HELP model results for determining the amount of leachate produced by disposal cells having two different liners. These results were also compared to model results generated by the Oklahoma Department of Environmental Quality, who used an altogether different disposal cell configuration.

The first, Cell A, configuration model included a 3-foot thick, recompact clay liner with a permeability of 10^{-7} cm/s. The second, Cell A, configuration model included a 5-foot thick, in situ clay liner with a permeability of 10^{-8} cm/s. Each of these cell configurations were also modeled for Cell B. The third set of modeling results discussed in this report are associated with a cell configuration modeled by the Oklahoma Department of Environmental Quality (ODEQ).

This evaluation was performed to support the final design of two disposal cells with 5-foot in situ clay liners with a permeability of 10^{-8} cm/s. This design provides more protection for groundwater than the State requirement of a 3-foot recompact clay liner with a permeability of 10^{-7} cm/s.



MODEL INPUT REQUIREMENTS

- *Climatological Data*
- *Design Data*
- *Soil Data*



The HELP program requires three general types of input data: climatological, design, and soil. A summary of data requirements and corresponding input values is presented below. The input values are also included on the model output sheets provided in Appendices B and C.

CLIMATOLOGICAL DATA

The climatological data required by the model can be classified into three groups; precipitation, temperature, and evapotranspiration. Ten years of precipitation and temperature data were synthetically generated by the model and used for each cell configuration modeled. The model has default precipitation and temperature data for two cities in Oklahoma, Oklahoma City and Tulsa. The default data for Tulsa was chosen for the model calculations because the Cushing site is closer to Tulsa than to Oklahoma City. Statistical characteristics of the synthetically generated, daily precipitation and temperature values were improved by inputting the area's actual normal values. Values for Tulsa were taken from the Water Encyclopedia and are included in Appendix A.

Evapotranspiration data is calculated by using the evaporative zone depth and maximum leaf area index for the site. The evaporative zone depth is the maximum depth from which water can be removed by evapotranspiration. The evaporative zone depth used for all of the cell configurations was 22 inches. This is the depth recommended by the model for the Tulsa area. The maximum leaf area index is the ratio of the leaf area of actively transpiring vegetation to the nominal surface area of the land on which the vegetation grows. The maximum leaf area index used for each model run was 2.0, which is the typical value for vegetation in the Tulsa area.

DESIGN DATA

Design data required by the model includes the area of the cell, the number of layers in the cell, and the type and thickness of each layer. Two cells were modeled under the disposal cell design, Cell A and Cell B. The configuration of each cell was based on dimensions provided in Table 4-4 of the Report on Disposal Cell Option Evaluation, Cushing Remedial Design. Table 4-4 has also been included in Appendix A. The cell configuration remained constant for each layer, except for the bottom, barrier clay liner. The thickness and soil properties of the fourth layer were varied to compare the effect of the liner on model results.

An area of 572,000 square feet and a total depth of 20 feet was used for Cell A. An area of 400,000 square feet and a total depth of 20.7 feet was used for Cell B. The cells were divided into four layers, numbered one to four, with layer one being the top layer.

Layer 1 for Cells A and B represents a topsoil/vegetation layer, and is considered a lateral drainage layer. A lateral drainage layer allows for vertical and lateral flow of water. A slope of 3 percent and a thickness of 6 inches was used for this layer. A runoff curve number for the site was generated by the model, and it was based on factors such as slope, soil texture, and vegetative cover. This number was constant for the two liner thicknesses modeled. The model also requires a drainage length for a lateral drainage layer. The drainage length for Cell A is 650 feet, while the drainage length for Cell B is 500 feet.



Layer 2 for Cells A and B is a barrier soil layer of 30 inches of clay. The barrier soil layer is intended to restrict water flow into and through the other soil layers. Since the program considers only downward flow, any water moving into a barrier soil layer will eventually percolate through the liner. Percolation rate depends on the depth of water saturated soil (head) located above the base of the layer.

Layer 3 of the disposal cells represents a layer of treated waste, and is considered a vertical percolation layer. The thickness of the waste in Cell A is 168 inches, and the thickness of the waste in Cell B is 176.4 inches.

Layer 4 is the barrier clay liner, and is the variable for evaluation of the disposal cell configuration. The first configuration has a 3-foot, recompacted clay liner for Layer 4 of Cells A and B. The second configuration has a 5-foot, in situ clay liner for Layer 4 of Cells A and B.

SOIL DATA

Required soil data includes soil type and initial soil moisture content. A soil texture can be entered manually, but the model also has 42 default soil textures with characteristic values for each. Each soil texture in the model has values for the following characteristics:

- Porosity (in vol/vol): the soil water content at saturation
- Field capacity (in vol/vol): the soil water content after a prolonged period of gravity drainage
- Wilting point (in vol/vol): the lowest soil water content that can be achieved by plant transpiration
- Saturated hydraulic conductivity (in cm/s): the rate at which water drains vertically through a saturated soil with no vertical pressure gradient.

Initial soil water content, in vol/vol, is also required. Initial soil water content is the ratio of the volume of water in a soil to the volume occupied by the soil. This can be initialized by the computer or input manually.

Soil texture, for Layer 1 of Cells A and B, is a fine, sandy loam with a saturated hydraulic conductivity of 1.5×10^{-3} cm/s and a fair stand of grass. Fine, sandy loam was chosen based on topsoil native to the area. Model default characteristics assigned to fine, sandy loam include a porosity of 0.4730 vol/vol, a field capacity of 0.2217 vol/vol, a wilting point of 0.1043 vol/vol, and an initial soil water content of 0.2217 vol/vol.

Soil texture, for Layer 2 of Cells A and B, is a clay with a permeability of 10^{-8} cm/s. Model default characteristics of a clay with 10^{-8} cm/s permeability include a porosity of 0.4 vol/vol, a field capacity of 0.3560 vol/vol, and a wilting point of 0.2899 vol/vol. An initial soil water content of 0.15 vol/vol was input manually because the clay will be compacted at optimum moisture content.

Layer 3 of Cells A and B represents treated waste. A hydraulic conductivity of 8.1×10^{-3} cm/s was input for the treated waste, based on measured permeabilities for treated waste.



Model default characteristics of a soil with a saturated hydraulic conductivity of 8.1×10^{-3} cm/s include a porosity of 0.4570 vol/vol, a field capacity of 0.1309 vol/vol, a wilting point of 0.0580 vol/vol, and an initial soil water content of 0.1309 vol/vol.

The first clay liner configuration modeled for Cells A and B was a recompacted, 3-foot clay liner with a permeability of 10^{-7} cm/s. Model default characteristics for a 10^{-7} cm/s clay include a porosity of 0.43 vol/vol, a field capacity of 0.366 vol/vol, and a wilting point of 0.28 vol/vol. An initial soil water content of 0.15 vol/vol was input manually because the recompacted clay will be installed at optimum moisture content.

The second clay liner configuration modeled for Cells A and B was an in situ, 5-foot clay liner with a permeability of 10^{-8} cm/s. Model default characteristics of a 10^{-8} clay include a porosity of 0.4 vol/vol, a field capacity of 0.356 vol/vol, a wilting point of 0.2899 vol/vol, and an initial soil water content of 0.356 vol/vol.



MODEL RESULTS



A summary of average annual totals for the 3-foot, recompacted clay liner; the 5-foot, in situ clay liner; and the ODEQ model are shown in Table 1. HELP model output data is included as Appendix B, and the ODEQ HELP modeling memo is included as Appendix C.

Percolation from Cell A, with three feet of recompacted clay, averaged 0.08 inches, or 3,912 cubic feet per year, which is 0.24 percent of the total precipitation. The peak, daily percolation from Layer 4 was 0.0004 inches, or 19.5 cubic feet. Percolation from Cell B, with three feet of recompacted clay, averaged 0.08 inches, or 2,734 cubic feet per year, which is 0.24 percent of the total precipitation. The peak, daily percolation from Layer 4 was 0.0004 inches, or 13.6 cubic feet.

Percolation from Cell A, with five feet of in situ clay, averaged 0.08 inches, or 3,846 cubic feet per year, which is 0.24 percent of the total precipitation. The peak, daily percolation from Layer 4 was 0.0003 inches, or 16.2 cubic feet. Percolation from Cell B, with five feet of in situ clay, averaged 0.08 inches, or 2,687 cubic feet per year, which is 0.24 percent of the total precipitation. The peak, daily percolation value from Layer 4 was 0.0003 inches, or 11.3 cubic feet.



**TABLE 3-1
COMPARISON OF MODEL RESULTS**

<i>Cell Option</i>	<i>3-ft Clay Liner Cell A 572,000 sq ft</i>			<i>5-ft Clay Liner Cell A 572,000 sq ft</i>			<i>ODEQ Cell 450,000 sq ft</i>			<i>3-ft Clay Liner Cell B 400,000 sq ft</i>			<i>5-ft Clay Liner Cell B 400,000 sq ft</i>		
<i>Model Parameter Result</i>	<i>Average Annual Totals</i>			<i>Average Annual Totals</i>			<i>Average Annual Totals</i>			<i>Average Annual Totals</i>			<i>Average Annual Totals</i>		
	<i>Inches</i>	<i>Cubic Feet</i>	<i>% *</i>	<i>Inches</i>	<i>Cubic Feet</i>	<i>% *</i>	<i>Inches</i>	<i>Cubic Feet</i>	<i>% *</i>	<i>Inches</i>	<i>Cubic Feet</i>	<i>% *</i>	<i>Inches</i>	<i>Cubic Feet</i>	<i>% *</i>
Precipitation	33.910	1616424	100	33.910	1616424	100	30.410	1140375	100	33.910	1130367	100	33.910	1130367	100
Runoff	3.796	180961	11.2	3.803	181283	11.22	1.830	68641	6.02	3.787	126226	11.17	3.794	126452	11.19
Evapotranspiration	29.809	1420877	87.9	29.802	1420559	87.88	23.661	887295	77.81	29.803	993437	87.89	29.797	993218	87.87
Later drainage from Layer 1	0.083	3939	0.24	0.083	3940	0.24	N/A	N/A	N/A	0.985	3284	0.29	0.099	3284	0.29
Percolation from Layer 2	0.082	3912	0.24	0.081	3868	0.24	N/A	N/A	N/A	0.082	2735	0.24	0.081	2702	0.24
Percolation from Layer 4	0.082	3912	0.24	0.081	3846	0.24	7.493	280967	24.64	0.082	2734	0.24	0.081	2687	0.24
Change in Water Storage	0.141	6735	0.42	0.143	6797	0.42	-2.574	-96531	-8.46	0.141	4685	0.41	0.142	4727	0.42
	<i>Peak Daily Totals</i>			<i>Peak Daily Totals</i>			<i>Peak Daily Totals</i>			<i>Peak Daily Totals</i>			<i>Peak Daily Totals</i>		
	<i>Inches</i>	<i>Cubic Feet</i>	<i>%</i>	<i>Inches</i>	<i>Cubic Feet</i>	<i>%</i>	<i>Inches</i>	<i>Cubic Feet</i>	<i>%</i>	<i>Inches</i>	<i>Cubic Feet</i>	<i>%</i>	<i>Inches</i>	<i>Cubic Feet</i>	<i>%</i>
Precipitation	3.45	164450	N/A	3.45	164450	N/A	2.92	109500	N/A	3.45	115000	N/A	3.45	115000	N/A
Runoff	3.16	150605.5	N/A	3.16	150602.9	N/A	0.446	16743.1	N/A	3.159	105315.7	N/A	3.159	105316	N/A
Later Drainage from Layer 1	0.001	47.5	N/A	0.001	47.5	N/A	N/A	N/A	N/A	0.0012	39.8	N/A	0.0012	39.8	N/A
Percolation from Layer 2	0.0004	19.5	N/A	0.0004	19.5	N/A	N/A	N/A	N/A	0.0004	13.6	N/A	0.0004	13.7	N/A
Head on Layer 2	6.4	N/A	N/A	6.4	N/A	N/A	N/A	N/A	N/A	6.4	N/A	N/A	6.4	N/A	N/A
Percolation from Layer 4	0.0004	19.5	N/A	0.0003	16.2	N/A	0.0223	636.8	N/A	0.0004	13.5	N/A	0.0003	11.3	N/A
Head on Layer 4	0	N/A	N/A	0	N/A	N/A	200.2	N/A	N/A	0	N/A	N/A	0	N/A	N/A
Snow Water	1.31	62205.4	N/A	1.31	62205.4	N/A	0.9	33846.2	N/A	1.31	43500.3	N/A	1.31	43500.3	N/A

N/A - Not Applicable

* - Percent numbers may be rounded



DISPOSAL CELL LINER COMPARISON AND CONCLUSION

- *Disposal Cell Liner
Comparison*
- *Conclusion*



DISPOSAL CELL LINER COMPARISON

Based on HELP modeling results for the average annual and peak daily percolation values, the 5-foot, in situ clay liner is as protective as the 3-foot, recompacted liner. The 5-foot liner is considered as protective because less leachate percolates through the bottom of the cell with the 5-foot, in situ liner than in the cell with the 3-foot, compacted liner.

The average, annual total percolation through Cell A (5-foot, in situ liner) is approximately 0.08 inches, or 3,846 cubic feet. This is slightly less than the 3,912 cubic feet, annual average percolation through Cell A having the 3-foot, recompacted clay liner. The daily peak percolation through Cell A (5-foot, in situ liner) is approximately 0.0003 inches, or 16.2 cubic feet. This is slightly less than the 19.5 cubic feet, daily peak percolation through Cell A having the 3-foot, recompacted clay liner.

The average, annual total percolation through Cell B (5-foot, in situ liner) is approximately 0.08 inches of water, or 2,687 cubic feet. This is slightly less than the 2,734 cubic feet, annual average percolation through Cell B having the 3-foot, recompacted clay liner. The daily peak percolation through Cell B (5-foot, in situ liner) is 0.0003 inches, or 11.3 cubic feet. This is slightly less than the 13.6 cubic feet daily peak percolation through Cell B having the 3-foot, recompacted clay liner.

Approximately 0.24 percent of the total annual precipitation percolated through Cells A and B having the 5-foot, in situ liner.

Average annual and daily peak percolation model results for the 5-foot, in situ liner were approximately two orders of magnitude lower than the ODEQ's model results. Average annual percolation for the cell the ODEQ modeled is approximately 7.5 inches, or 281,000 cubic feet, compared to 0.08 inches, or 3846 cubic feet, for Cell A having the 5-foot, in situ liner. The daily peak percolation through the ODEQ cell is 0.02 inches, or 337 cubic feet, compared to 0.0003 inches, or 16.2 cubic feet, through Cell A having the 5-foot, in situ liner.

Approximately 25 percent of the total annual precipitation percolated through the ODEQ cell, compared to only 0.24 percent of the total annual precipitation which percolated through Cell A with a 5-foot, in situ liner.

It is important to note that the ODEQ assumed very conservative model input data to maximize the amount of leachate generated. The ODEQ assumed equally conservative input data to assess the impact of leachate on the aquifer below the disposal cell, using a fate and transport model. Under this scenario, which resulted in a maximum amount of leachate and worst case fate and transport to the aquifer, the ODEQ concluded that a single, 3-foot thick layer of 1×10^{-7} clay would be adequate as the bottom liner of the proposed disposal cell (see Appendix C).



CONCLUSION

The 5-foot, in situ liner is as protective of the groundwater as the 3-foot, compacted liner, based on HELP model results for average annual and peak daily percolation. In addition, the 5-foot, in situ liner can be considered adequate, since the ODEQ concluded that a single, 3-foot thick, clay liner was adequate under conditions where significantly more leachate was generated.



***APPENDIX A
HELP MODELING DATA REFERENCES***



TABLE 1-2. NORMAL DAILY MINIMUM TEMPERATURE—
SELECTED CITIES OF THE UNITED STATES (continued)

[In Fahrenheit degrees. Airport data except as noted. Based on standard 30-year period 1951 through 1980]

ST.	STATION	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
NY	ALBANY	11.9	14.0	24.6	35.5	45.4	55.0	59.6	57.6	49.6	39.4	30.8	18.2	36.8
	BUFFALO	17.0	17.5	25.6	35.3	46.3	56.4	61.2	59.6	52.7	42.7	33.6	22.5	39.3
	NEW YORK ¹	25.6	26.6	34.1	43.8	53.3	62.7	68.2	67.1	60.1	49.9	40.8	30.3	46.9
	SYRACUSE	15.0	15.8	25.2	36.0	46.0	55.4	60.3	58.9	51.8	41.7	33.3	21.3	38.4
NC	ASHEVILLE	26.0	27.6	34.4	42.7	51.0	58.2	62.4	61.6	55.8	43.3	34.2	28.2	43.8
	RALEIGH	29.1	30.3	37.7	46.5	55.3	62.6	67.1	66.8	60.4	47.7	38.1	31.2	47.7
	WILMINGTON	35.3	36.6	43.3	51.8	60.4	67.1	71.3	70.8	65.7	53.7	43.9	37.2	53.1
ND	BISMARCK	-4.2	3.7	15.6	30.8	42.0	51.8	56.4	54.2	43.2	32.8	17.7	4.8	29.1
	WILLISTON	-4.3	3.5	14.3	29.6	41.5	51.1	56.0	53.7	43.0	32.0	17.0	4.3	28.5
OH	CINCINNATI	20.4	23.0	32.0	42.4	51.7	60.5	64.9	63.3	56.3	43.9	34.1	25.7	43.2
	CLEVELAND	18.5	19.9	28.4	38.0	47.9	57.2	61.4	60.5	54.0	43.6	34.3	24.6	40.7
	COLUMBUS	19.4	21.5	30.6	40.5	50.2	59.0	63.2	61.7	54.6	42.8	33.5	24.7	41.8
	TOLEDO	15.5	17.5	26.1	36.5	46.8	56.0	60.2	58.4	51.2	40.1	30.6	20.6	38.3
OK	OKLAHOMA CITY	25.2	29.4	37.1	48.6	57.7	66.3	70.6	69.4	61.9	50.2	37.6	29.1	48.6
	TULSA	24.8	29.5	37.7	49.5	58.5	67.5	72.4	70.3	62.5	50.3	38.1	29.3	49.2
OR	EUGENE	33.8	35.5	36.5	38.7	42.9	48.0	51.0	51.1	47.7	42.0	37.8	35.3	41.7
	MEDFORD	30.2	31.9	33.9	36.8	42.7	49.3	54.2	53.4	47.4	39.6	34.5	31.2	40.4
	PORTLAND	33.5	36.0	37.4	40.6	46.4	52.2	55.8	55.8	51.1	44.6	38.6	35.4	44.0
PC	GUAM	71.0	71.1	71.2	72.4	72.9	73.1	72.5	72.2	72.2	72.4	73.1	72.6	72.2
	JOHNSTON ISLAND	72.8	72.7	72.9	73.9	75.3	76.3	76.9	77.4	77.2	76.9	75.5	73.9	75.1
	KWAJALEIN,													
	MARSHALL IS.	76.8	76.9	77.4	77.1	76.9	76.9	76.9	77.0	77.1	77.0	77.1	77.2	77.0
	PAGO PAGO,													
	AMER SAMOA	74.9	74.8	75.1	74.6	74.5	75.0	74.3	73.9	74.2	75.0	75.1	75.1	74.7
	TRUK, E. CAROLINE IS.	76.9	76.9	77.0	76.8	76.4	76.0	75.2	75.1	75.3	75.5	76.1	76.8	76.2
	WAKE ISLAND	72.1	71.5	72.5	73.0	74.7	76.4	76.9	77.0	77.3	76.7	75.6	73.7	74.8
	YAP, W. CAROLINE IS.	75.0	75.2	75.4	75.9	75.8	75.4	74.9	74.7	74.8	74.9	75.4	75.4	75.2
PA	ERIE	18.0	17.7	25.8	36.1	45.4	55.2	59.9	59.4	53.1	43.2	34.3	24.2	39.4
	HARRISBURG	22.1	23.5	31.5	41.5	51.0	60.5	65.3	64.2	56.6	44.6	35.4	26.2	43.5
	PHILADELPHIA	23.8	25.0	33.1	42.6	52.5	61.5	66.8	66.0	58.6	46.5	37.1	28.0	45.1
	PITTSBURGH	19.2	20.7	29.4	39.4	48.5	57.1	61.3	60.1	53.3	42.1	33.3	24.3	40.7
PR	SAN JUAN	70.3	70.0	70.6	72.3	73.9	75.3	76.1	76.1	75.5	74.9	73.4	71.8	73.4
RI	PROVIDENCE	20.0	20.9	29.2	38.3	47.6	57.0	63.3	61.9	53.8	43.1	34.8	24.1	41.2
SC	CHARLESTON	36.9	38.4	45.3	52.5	61.4	68.0	71.6	71.2	66.7	54.7	44.6	38.5	54.2
	COLUMBIA	33.2	34.6	41.9	50.5	59.1	66.1	70.1	69.4	63.9	50.3	40.6	34.7	51.2
	GREENVILLE-													
	SPARTANBURG	31.2	32.6	39.4	48.3	56.9	64.2	68.2	67.4	61.7	49.1	39.6	33.2	49.3
SD	RAPID CITY	9.2	14.6	21.0	32.1	43.0	52.5	58.7	57.0	46.4	36.1	23.0	14.8	34.0
	SIoux FALLS	1.9	8.9	20.6	34.6	45.7	56.3	61.8	59.7	48.5	36.7	22.3	10.1	33.9
TN	BRISTOL-JOHNSON													
	CITY-KINGSPORT	25.5	27.4	34.9	43.8	52.5	60.1	64.3	63.4	57.2	44.7	35.1	28.3	44.8
	KNOXVILLE	29.5	31.7	39.3	48.2	56.5	64.0	68.0	67.1	61.2	48.1	38.4	31.9	48.7
	MEMPHIS	30.9	34.1	41.9	52.2	60.9	68.9	72.6	70.8	64.1	51.3	41.1	34.3	51.9
	NASHVILLE	27.8	30.1	38.3	48.1	56.9	64.8	69.0	67.8	61.3	48.0	38.0	31.3	48.5
TX	AUSTIN	38.8	42.2	49.3	58.3	65.1	71.5	73.9	73.7	69.1	58.7	48.1	41.4	57.5
	CORPUS CHRISTI	46.1	48.7	55.7	63.9	69.5	74.1	75.6	75.8	72.8	64.1	54.9	48.8	62.5
	DALLAS-FORT WORTH	35.9	37.8	44.9	53.0	62.9	70.8	74.7	73.7	67.5	56.3	44.9	37.4	55.0
	EL PASO	30.4	34.1	40.5	48.5	56.6	65.7	69.6	67.5	60.6	48.7	37.0	30.6	49.2
	HOUSTON	40.8	43.2	49.8	58.3	64.7	70.2	72.5	72.1	68.1	57.5	48.6	42.7	57.4
	LUBBOCK	24.3	27.9	35.2	45.6	55.2	64.3	67.6	65.7	58.7	47.3	34.8	27.4	46.2
UT	SALT LAKE CITY	19.7	24.4	29.9	37.2	45.2	53.3	61.8	59.7	50.0	39.3	29.2	21.6	39.3
VT	BURLINGTON	7.7	8.8	20.8	32.7	44.0	54.0	58.6	56.6	48.7	38.7	29.6	14.9	34.6
VA	LYNCHBURG	25.9	27.6	35.1	44.6	53.2	60.6	65.1	64.5	57.9	46.1	36.7	29.1	45.5
	NORFOLK	31.7	32.3	39.4	48.1	57.2	65.3	69.9	69.6	64.2	52.8	43.0	35.0	50.7
	RICHMOND	26.5	28.1	35.8	45.1	54.2	62.2	67.2	66.4	59.3	46.7	37.3	29.6	46.5
WA	SEATTLE ¹	35.9	38.2	38.8	42.4	47.7	53.0	56.0	56.3	52.9	47.1	41.1	38.1	45.6
	SPOKANE	20.0	25.7	29.0	34.9	42.5	49.3	55.3	54.3	46.5	36.7	25.5	23.7	37.2
	WALLA WALLA	28.4	33.9	37.3	42.4	49.3	55.8	62.2	61.2	53.6	44.5	35.9	31.4	44.7
WV	CHARLESTON	23.9	25.8	34.1	43.3	51.8	59.4	63.8	63.1	56.4	44.0	35.0	27.8	44.0
WI	GREEN BAY	5.4	8.7	20.1	33.6	43.5	53.1	58.1	56.3	47.9	38.2	26.3	13.0	33.7
	MADISON	6.7	11.0	21.5	34.1	44.2	53.8	58.3	56.3	47.8	37.8	26.0	14.1	34.3
	MILWAUKEE	11.3	15.8	24.9	35.6	44.7	54.7	61.1	60.2	52.5	41.9	29.9	18.2	37.9
WY	CASPER	11.9	16.3	20.2	29.3	38.9	47.6	54.7	52.8	42.5	33.2	21.9	15.7	32.1
	CHEYENNE	14.8	17.9	20.6	29.6	39.7	48.5	54.6	52.8	43.7	34.0	23.1	18.2	33.1

¹ City office data.

Source: U.S. National Oceanic and Atmospheric Administration, Comparative Climatic Data for the United States through 1986

TABLE 1-7. NORMAL MONTHLY PRECIPITATION—
SELECTED CITIES OF THE UNITED STATES (continued)

[In inches. Includes liquid water equivalent of snowfall. Airport data except as noted.
Based on standard 30-year period 1951 through 1980]

ST.	STATION	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
NY	ALBANY	2.39	2.26	3.01	2.94	3.31	3.29	3.00	3.34	3.23	2.93	3.04	3.00	35.74
	BUFFALO	3.02	2.40	2.97	3.06	2.89	2.72	2.96	4.16	3.37	2.93	3.62	3.42	37.52
	NEW YORK ¹	3.21	3.13	4.22	3.75	3.76	3.23	3.77	4.03	3.66	3.41	4.14	3.81	44.12
	SYRACUSE	2.61	2.65	3.11	3.34	3.16	3.63	3.76	3.77	3.29	3.14	3.45	3.20	39.11
NC	ASHEVILLE	3.48	3.60	5.13	3.84	4.19	4.20	4.43	4.79	3.96	3.29	3.29	3.51	47.71
	RALEIGH	3.55	3.43	3.69	2.91	3.67	3.66	4.38	4.44	3.29	2.73	2.87	3.14	41.76
	WILMINGTON	3.64	3.44	4.04	2.98	4.22	5.65	7.44	6.64	5.71	2.97	3.19	3.43	53.35
ND	BISMARCK	0.51	0.45	0.70	1.51	2.23	3.01	2.05	1.89	1.38	0.81	0.51	0.51	15.36
	WILLISTON	0.55	0.50	0.57	1.29	1.85	2.68	1.83	1.42	1.37	0.74	0.50	0.55	13.85
OH	CINCINNATI	3.13	2.73	3.95	3.58	3.84	4.09	4.28	2.97	2.91	2.54	3.12	3.00	40.14
	CLEVELAND	2.47	2.20	2.99	3.32	3.30	3.49	3.37	3.38	2.92	2.45	2.76	2.75	35.40
	COLUMBUS	2.75	2.18	3.23	3.41	3.76	4.01	4.01	3.70	2.76	1.91	2.64	2.61	36.97
	TOLEDO	1.99	1.80	2.64	3.04	2.90	3.49	3.26	3.19	2.53	1.94	2.41	2.59	31.78
OK	OKLAHOMA CITY	0.96	1.29	2.07	2.91	5.50	3.87	3.04	2.40	3.41	2.71	1.53	1.20	30.89
	TULSA	1.35	1.74	3.14	4.15	5.14	4.57	3.51	3.01	4.37	3.41	2.56	1.82	38.77
OR	EUGENE	8.39	5.12	5.11	2.76	1.97	1.24	0.27	0.95	1.45	3.47	6.82	8.49	46.04
	MEDFORD	3.42	2.12	1.85	1.07	1.19	0.67	0.25	0.46	0.75	1.68	2.89	3.49	19.84
	PORTLAND	6.16	3.93	3.61	2.31	2.08	1.47	0.46	1.13	1.61	3.05	5.17	6.41	37.39
PC	GUAM	5.43	4.76	4.19	4.14	6.41	5.53	10.31	13.92	14.25	13.87	8.98	6.07	97.86
	JOHNSTON ISLAND	2.35	1.88	2.72	2.41	1.81	0.92	1.05	2.11	2.09	3.02	3.06	3.10	26.52
	KWAJALEIN, MARSHALL IS.	4.91	2.97	5.17	7.60	11.24	10.11	10.30	10.30	10.94	12.24	10.57	7.96	104.71
	PAGO PAGO, AMER SAMOA	12.78	12.53	11.38	11.25	10.72	8.56	6.51	7.08	6.69	11.05	11.20	14.21	123.96
	TRUK, E. CAROLINE IS.	8.36	6.67	9.11	12.76	15.64	12.37	14.32	14.04	13.23	14.68	12.07	12.59	145.84
	WAKE ISLAND	1.17	1.20	1.94	2.09	1.87	2.34	3.84	5.46	5.66	4.76	2.77	1.76	34.86
	YAP, W. CAROLINE IS.	7.92	5.54	6.28	6.56	9.96	11.39	14.24	14.64	13.18	12.56	9.84	10.07	122.18
PA	ERIE	2.49	2.12	2.91	3.49	3.28	3.72	3.28	3.85	3.89	3.37	3.74	3.25	39.39
	HARRISBURG	2.96	3.73	3.50	3.19	3.67	3.63	3.32	3.29	3.60	2.73	3.24	3.23	39.09
	PHILADELPHIA	3.18	2.81	3.86	3.47	3.18	3.92	3.88	4.10	3.42	2.83	3.32	3.45	41.42
	PITTSBURGH	2.86	2.40	3.58	3.28	3.54	3.30	3.83	3.31	2.80	2.49	2.34	2.57	36.30
PR	SAN JUAN	3.01	2.02	2.31	3.62	5.64	4.66	4.87	5.93	5.99	5.89	5.59	4.46	53.99
RI	PROVIDENCE	4.06	3.72	4.29	3.95	3.48	2.79	3.01	4.04	3.54	3.75	4.22	4.47	45.32
SC	CHARLESTON	3.33	3.37	4.38	2.58	4.41	6.54	7.33	6.50	4.94	2.92	2.18	3.11	51.59
	COLUMBIA	4.38	3.99	5.16	3.59	3.85	4.45	5.35	5.56	4.23	2.55	2.51	3.50	49.12
	GREENVILLE- SPARTANBURG	4.21	4.39	5.87	4.35	4.22	4.77	4.08	3.66	4.35	3.49	3.21	3.93	50.53
SD	RAPID CITY	0.42	0.62	1.02	1.96	2.63	3.26	2.12	1.44	1.03	0.81	0.51	0.45	16.27
	SIOUX FALLS	0.50	0.93	1.58	2.36	3.21	3.70	2.71	3.13	2.79	1.57	0.92	0.72	24.12
TN	BRISTOL-JOHNSON CITY- KINGSPORT	3.56	3.43	4.29	3.46	3.61	3.46	4.19	3.23	3.00	2.50	2.98	3.53	41.24
	KNOXVILLE	4.65	4.18	5.49	3.87	3.71	3.95	4.33	3.02	2.99	2.73	3.78	4.59	47.29
	MEMPHIS	4.61	4.33	5.44	5.77	5.06	3.58	4.03	3.74	3.62	2.37	4.17	4.81	51.57
	NASHVILLE	4.49	4.03	5.58	4.47	4.56	3.70	3.82	3.40	3.71	2.58	3.52	4.63	48.49
TX	AUSTIN	1.60	2.49	1.68	3.11	4.19	3.06	1.89	2.24	3.60	3.38	2.20	2.06	31.50
	CORPUS CHRISTI	1.63	1.55	0.84	1.99	3.05	3.36	1.96	3.51	6.15	3.19	1.55	1.40	30.18
	DALLAS-FORT WORTH	1.65	1.93	2.42	3.63	4.27	2.59	2.00	1.76	3.31	2.47	1.76	1.67	29.46
	EL PASO	0.38	0.45	0.32	0.19	0.24	0.56	1.60	1.21	1.42	0.73	0.33	0.39	7.82
	HOUSTON	3.21	3.25	2.68	4.24	4.69	4.06	3.33	3.66	4.93	3.67	3.38	3.66	44.76
	LUBBOCK	0.38	0.57	0.90	1.00	2.59	2.81	2.34	2.20	2.06	1.81	0.59	0.43	17.76
UT	SALT LAKE CITY	1.35	1.33	1.72	2.21	1.47	0.97	0.72	0.92	0.89	1.14	1.22	1.37	15.31
VT	BURLINGTON	1.85	1.73	2.20	2.77	2.96	3.64	3.43	3.87	3.20	2.81	2.80	2.43	33.69
VA	LYNCHBURG	3.06	2.93	3.69	2.90	3.65	3.47	3.85	3.69	3.23	3.36	2.92	3.16	39.91
	NORFOLK	3.72	3.28	3.86	2.87	3.75	3.45	5.15	5.33	4.35	3.41	2.68	3.17	45.22
	RICHMOND	3.23	3.13	3.57	2.90	3.55	3.60	5.14	5.01	3.52	3.74	3.29	3.39	44.07
WA	SEATTLE ¹	5.94	4.20	3.70	2.46	1.66	1.53	0.89	1.38	2.03	3.40	5.36	6.29	38.84
	SPOKANE	2.47	1.61	1.36	1.08	1.38	1.23	0.50	0.74	0.71	1.08	2.06	2.49	16.71
	WALLA WALLA	2.12	1.40	1.41	1.35	1.40	0.93	0.35	0.71	0.83	1.40	1.87	2.19	15.96
WV	CHARLESTON	3.48	3.11	4.00	3.52	3.68	3.32	5.36	4.15	3.01	2.63	2.90	3.27	42.43
WI	GREEN BAY	1.19	1.05	1.90	2.70	3.13	3.17	3.25	3.16	3.17	2.10	1.76	1.42	28.00
	MADISON	1.11	1.02	2.15	3.10	3.34	3.89	3.75	3.82	3.06	2.24	1.83	1.53	30.84
	MILWAUKEE	1.64	1.33	2.58	3.37	2.66	3.59	3.54	3.09	2.88	2.25	1.98	2.03	30.94
WY	CASPER	0.50	0.56	0.99	1.51	2.13	1.24	1.06	0.63	0.75	0.88	0.66	0.51	11.43
	CHEYENNE	0.41	0.40	0.97	1.24	2.39	2.00	1.87	1.39	1.06	0.68	0.53	0.37	13.31

¹ City office data.

Source: U.S. National Oceanic and Atmospheric Administration, Comparative Climatic Data for the United States through 1986

Post-It™ brand fax transmittal memo 7571		# of pages = 4	
To	Bob Helmburger	From	T. GIBSON
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Dept.		Phone	918-225-7753
Fax	214-450-4101	Fax	918-225-7749

KM-814



Hydrology
(UNIT)

FROM S. R. Lower
Ext. 2696 *STL*

SUBJECT Cushing Pit 5 Formation
Clay Permeabilities

July 11, 1993

Pursuant to your request, core samples retrieved from boreholes drilled around Cushing Pit 5 in September 1992 were submitted to Standard Testing in Oklahoma City for determination of permeabilities. In addition, compacted cylinder samples of treated and solidified Pit 5 sludge mixes 2 and 4 provided by you were also submitted for permeability tests.

Formation Clay Permeabilities

One core sample was selected from each of the four boreholes drilled around Pit 5 in September 1992. Locations of these boreholes are shown on the attached map.

Criteria used in the selection of samples was the absence of sand, silt, and visible parting. Thus, only those sections of the cores that appeared to be predominantly clay were selected. When possible, sections of cores that were obviously sandy, silty, or shaley were rejected.

The depth intervals selected for permeability testing are as follows. Depths are given in feet below ground level and elevation in feet above Mean Sea Level:

<u>Borehole</u>	<u>Depth Interval</u>	<u>Elevation</u>
P5-1A	50 - 53.5 feet	789.4 - 785.9
P5-2	53 - 53.5 feet	790.8 - 790.3
P5-3	40 - 44.5 feet	818.6 - 814.1
P5-4	33.5 - 34 feet	818.6 - 818.1

Descriptions of the lithology at these intervals, and the permeabilities as determined by Standard Testing, are presented below. The laboratory report sheet is attached:

<u>Borehole</u>	<u>Description</u>	<u>Permeability (cm/sec)</u>
P5-1A	Reddish-brown silty clay	1.0×10^{-7}
P5-2	Gray silty clay w/gravel	9.9×10^{-7}
P5-3	Reddish-brown silty clay	1.8×10^{-4}
P5-4	Dark red sandy, shaley clay	9.9×10^{-4}

L. K. Bailey
January 11, 1993
Page 2

Treated/Solidified Pit 5 Sludge

As mentioned above, compacted cylinder samples of the treated and solidified Pit 5 sludge mixes 2 and 4 you provided were also submitted for permeability tests. The permeabilities as determined by Standard Testing for these samples are presented below. The laboratory report sheet is attached:

<u>Solidified Sample</u>	<u>Permeability (cm/sec)</u>
Mix 2	8.1×10^{-3}
Mix 4	3.1×10^{-3}

* * *

Should you have any questions or comments regarding these permeability tests, please call at extension 2696. The Mix 2 and Mix 4 samples will be returned to you as soon I can retrieve them up from the laboratory.

Attachments

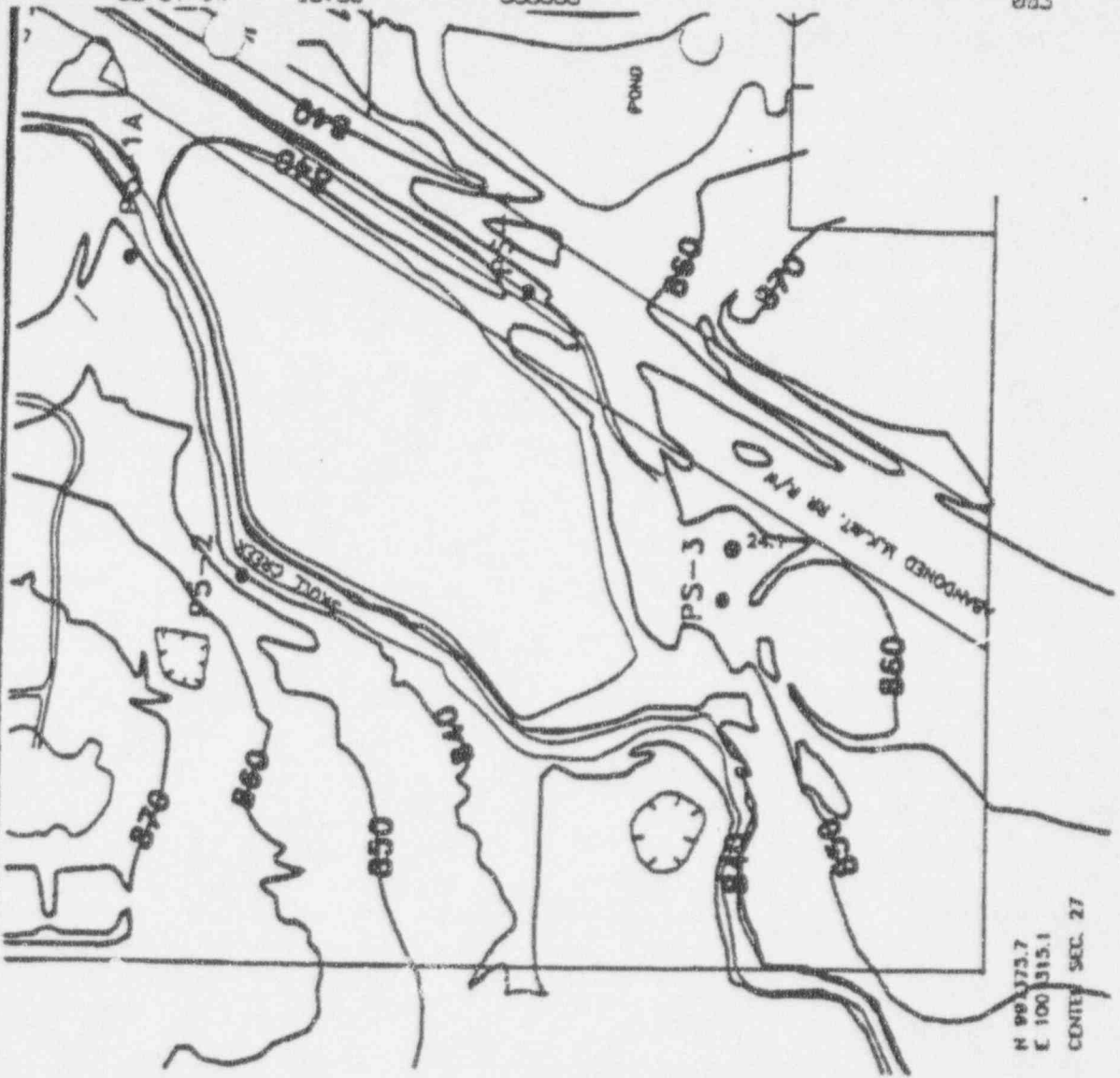
cc: S. M. Logan
J. J. Lux
J. G. Ostmeyer

02/07/94

16:38

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003



N 99 373.7
 E 100 315.1
 CONTEY SEC. 27



KERR-MCGEE CORPORATION			
<small>MEMPHIS, TENN. • P.O. BOX 1000 • MEMPHIS, TENN. 38101</small>			
CONTOUR MAP SHOWING PIT			
5 - SEPTEMBER 1992			
LOCATION: CUSHING, OK			
PREPARED BY	CHECKED BY	SCALE	
DRAWN BY	APPROVED BY	DATE	
PROJECT NO.		REVISED BY	



CORPORATION OF OKLAHOMA AND CENTRAL LABORATORY
3400 N. LINCOLN, OKLAHOMA CITY, OK 73105 (405) 528-0541

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REPORT Flexible Wall Permeability Tests Date 12/14/92
Project Kerr-McGee Corporation Specification ASTM
Location Cushing Facility Quantity Represented Six Intact Samples
Architect/Engineer _____ Sampled by Client
Contractor _____ by Order of Steve Lower
Reported To Kerr-McGee Date 1/6/93 Order Number _____

TEST RESULTS

Laboratory Number G-827

Sample	P5-1A	P5-2	P5-3	P5-4	Mix #2	Mix #4
Soil Description	Reddish Brown Silty Clay	Gray Silty Clay w/Gravel	Reddish Brown Silty Clay	Dark Red Sandy Shaley Clay	Stabilized Mixture	Stabilized Mixture
Dry Density, pcf	121.5	103.8	115.3	131.9	72.8	92.0
Moisture, %	14.8	21.5	16.4	10.9	8.8	4.5
Coefficient of Permeability, k, cm/sec.	1.02x10 ⁻⁷	9.9x10 ⁻⁷	1.8x10 ⁻⁶	9.9x10 ⁻⁶	8.1x10 ⁻⁵	3.1x10 ⁻³

THIS REPORT APPLIES ONLY TO THE STANDARDS OR PROCEDURES INDICATED AND TO THE SAMPLE TESTED AND/OR OBSERVED AND ARE NOT NECESSARILY INDICATIVE OF THE QUALITIES OF APPARENTLY IDENTICAL OR SIMILAR PRODUCTS, OR PROCEDURES. NOR DO THEY REPRESENT AN ON GOING QUALITY ASSURANCE PROGRAM UNLESS SO NOTED. THESE REPORTS ARE FOR THE EXCLUSIVE USE OF THE ADDRESSED CLIENT AND ARE RENDERED UPON THE CONDITION THAT THEY WILL NOT BE REPRODUCED WHOLLY OR IN PART FOR ADVERTISING OR OTHER PURPOSES OVER OUR SIGNATURE OR IN CONNECTION WITH OUR NAME WITHOUT SPECIAL WRITTEN PERMISSION.

Charge: Kerr-McGee
Orig. & 2cc To Same
1cc Lab



Respectfully Submitted
STANDARD TESTING AND ENGINEERING CO.

Professional Engineer Seal
Original Signature
16316
Petros, L. H. W. L. S., P. E.

"TEST FOR ASSURANCE"

HELP Model Input

CELL B

	Top Soil	Clay Cup	compact Limestone	Clay Liner	
Tr thickness	6"	30"	[1764]	60"	36"
Porosity	.4780	.4000	.4570	.4000	.4300
Field Capacity	.2217	.3560	.1309	.3560	.3600
Wilting Point	.1043	.2249	.0520	.2499	.290
Initial Soil Water Content	.2217	.1500	.1309	.3560	.15
Saturated Hydraulic Cond.	.00156	10^{-8}	6.1×10^{-3}	10^{-9}	10^{-7}
Slope	3%				
Drainage Dist	[500']				

Area of Cell = [400,000 ft²]

Climatological Data Tulsa mean monthly values

	Jan/July	Feb/Aug	Mar/Sep	Apr/Oct	May/Nov	June/Dec
Precip	1.35	1.77	3.14	4.15	5.14	4.57
	5.51	3.01	4.37	3.41	2.56	1.82
Temp	35.2	40.7	49.3	60.9	69.1	72.7
	83.2	81.7	73.8	62.6	49.2	39.8

Latitude for Cushing was used 36°

Model was run for 20 years.

HELP Mod. Inert

CELLA

	Top Soil	Clay Cap	compacted waste	Clay Liner		
Tr. excess	6"	30"	166.0	60" 36"		5
Porosity	.4730	.4300	.4570	.400	.430	7
Field Capacity	.2217	.3560	.1307	.3560	.3660	9
Wilt. Point	.1043	.2899	.0580	.2899	.290	11
Initial Soil Water Content	.2217	.1500	.1309	.3560	.15	16
Saturated Hydraulic Cond.	.00156	10^{-7}	8.1×10^{-3}	10^{-6}	10^{-7}	13
Slope	3%		.0081			
Leakage Distance	650'	100'				

Area of Cell 572,000 ft² (19)

Climatological Data Tulsa (see sheet 1)

Model was run for 20 years

**RECORD OF
COMMUNICATION**

(Record of Item Checked Below)

Phone Call
 Conference

Disc. Field Trip

Other(Specify)

TO: M.Holmes

FROM: D.Cheek

Fluor Daniel, Inc. ESBU

DATE: 1/31/94

TIME: 830 hrs.

SUBJECT: KERR-MCGEE CUSHING SITE

SUMMARY OF COMMUNICATION:

I spoke with Mike Holmes and asked him if the total depth in the quantities summary table included the bottom liner. He said that it did not. He said it only contained the top two layer and the waste layer. Mike called back and said that in table 4.4 of the Disposal Option Evaluation the total depth included a 3 ft. liner.

CONCLUSIONS, ACTION TAKEN OR REQUIRED:

INFORMATION COPIES

TO: Project #

TABLE 4-4
DISPOSAL CELL SIZE, PARAMETERS, AND QUANTITIES

Option	Cell	Approx. Disposal Cell Size (ft)	Approx. Depth (ft)	Approx. Height (ft)	Total Clay Required (yd ³)	Total Excavated Volume (yd ³)	Disposal Cell Capacity (yd ³)	Top Soil Required (yd ³)	Pit Backfill Haul (yd ³)
1A	A	900 x 500	25.3	12.1	102,571	329,774	400,000	8,738	217,990
2A	A	900 x 500	20.1	8.7	102,571	276,281	304,000	8,859	164,497
	B	800 x 500	11.4	2.4	90,115	151,755	96,000	8,063	53,492
3A	A	900 x 500	16.9	6.6	102,571	240,392	239,000	8,934	128,608
	B	800 x 500	14.7	4.5	90,115	187,645	161,000	7,988	89,382
1B	A	1,400 x 600	21.7	7.4	190,192	574,992	600,000	16,810	367,990
2B	A	1,400 x 600	17.8	5.5	189,829	485,379	457,000	16,868	278,662
	B	800 x 500	14.7	3.2	90,439	187,800	143,000	8,034	89,327
3B	A	880 x 850	20.0	6.6	128,630	359,138	359,000	11,345	218,263
	B	800 x 500	20.7	6.1	90,787	248,444	241,000	7,930	149,727





**FLUOR DANIEL
WILLIAMS BROTHERS**

**COMMUNICATION SERVICES
FACSIMILE TRANSMISSION SHEET**

TO: Rob Franke *MD*

FROM: Norman Blaker

COMPANY: Kerr-McGee

PHONE NO: 918/561-9653

LOCATION:

PROJECT NO: 11832100

FAX NO: 214/450-4101

FAX NO: 918/561-9597

DATE: January 28, 1994

THIS PAGE PLUS: 1

Reference: Cushing Remedial Design

Attached is copy of letter received today, January 28, 1994 from Kerr-McGee.

This letter gives direction for the disposal cells design.

IF THIS TRANSMISSION IS NOT COMPLETE OR LEGIBLE PLEASE NOTIFY:
918/561-9736 or 561-9660

**KERR-MCGEE CORPORATION**

KERR MCGEE CENTER • OKLAHOMA CITY, OKLAHOMA 73175

RECU'D
1-28-94
VLD

January 26, 1994

Mr. Norm Blaker
Fluor Daniel Williams Brothers
119 East 6th Street
Tulsa, OK 74121-1310

Dear Mr. Blaker:

After reviewing the additional cost estimate data we received today, Roy Smith, Jeff Ostmeyer, and I agreed to go forward with Option 3 in the disposal cell design. We will plan to dispose of all material from Pit 4 in the disposal cell in the northwest corner.

However, I would like to address a change in our concept of 400,000 and 600,000 cubic yard designs. We have a much higher degree of uncertainty concerning the volume of pit 5 (compared to the other four pits), and we also know of a significant number of other waste pits in the southern portion of the property. Roy, Jeff, and I therefore decided it would be best to design the 400,000 c.y. cells so the disposal cells contain waste in proportion to their estimated quantities. However, the additional 200,000 c.y. that go into the 600,000 c.y. design should be divided so that 50,000 c.y. goes into the northwestern cell, and 150,000 c.y. goes into the southeastern disposal cell.

Hopefully, this letter is understandable and gives you the information you need to proceed with the disposal cell design. I will be in Washington, D.C. Thursday and Friday, so I will be difficult to reach. If you have questions or comments, you may leave a voice mail message or call me at home over the weekend at (405) 354-8105. I will be in Cushing on Monday, and can be reached at (918) 225-7753. Thanks for your help.

Sincerely,

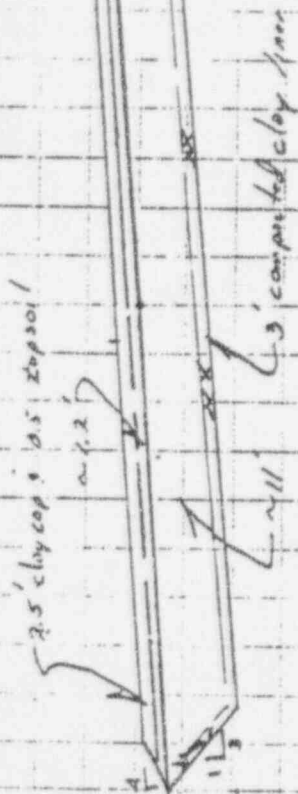
Jeff Lux



SUBJECT
OPTION 3A
= CELL B

PROJECT NO. B321	CLIENT KERK-McGEE
PREPARED BY HOLMES	CHECKED BY
DATE	SHEET 5 OF

SECTION G-G



SECTION H-H

900 880 860 840 820 3000 2700 2400 2100 1800 1500 1200 900 880 860 840 820 3000 2700 2400 2100 1800 1500 1200 900

APPENDIX B
HELP MODEL OUTPUT DATA



KERR-MCGEE REMEDIAL DESIGN CUSHING
CELL A (3 ft. liner)
02/08/94

FAIR GRASS

LAYER 1

LATERAL DRAINAGE LAYER

THICKNESS	=	6.00 INCHES
POROSITY	=	0.4730 VOL/VOL
FIELD CAPACITY	=	0.2217 VOL/VOL
WILTING POINT	=	0.1043 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.2217 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.001530000009 CM/SEC
SLOPE	=	3.00 PERCENT
DRAINAGE LENGTH	=	650.0 FEET

LAYER 2

BARRIER SOIL LINER

THICKNESS	=	30.00 INCHES
POROSITY	=	0.4000 VOL/VOL
FIELD CAPACITY	=	0.3560 VOL/VOL
WILTING POINT	=	0.2899 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.1500 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.000000010000 CM/SEC

LAYER 3

VERTICAL PERCOLATION LAYER

THICKNESS	=	168.00 INCHES
POROSITY	=	0.4570 VOL/VOL
FIELD CAPACITY	=	0.1309 VOL/VOL

WILTING POINT = 0.0530 VOL/VOL
 INITIAL SOIL WATER CONTENT = 0.1309 VOL/VOL
 SATURATED HYDRAULIC CONDUCTIVITY = 0.008100000210 CM/SEC

LAYER 4

BARRIER SOIL LINER

THICKNESS = 36.00 INCHES
 POROSITY = 0.4300 VOL/VOL
 FIELD CAPACITY = 0.3660 VOL/VOL
 WILTING POINT = 0.2800 VOL/VOL
 INITIAL SOIL WATER CONTENT = 0.1500 VOL/VOL
 SATURATED HYDRAULIC CONDUCTIVITY = 0.000000100000 CM/SEC

GENERAL SIMULATION DATA

SCS RUNOFF CURVE NUMBER = 74.26
 TOTAL AREA OF COVER = 572000. SQ FT
 EVAPORATIVE ZONE DEPTH = 22.00 INCHES
 UPPER LIMIT VEG. STORAGE = 2.8380 INCHES
 INITIAL VEG. STORAGE = 1.3302 INCHES
 INITIAL SNOW WATER CONTENT = 0.0000 INCHES
 INITIAL TOTAL WATER STORAGE IN
 SOIL AND WASTE LAYERS = 33.2214 INCHES

SOIL WATER CONTENT INITIALIZED BY USER.

CLIMATOLOGICAL DATA

SYNTHETIC RAINFALL WITH SYNTHETIC DAILY TEMPERATURES AND
 SOLAR RADIATION FOR TULSA OKLAHOMA

MAXIMUM LEAF AREA INDEX = 2.00
 START OF GROWING SEASON (JULIAN DATE) = 98
 END OF GROWING SEASON (JULIAN DATE) = 307

LAYER 4 (INCHES)	0.00	0.00	0.00	0.00	0.00	0.00
STD. DEV. OF DAILY HEAD ON LAYER 4 (INCHES)	0.00	0.00	0.00	0.00	0.00	0.00

ANNUAL TOTALS FOR YEAR 1

	(INCHES)	(CU. FT.)	PERCENT
PRECIPITATION	32.52	1550120.	100.00
RUNOFF	2.118	100955.	6.51
EVAPOTRANSPIRATION	30.228	1440845.	92.95
LATERAL DRAINAGE FROM LAYER 1	0.0580	2765.	0.18
PERCOLATION FROM LAYER 2	0.0536	2554.	0.16
PERCOLATION FROM LAYER 4	0.0535	2552.	0.16
CHANGE IN WATER STORAGE	0.063	3004.	0.19
SOIL WATER AT START OF YEAR	33.22	1583553.	
SOIL WATER AT END OF YEAR	33.28	1586557.	
SNOW WATER AT START OF YEAR	0.00	0.	
SNOW WATER AT END OF YEAR	0.00	0.	
ANNUAL WATER BUDGET BALANCE	0.00	0.	0.00

MONTHLY TOTALS FOR YEAR 2

 JAN/JUL FEB/AUG MAR/SEP APR/OCT MAY/NOV JUN/DEC

PRECIPITATION (INCHES)	2.58 4.55	2.25 2.93	0.88 6.52	1.74 2.49	5.12 1.86	7.39 1.87
RUNOFF (INCHES)	0.000 0.461	0.595 0.040	0.000 3.616	0.000 0.148	0.733 0.000	1.671 0.000
EVAPOTRANSPIRATION (INCHES)	1.388 4.084	2.257 0.669	1.358 4.157	1.726 1.210	3.364 2.211	7.511 1.904
LATERAL DRAINAGE FROM LAYER 1 (INCHES)	0.0122 0.0044	0.0210 0.0000	0.0066 0.0132	0.0044 0.0023	0.0072 0.0121	0.0132 0.0174
PERCOLATION FROM LAYER 2 (INCHES)	0.0115 0.0038	0.0111 0.0001	0.0111 0.0088	0.0106 0.0030	0.0103 0.0112	0.0102 0.0119
PERCOLATION FROM LAYER 4 (INCHES)	0.0115 0.0038	0.0111 0.0000	0.0111 0.0089	0.0106 0.0027	0.0103 0.0112	0.0106 0.0119

 MONTHLY SUMMARIES FOR DAILY HEADS

AVG. DAILY HEAD ON LAYER 2 (INCHES)	2.77 0.97	4.79 0.00	1.62 2.91	1.09 0.55	1.63 2.90	2.95 3.96
STD. DEV. OF DAILY HEAD ON LAYER 2 (INCHES)	1.47 1.72	0.78 0.02	0.61 2.31	0.60 1.44	1.66 1.36	1.91 0.61
AVG. DAILY HEAD ON LAYER 4 (INCHES)	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00
STD. DEV. OF DAILY HEAD ON LAYER 4 (INCHES)	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00

ANNUAL TOTALS FOR YEAR 2

	(INCHES)	(CU. FT.)	PERCENT
PRECIPITATION	40.18	1915247.	100.00
RUNOFF	7.264	346274.	18.08
EVAPOTRANSPIRATION	31.839	1517651.	79.24
LATERAL DRAINAGE FROM LAYER 1	0.1142	5443.	0.28
PERCOLATION FROM LAYER 2	0.1036	4937.	0.26
PERCOLATION FROM LAYER 4	0.1036	4937.	0.26
CHANGE IN WATER STORAGE	0.859	40942.	2.14
SOIL WATER AT START OF YEAR	33.28	1586557.	
SOIL WATER AT END OF YEAR	34.14	1627499.	
SNOW WATER AT START OF YEAR	0.00	0.	
SNOW WATER AT END OF YEAR	0.00	0.	
ANNUAL WATER BUDGET BALANCE	0.00	0.	0.00

MONTHLY TOTALS FOR YEAR 3

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION (INCHES)	1.70 1.45	0.14 5.76	6.31 4.63	2.63 4.10	6.23 0.70	4.81 1.49
RUNOFF (INCHES)	0.117 0.000	0.000 0.287	1.669 1.084	0.000 1.426	1.573 0.082	0.000 0.000
EVAPOTRANSPIRATION (INCHES)	1.389 1.481	1.607 3.891	3.619 4.022	3.258 1.978	4.599 1.981	5.462 1.248

LATERAL DRAINAGE FROM LAYER 1 (INCHES)	0.0231 0.0000	0.0103 0.0067	0.0145 0.0077	0.0055 0.0079	0.0066 0.0120	0.0022 0.0074
PERCOLATION FROM LAYER 2 (INCHES)	0.0122 0.0000	0.0104 0.0052	0.0117 0.0061	0.0107 0.0063	0.0111 0.0112	0.0042 0.0112
PERCOLATION FROM LAYER 4 (INCHES)	0.0122 0.0000	0.0104 0.0050	0.0117 0.0061	0.0107 0.0063	0.0111 0.0112	0.0043 0.0112

 MONTHLY SUMMARIES FOR DAILY HEADS

AVG. DAILY HEAD ON LAYER 2 (INCHES)	4.79 0.00	2.56 1.50	3.23 1.79	1.44 1.70	1.55 2.77	0.54 1.78
STD. DEV. OF DAILY HEAD ON LAYER 2 (INCHES)	0.85 0.00	1.48 1.99	1.70 2.06	0.64 2.24	1.63 1.53	0.81 0.74
AVG. DAILY HEAD ON LAYER 4 (INCHES)	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00
STD. DEV. OF DAILY HEAD ON LAYER 4 (INCHES)	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00

ANNUAL TOTALS FOR YEAR 3

	(INCHES)	(CU. FT.)	PERCENT
PRECIPITATION	39.95	1904283.	100.00
RUNOFF	6.237	297287.	15.61
EVAPOTRANSPIRATION	34.534	1646102.	86.44
LATERAL DRAINAGE FROM LAYER 1	0.1038	4950.	0.26
PERCOLATION FROM LAYER 2	0.1001	4772.	0.25
PERCOLATION FROM LAYER 4	0.1001	4772.	0.25

CHANGE IN WATER STORAGE	-1.024	-48828.	-2.56
SOIL WATER AT START OF YEAR	34.14	1627499.	
SOIL WATER AT END OF YEAR	33.12	1578670.	
SNOW WATER AT START OF YEAR	0.00	0.	
SNOW WATER AT END OF YEAR	0.00	0.	
ANNUAL WATER BUDGET BALANCE	0.00	0.	0.00

MONTHLY TOTALS FOR YEAR 4

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION (INCHES)	1.49 3.78	1.43 1.04	1.13 2.08	0.66 2.19	2.38 3.58	3.46 2.96
RUNOFF (INCHES)	0.000 0.115	0.000 0.000	0.000 0.000	0.000 0.009	0.000 1.775	0.000 1.072
EVAPOTRANSPIRATION (INCHES)	1.349 1.433	1.166 3.246	1.684 1.841	0.577 0.389	2.671 2.069	3.648 1.698
LATERAL DRAINAGE FROM LAYER 1 (INCHES)	0.0088 0.0002	0.0043 0.0033	0.0052 0.0000	0.0017 0.0006	0.0020 0.0202	0.0042 0.0205
PERCOLATION FROM LAYER 2 (INCHES)	0.0113 0.0003	0.0102 0.0031	0.0110 0.0000	0.0104 0.0004	0.0044 0.0117	0.0033 0.0121
PERCOLATION FROM LAYER 4 (INCHES)	0.0113 0.0002	0.0102 0.0033	0.0110 0.0000	0.0104 0.0003	0.0046 0.0117	0.0033 0.0121

MONTHLY SUMMARIES FOR DAILY HEADS

AVG. DAILY HEAD ON LAYER 2 (INCHES)	2.25	1.10	1.25	0.42	0.50	0.92
	0.09	0.70	0.00	0.18	4.46	4.42
STD. DEV. OF DAILY HEAD ON LAYER 2 (INCHES)	0.85	0.20	0.21	0.28	0.93	1.79
	0.50	1.49	0.00	0.97	0.98	0.91
AVG. DAILY HEAD ON LAYER 4 (INCHES)	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00
STD. DEV. OF DAILY HEAD ON LAYER 4 (INCHES)	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00

ANNUAL TOTALS FOR YEAR 4

	(INCHES)	(CU. FT.)	PERCENT
	-----	-----	-----
PRECIPITATION	26.18	1247913.	100.00
RUNOFF	2.971	141601.	11.35
EVAPOTRANSPIRATION	21.771	1037751.	83.16
LATERAL DRAINAGE FROM LAYER 1	0.0711	3388.	0.27
PERCOLATION FROM LAYER 2	0.0783	3733.	0.30
PERCOLATION FROM LAYER 4	0.0783	3733.	0.30
CHANGE IN WATER STORAGE	1.289	61440.	4.92
SOIL WATER AT START OF YEAR	33.12	1578670.	
SOIL WATER AT END OF YEAR	34.41	1640110.	
SNOW WATER AT START OF YEAR	0.00	0.	
SNOW WATER AT END OF YEAR	0.00	0.	
ANNUAL WATER BUDGET BALANCE	0.00	0.	0.00

ON LAYER 4 (INCHES) 0.00 0.00 0.00 0.00 0.00 0.00

ANNUAL TOTALS FOR YEAR 5

	(INCHES)	(CU. FT.)	PERCENT
PRECIPITATION	24.96	1189760.	100.00
RUNOFF	1.292	61602.	5.18
EVAPOTRANSPIRATION	24.606	1172886.	98.58
LATERAL DRAINAGE FROM LAYER 1	0.0748	3565.	0.30
PERCOLATION FROM LAYER 2	0.0776	3697.	0.31
PERCOLATION FROM LAYER 4	0.0776	3697.	0.31
CHANGE IN WATER STORAGE	-1.091	-51991.	-4.37
SOIL WATER AT START OF YEAR	34.41	1640110.	
SOIL WATER AT END OF YEAR	33.32	1588119.	
SNOW WATER AT START OF YEAR	0.00	0.	
SNOW WATER AT END OF YEAR	0.00	0.	
ANNUAL WATER BUDGET BALANCE	0.00	1.	0.00

MONTHLY TOTALS FOR YEAR 6

JAN/JUL FEB/AUG MAR/SEP APR/OCT MAY/NOV JUN/DEC

PRECIPITATION (INCHES)	3.36	1.72	1.48	2.06	4.72	6.93
	5.60	1.24	4.44	0.65	0.29	2.76
RUNOFF (INCHES)	1.281	0.027	0.000	0.000	0.150	2.092
	0.570	0.000	0.004	0.000	0.000	0.129
EVAPOTRANSPIRATION (INCHES)	1.156	2.522	2.105	1.636	5.117	4.293
	5.600	1.237	4.434	0.512	0.348	0.803
LATERAL DRAINAGE FROM LAYER 1 (INCHES)	0.0176	0.0157	0.0062	0.0009	0.0099	0.0098
	0.0046	0.0000	0.0050	0.0000	0.0000	0.0077
PERCOLATION FROM LAYER 2 (INCHES)	0.0119	0.0107	0.0111	0.0037	0.0112	0.0061
	0.0056	0.0000	0.0065	0.0000	0.0000	0.0065
PERCOLATION FROM LAYER 4 (INCHES)	0.0119	0.0107	0.0111	0.0037	0.0113	0.0060
	0.0058	0.0001	0.0063	0.0000	0.0000	0.0064

MONTHLY SUMMARIES FOR DAILY HEADS

AVG. DAILY HEAD ON LAYER 2 (INCHES)	3.76	3.75	1.52	0.23	2.22	2.18
	1.00	0.00	1.16	0.00	0.00	1.59
STD. DEV. OF DAILY HEAD ON LAYER 2 (INCHES)	1.72	1.30	0.83	0.44	1.71	2.37
	1.75	0.00	1.59	0.00	0.00	2.44
AVG. DAILY HEAD ON LAYER 4 (INCHES)	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00
STD. DEV. OF DAILY HEAD ON LAYER 4 (INCHES)	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00

ANNUAL TOTALS FOR YEAR 6

	(INCHES)	(CU. FT.)	PERCENT
PRECIPITATION	35.25	1680250.	100.00

RUNOFF	4.253	202711.	12.06
EVAPOTRANSPIRATION	29.762	1418678.	84.43
LATERAL DRAINAGE FROM LAYER 1	0.0774	3687.	0.22
PERCOLATION FROM LAYER 2	0.0732	3488.	0.21
PERCOLATION FROM LAYER 4	0.0732	3488.	0.21
CHANGE IN WATER STORAGE	1.084	51686.	3.08
SOIL WATER AT START OF YEAR	33.32	1588119.	
SOIL WATER AT END OF YEAR	34.40	1639805.	
SNOW WATER AT START OF YEAR	0.00	0.	
SNOW WATER AT END OF YEAR	0.00	0.	
ANNUAL WATER BUDGET BALANCE	0.00	0.	0.00

MONTHLY TOTALS FOR YEAR 7

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION (INCHES)	0.33 5.63	1.66 0.52	0.33 3.82	3.10 3.64	8.75 1.49	1.81 1.12
RUNOFF (INCHES)	0.000 0.112	0.000 0.000	0.000 0.000	0.603 0.000	2.127 0.000	0.000 0.000
EVAPOTRANSPIRATION (INCHES)	1.614 4.347	1.635 1.659	0.788 3.225	1.309 3.552	6.340 1.955	3.378 1.086
LATERAL DRAINAGE FROM LAYER 1 (INCHES)	0.0137 0.0054	0.0050 0.0009	0.0030 0.0018	0.0035 0.0059	0.0208 0.0034	0.0013 0.0001

PERCOLATION FROM LAYER 2 (INCHES)	0.0117	0.0099	0.0106	0.0022	0.0121	0.0018
	0.0054	0.0018	0.0028	0.0091	0.0105	0.0007
PERCOLATION FROM LAYER 4 (INCHES)	0.0117	0.0099	0.0107	0.0022	0.0121	0.0022
	0.0051	0.0021	0.0028	0.0088	0.0105	0.0010

 MONTHLY SUMMARIES FOR DAILY HEADS

AVG. DAILY HEAD ON LAYER 2 (INCHES)	3.11	1.34	0.70	0.79	4.32	0.30
	1.29	0.20	0.47	1.49	0.83	0.01
STD. DEV. OF DAILY HEAD ON LAYER 2 (INCHES)	1.18	0.32	0.35	1.79	1.61	0.83
	1.63	0.55	0.92	1.10	0.27	0.05
AVG. DAILY HEAD ON LAYER 4 (INCHES)	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00
STD. DEV. OF DAILY HEAD ON LAYER 4 (INCHES)	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00

ANNUAL TOTALS FOR YEAR 7

	(INCHES)	(CU. FT.)	PERCENT
PRECIPITATION	32.20	1534867.	100.00
RUNOFF	2 842	135447.	8.82
EVAPOTRANSPIRATION	30.889	1472355.	95.93
LATERAL DRAINAGE FROM LAYER 1	0.0648	3089.	0.20
PERCOLATION FROM LAYER 2	0.0786	3746.	0.24
PERCOLATION FROM LAYER 4	0.0789	3763.	0.25
CHANGE IN WATER STORAGE	-1.674	-79788.	-5.20

SOIL WATER AT START OF YEAR	34.40	1639805.	
SOIL WATER AT END OF YEAR	32.73	1560017.	
SNOW WATER AT START OF YEAR	0.00	0.	
SNOW WATER AT END OF YEAR	0.00	0.	
ANNUAL WATER BUDGET BALANCE	0.00	0.	0.00

MONTHLY TOTALS FOR YEAR 8

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION (INCHES)	0.61 1.65	1.98 2.07	0.99 3.79	3.61 4.98	11.03 1.29	1.21 1.00
RUNOFF (INCHES)	0.000 0.000	0.000 0.000	0.000 0.000	0.080 0.386	4.740 0.018	0.000 0.000
EVAPOTRANSPIRATION (INCHES)	0.649 1.677	1.402 2.040	1.013 3.526	2.239 2.988	6.370 2.455	3.097 0.744
LATERAL DRAINAGE FROM LAYER 1 (INCHES)	0.0000 0.0003	0.0007 0.0000	0.0010 0.0023	0.0031 0.0107	0.0149 0.0149	0.0021 0.0038
PERCOLATION FROM LAYER 2 (INCHES)	0.0000 0.0011	0.0028 0.0000	0.0042 0.0035	0.0098 0.0085	0.0117 0.0114	0.0020 0.0109
PERCOLATION FROM LAYER 4 (INCHES)	0.0000 0.0012	0.0025 0.0000	0.0045 0.0031	0.0095 0.0085	0.0117 0.0114	0.0023 0.0109

MONTHLY SUMMARIES FOR DAILY HEADS

AVG. DAILY HEAD ON LAYER 2 (INCHES)	0.00	0.19	0.23	0.79	3.28	0.45
	0.07	0.00	0.61	2.39	3.37	0.90
STD. DEV. OF DAILY HEAD ON LAYER 2 (INCHES)	0.00	0.32	0.34	1.05	1.64	1.13
	0.20	0.00	1.01	1.96	1.37	0.18
AVG. DAILY HEAD ON LAYER 4 (INCHES)	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00
STD. DEV. OF DAILY HEAD ON LAYER 4 (INCHES)	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00

ANNUAL TOTALS FOR YEAR 8

	(INCHES)	(CU. FT.)	PERCENT
PRECIPITATION	34.21	1630676.	100.00
RUNOFF	5.225	249059.	15.27
EVAPOTRANSPIRATION	28.201	1344234.	82.43
LATERAL DRAINAGE FROM LAYER 1	0.0537	2560.	0.16
PERCOLATION FROM LAYER 2	0.0659	3142.	0.19
PERCOLATION FROM LAYER 4	0.0656	3126.	0.19
CHANGE IN WATER STORAGE	0.665	31697.	1.94
SOIL WATER AT START OF YEAR	32.73	1560017.	
SOIL WATER AT END OF YEAR	33.39	1591715.	
SNOW WATER AT START OF YEAR	0.00	0.	
SNOW WATER AT END OF YEAR	0.00	0.	
ANNUAL WATER BUDGET BALANCE	0.00	0.	0.00

MONTHLY TOTALS FOR YEAR 9

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION (INCHES)	1.58 2.57	0.14 0.88	0.92 3.60	5.90 6.18	4.19 1.26	1.30 3.29
RUNOFF (INCHES)	0.000 0.000	0.000 0.000	0.000 0.000	0.035 1.510	0.539 0.000	0.000 0.617
EVAPOTRANSPIRATION (INCHES)	0.711 3.605	1.655 0.989	0.583 2.177	5.078 3.840	4.720 2.633	0.367 1.456
LATERAL DRAINAGE FROM LAYER 1 (INCHES)	0.0058 0.0007	0.0071 0.0000	0.0001 0.0022	0.0125 0.0192	0.0067 0.0154	0.0000 0.0116
PERCOLATION FROM LAYER 2 (INCHES)	0.0110 0.0026	0.0101 0.0000	0.0012 0.0042	0.0106 0.0120	0.0082 0.0115	0.0002 0.0115
PERCOLATION FROM LAYER 4 (INCHES)	0.0110 0.0027	0.0101 0.0000	0.0014 0.0039	0.0104 0.0120	0.0083 0.0115	0.0003 0.0115

MONTHLY SUMMARIES FOR DAILY HEADS

AVG. DAILY HEAD ON LAYER 2 (INCHES)	1.47 0.19	1.86 0.00	0.02 0.58	2.90 4.15	1.51 3.70	0.00 2.83
STD. DEV. OF DAILY HEAD ON LAYER 2 (INCHES)	0.94 0.38	1.16 0.00	0.06 1.18	1.63 1.02	1.65 0.99	0.02 1.25
AVG. DAILY HEAD ON LAYER 4 (INCHES)	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00
STD. DEV. OF DAILY HEAD ON LAYER 4 (INCHES)	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00

 ANNUAL TOTALS FOR YEAR 9

	(INCHES)	(CU. FT.)	PERCENT
PRECIPITATION	31.81	1516277.	100.00
RUNOFF	2.701	128770.	8.49
EVAPOTRANSPIRATION	27.814	1325819.	87.44
LATERAL DRAINAGE FROM LAYER 1	0.0813	3878.	0.26
PERCOLATION FROM LAYER 2	0.0831	3962.	0.26
PERCOLATION FROM LAYER 4	0.0831	3962.	0.26
CHANGE IN WATER STORAGE	1.130	53849.	3.55
SOIL WATER AT START OF YEAR	33.39	1591715.	
SOIL WATER AT END OF YEAR	34.52	1645563.	
SNOW WATER AT START OF YEAR	0.00	0.	
SNOW WATER AT END OF YEAR	0.00	0.	
ANNUAL WATER BUDGET BALANCE	0.00	0.	0.00

 MONTHLY TOTALS FOR YEAR 10

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION (INCHES)	2.09 4.97	2.12 4.76	2.21 6.30	2.96 4.89	3.32 2.09	3.96 2.18

RUNOFF (INCHES)	0.424	0.000	0.000	0.000	0.000	0.000
	0.000	0.132	0.983	1.522	0.000	0.000
EVAPOTRANSPIRATION (INCHES)	1.741	2.156	2.849	3.382	3.130	3.948
	4.829	4.095	5.658	3.053	2.053	1.551
LATERAL DRAINAGE FROM LAYER 1 (INCHES)	0.0248	0.0152	0.0106	0.0064	0.0032	0.0018
	0.0010	0.0032	0.0150	0.0177	0.0143	0.0139
PERCOLATION FROM LAYER 2 (INCHES)	0.0123	0.0107	0.0114	0.0107	0.0065	0.0029
	0.0029	0.0036	0.0107	0.0119	0.0114	0.0117
PERCOLATION FROM LAYER 4 (INCHES)	0.0123	0.0107	0.0114	0.0107	0.0065	0.0029
	0.0029	0.0036	0.0107	0.0119	0.0114	0.0117

 MONTHLY SUMMARIES FOR DAILY HEADS

AVG. DAILY HEAD ON LAYER 2 (INCHES)	5.01	3.73	2.34	1.57	0.79	0.47
	0.24	0.71	3.34	3.91	3.55	3.32
STD. DEV. OF DAILY HEAD ON LAYER 2 (INCHES)	0.51	1.10	1.55	1.11	1.06	0.85
	0.51	1.54	1.87	1.32	0.49	1.02
AVG. DAILY HEAD ON LAYER 4 (INCHES)	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00
STD. DEV. OF DAILY HEAD ON LAYER 4 (INCHES)	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00

ANNUAL TOTALS FOR YEAR 10

	(INCHES)	(CU. FT.)	PERCENT
PRECIPITATION	41.85	1994850.	100.00
RUNOFF	3.061	145906.	7.31
EVAPOTRANSPIRATION	38.443	1832448.	91.86

LATERAL DRAINAGE FROM LAYER 1	0.1273	6057.	0.30
PERCOLATION FROM LAYER 2	0.1067	5088.	0.26
PERCOLATION FROM LAYER 4	0.1067	5088.	0.26
CHANGE IN WATER STORAGE	0.112	5342.	0.27
SOIL WATER AT START OF YEAR	34.52	1645563.	
SOIL WATER AT END OF YEAR	34.43	1641191.	
SNOW WATER AT START OF YEAR	0.00	0.	
SNOW WATER AT END OF YEAR	0.20	9715.	
ANNUAL WATER BUDGET BALANCE	0.00	-2.	0.00

AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1 THROUGH 10

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	1.61 3.51	1.40 2.19	1.69 4.80	3.03 3.15	5.00 1.74	3.96 1.82
STD. DEVIATIONS	0.94 1.69	0.77 1.81	1.70 1.71	1.62 1.97	2.97 1.11	2.23 0.95
RUNOFF						
TOTALS	0.221 0.126	0.090 0.046	0.167 0.627	0.128 0.500	0.986 0.347	0.376 0.182
STD. DEVIATIONS	0.408 0.212	0.198 0.094	0.528 1.133	0.241 0.691	1.513 0.707	0.799 0.368
EVAPOTRANSPIRATION						

TOTALS	1.266	1.753	1.638	2.515	4.222	4.090
	3.222	2.052	3.738	2.233	1.792	1.288
STD. DEVIATIONS	0.390	0.576	0.966	1.356	1.488	1.861
	1.613	1.293	1.244	1.239	0.795	0.386

LATERAL DRAINAGE FROM LAYER 1

TOTALS	0.0127	0.0094	0.0052	0.0050	0.0076	0.0039
	0.0017	0.0014	0.0067	0.0076	0.0116	0.0099
STD. DEVIATIONS	0.0090	0.0071	0.0047	0.0036	0.0063	0.0042
	0.0022	0.0023	0.0057	0.0066	0.0080	0.0062

PERCOLATION FROM LAYER 2

TOTALS	0.0098	0.0087	0.0083	0.0084	0.0082	0.0038
	0.0022	0.0014	0.0058	0.0065	0.0092	0.0099
STD. DEVIATIONS	0.0043	0.0039	0.0046	0.0035	0.0039	0.0028
	0.0022	0.0019	0.0034	0.0042	0.0046	0.0036

PERCOLATION FROM LAYER 4

TOTALS	0.0098	0.0086	0.0084	0.0083	0.0082	0.0039
	0.0022	0.0014	0.0057	0.0064	0.0091	0.0099
STD. DEVIATIONS	0.0043	0.0039	0.0046	0.0035	0.0039	0.0028
	0.0021	0.0019	0.0034	0.0043	0.0046	0.0035

AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1 THROUGH 10

	(INCHES)	(CU. FT.)	PERCENT

PRECIPITATION	33.91 (5.575)	1616424.	100.00
RUNOFF	3.796 (1.905)	180961.	11.20
EVAPOTRANSPIRATION	29.809 (4.721)	1420877.	87.90
LATERAL DRAINAGE FROM LAYER 1	0.0826 (0.0246)	3939.	0.24

PERCOLATION FROM LAYER 2	0.0821 (0.0170)	3912.	0.24
PERCOLATION FROM LAYER 4	0.0821 (0.0170)	3912.	0.24
CHANGE IN WATER STORAGE	0.141 (1.062)	6735.	0.42

PEAK DAILY VALUES FOR YEARS 1 THROUGH 10

	(INCHES)	(CU. FT.)
PRECIPITATION	3.45	164450.0
RUNOFF	3.160	150605.5
LATERAL DRAINAGE FROM LAYER 1	0.0010	47.5
PERCOLATION FROM LAYER 2	0.0004	19.5
HEAD ON LAYER 2	6.4	
PERCOLATION FROM LAYER 4	0.0004	19.5
HEAD ON LAYER 4	0.0	
SNOW WATER	1.31	62205.4
MAXIMUM VEG. SOIL WATER (VOL/VOL)	0.4730	
MINIMUM VEG. SOIL WATER (VOL/VOL)	0.0959	

FINAL WATER STORAGE AT END OF YEAR 10

LAYER	(INCHES)	(VOL/VOL)
1	2.54	0.4232
2	4.50	0.1500
3	21.99	0.1309
4	5.40	0.1500
SNOW WATER	0.20	

KERR-MCGEE REMEDIAL DESIGN CUSHING
CELL B (3 ft. liner)
03/21/94

FAIR GRASS

LAYER 1

LATERAL DRAINAGE LAYER

THICKNESS	=	6.00 INCHES
POROSITY	=	0.4730 VOL/VOL
FIELD CAPACITY	=	0.2217 VOL/VOL
WILTING POINT	=	0.1043 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.2217 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.001530000009 CM/SEC
SLOPE	=	3.00 PERCENT
DRAINAGE LENGTH	=	500.0 FEET

LAYER 2

BARRIER SOIL LINER

THICKNESS	=	30.00 INCHES
POROSITY	=	0.4000 VOL/VOL
FIELD CAPACITY	=	0.3560 VOL/VOL
WILTING POINT	=	0.2899 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.1500 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.000000010000 CM/SEC

LAYER 3

VERTICAL PERCOLATION LAYER

THICKNESS	=	176.40 INCHES
POROSITY	=	0.4570 VOL/VOL
FIELD CAPACITY	=	0.1309 VOL/VOL

WILTING POINT = 0.0580 VOL/VOL
INITIAL SOIL WATER CONTENT = 0.1309 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY = 0.008100000210 CM/SEC

LAYER 4

BARRIER SOIL LINER

THICKNESS = 36.00 INCHES
POROSITY = 0.4300 VOL/VOL
FIELD CAPACITY = 0.3660 VOL/VOL
WILTING POINT = 0.2800 VOL/VOL
INITIAL SOIL WATER CONTENT = 0.1500 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY = 0.000000100000 CM/SEC

GENERAL SIMULATION DATA

SCS RUNOFF CURVE NUMBER = 74.26
TOTAL AREA OF COVER = 400000. SQ FT
EVAPORATIVE ZONE DEPTH = 22.00 INCHES
UPPER LIMIT VEG. STORAGE = 2.8380 INCHES
INITIAL VEG. STORAGE = 1.3302 INCHES
INITIAL SNOW WATER CONTENT = 0.0000 INCHES
INITIAL TOTAL WATER STORAGE IN
SOIL AND WASTE LAYERS = 34.3210 INCHES

SOIL WATER CONTENT INITIALIZED BY USER.

CLIMATOLOGICAL DATA

SYNTHETIC RAINFALL WITH SYNTHETIC DAILY TEMPERATURES AND
SOLAR RADIATION FOR TULSA OKLAHOMA

MAXIMUM LEAF AREA INDEX = 2.00
START OF GROWING SEASON (JULIAN DATE) = 98
END OF GROWING SEASON (JULIAN DATE) = 307

LAYER 4 (INCHES)	0.00	0.00	0.00	0.00	0.00	0.00
STD. DEV. OF DAILY HEAD ON LAYER 4 (INCHES)	0.00	0.00	0.00	0.00	0.00	0.00

ANNUAL TOTALS FOR YEAR 1

	(INCHES)	(CU. FT.)	PERCENT
PRECIPITATION	32.52	1084000.	100.00
RUNOFF	2.111	70368.	6.49
EVAPOTRANSPIRATION	30.226	1007543.	92.95
LATERAL DRAINAGE FROM LAYER 1	0.0689	2295.	0.21
PERCOLATION FROM LAYER 2	0.0536	1786.	0.16
PERCOLATION FROM LAYER 4	0.0535	1784.	0.16
CHANGE IN WATER STORAGE	0.060	2009.	0.19
SOIL WATER AT START OF YEAR	34.32	1144032.	
SOIL WATER AT END OF YEAR	34.38	1146041.	
SNOW WATER AT START OF YEAR	0.00	0.	
SNOW WATER AT END OF YEAR	0.00	0.	
ANNUAL WATER BUDGET BALANCE	0.00	1.	0.00

MONTHLY TOTALS FOR YEAR 2

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION (INCHES)	2.58 4.55	2.25 2.93	0.88 6.52	1.74 2.49	5.12 1.86	7.39 1.87
RUNOFF (INCHES)	0.000 0.461	0.588 0.040	0.000 3.615	0.000 0.148	0.733 0.000	1.669 0.000
EVAPOTRANSPIRATION (INCHES)	1.388 4.083	2.257 0.669	1.358 4.156	1.726 1.210	3.359 2.211	7.510 1.903
LATERAL DRAINAGE FROM LAYER 1 (INCHES)	0.0139 0.0052	0.0249 0.0000	0.0082 0.0157	0.0052 0.0028	0.0088 0.0144	0.0156 0.0204
PERCOLATION FROM LAYER 2 (INCHES)	0.0115 0.0038	0.0110 0.0001	0.0111 0.0088	0.0106 0.0030	0.0103 0.0112	0.0102 0.0119
PERCOLATION FROM LAYER 4 (INCHES)	0.0115 0.0038	0.0110 0.0000	0.0111 0.0089	0.0106 0.0027	0.0103 0.0112	0.0105 0.0119

MONTHLY SUMMARIES FOR DAILY HEADS

AVG. DAILY HEAD ON LAYER 2 (INCHES)	2.76 0.97	4.78 0.00	1.61 2.91	1.08 0.55	1.62 2.90	2.95 3.95
STD. DEV. OF DAILY HEAD ON LAYER 2 (INCHES)	1.47 1.72	0.78 0.02	0.61 2.31	0.60 1.44	1.66 1.36	1.91 0.61
AVG. DAILY HEAD ON LAYER 4 (INCHES)	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00
STD. DEV. OF DAILY HEAD ON LAYER 4 (INCHES)	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00

ANNUAL TOTALS FOR YEAR 2

	(INCHES)	(CU. FT.)	PERCENT
PRECIPITATION	40.18	1339333.	100.00
RUNOFF	7.254	241807.	18.05
EVAPOTRANSPIRATION	31.831	1061019.	79.22
LATERAL DRAINAGE FROM LAYER 1	0.1354	4514.	0.34
PERCOLATION FROM LAYER 2	0.1036	3452.	0.26
PERCOLATION FROM LAYER 4	0.1035	3452.	0.26
CHANGE IN WATER STORAGE	0.856	28541.	2.13
SOIL WATER AT START OF YEAR	34.38	1146041.	
SOIL WATER AT END OF YEAR	35.24	1174581.	
SNOW WATER AT START OF YEAR	0.00	0.	
SNOW WATER AT END OF YEAR	0.00	0.	
ANNUAL WATER BUDGET BALANCE	0.00	0.	0.00

MONTHLY TOTALS FOR YEAR 3

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION (INCHES)	1.70 1.45	0.14 5.76	6.31 4.63	2.63 4.10	6.23 0.70	4.81 1.49
RUNOFF (INCHES)	0.108 0.000	0.000 0.287	1.665 1.083	0.000 1.425	1.570 0.081	0.000 0.000
EVAPOTRANSPIRATION (INCHES)	1.389 1.481	1.607 3.890	3.619 4.021	3.258 1.977	4.599 1.981	5.461 1.247

LATERAL DRAINAGE FROM LAYER 1 (INCHES)	0.0274	0.0124	0.0172	0.0070	0.0079	0.0029
	0.0000	0.0079	0.0092	0.0095	0.0144	0.0083
PERCOLATION FROM LAYER 2 (INCHES)	0.0122	0.0104	0.0117	0.0107	0.0111	0.0042
	0.0000	0.0052	0.0061	0.0063	0.0112	0.0112
PERCOLATION FROM LAYER 4 (INCHES)	0.0122	0.0104	0.0117	0.0107	0.0111	0.0043
	0.0000	0.0050	0.0061	0.0063	0.0112	0.0112

 MONTHLY SUMMARIES FOR DAILY HEADS

AVG. DAILY HEAD ON LAYER 2 (INCHES)	4.78	2.55	3.22	1.44	1.54	0.54
	0.00	1.50	1.79	1.70	2.77	1.77
STD. DEV. OF DAILY HEAD ON LAYER 2 (INCHES)	0.85	1.48	1.70	0.64	1.63	0.81
	0.00	1.99	2.06	2.24	1.53	0.74
AVG. DAILY HEAD ON LAYER 4 (INCHES)	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00
STD. DEV. OF DAILY HEAD ON LAYER 4 (INCHES)	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00

ANNUAL TOTALS FOR YEAR 3

	(INCHES)	(CU. FT.)	PERCENT
PRECIPITATION	39.95	1331666.	100.00
RUNOFF	6.218	207281.	15.57
EVAPOTRANSPIRATION	34.530	1150984.	86.43
LATERAL DRAINAGE FROM LAYER 1	0.1239	4131.	0.31
PERCOLATION FROM LAYER 2	0.1001	3337.	0.25
PERCOLATION FROM LAYER 4	0.1001	3337.	0.25

CHANGE IN WATER STORAGE	-1.022	-34067.	-2.56
SOIL WATER AT START OF YEAR	35.24	1174581.	
SOIL WATER AT END OF YEAR	34.22	1140515.	
SNOW WATER AT START OF YEAR	0.00	0.	
SNOW WATER AT END OF YEAR	0.00	0.	
ANNUAL WATER BUDGET BALANCE	0.00	0.	0.00

MONTHLY TOTALS FOR YEAR 4

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION (INCHES)	1.49 3.78	1.43 1.04	1.13 2.08	0.66 2.19	2.38 3.58	3.46 2.96
RUNOFF (INCHES)	0.000 0.115	0.000 0.000	0.000 0.000	0.000 0.009	0.000 1.772	0.000 1.070
EVAPOTRANSPIRATION (INCHES)	1.349 1.433	1.166 3.246	1.684 1.841	0.577 0.389	2.661 2.070	3.649 1.698
LATERAL DRAINAGE FROM LAYER 1 (INCHES)	0.0102 0.0003	0.0055 0.0039	0.0066 0.0000	0.0021 0.0007	0.0024 0.0238	0.0050 0.0243
PERCOLATION FROM LAYER 2 (INCHES)	0.0113 0.0003	0.0102 0.0031	0.0110 0.0000	0.0103 0.0004	0.0044 0.0117	0.0034 0.0121
PERCOLATION FROM LAYER 4 (INCHES)	0.0113 0.0002	0.0102 0.0033	0.0110 0.0000	0.0103 0.0003	0.0046 0.0117	0.0034 0.0121

MONTHLY SUMMARIES FOR DAILY HEADS

AVG. DAILY HEAD ON LAYER 2 (INCHES)	2.24	1.09	1.23	0.39	0.49	0.92
	0.09	0.70	0.00	0.18	4.45	4.41
STD. DEV. OF DAILY HEAD ON LAYER 2 (INCHES)	0.85	0.20	0.21	0.29	0.93	1.79
	0.50	1.49	0.00	0.97	0.98	0.92
AVG. DAILY HEAD ON LAYER 4 (INCHES)	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00
STD. DEV. OF DAILY HEAD ON LAYER 4 (INCHES)	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00

ANNUAL TOTALS FOR YEAR 4

	(INCHES)	(CU. FT.)	PERCENT
PRECIPITATION	26.18	872667.	100.00
RUNOFF	2.966	98866.	11.33
EVAPOTRANSPIRATION	21.761	725383.	83.12
LATERAL DRAINAGE FROM LAYER 1	0.0848	2827.	0.32
PERCOLATION FROM LAYER 2	0.0785	2615.	0.30
PERCOLATION FROM LAYER 4	0.0785	2615.	0.30
CHANGE IN WATER STORAGE	1.289	42977.	4.92
SOIL WATER AT START OF YEAR	34.22	1140515.	
SOIL WATER AT END OF YEAR	35.50	1183491.	
SNOW WATER AT START OF YEAR	0.00	0.	
SNOW WATER AT END OF YEAR	0.00	0.	
ANNUAL WATER BUDGET BALANCE	0.00	0.	0.00

ON LAYER 4 (INCHES) 0.00 0.00 0.00 0.00 0.00 0.00

ANNUAL TOTALS FOR YEAR 5

	(INCHES)	(CU. FT.)	PERCENT
PRECIPITATION	24.96	832000.	100.00
RUNOFF	1.280	42656.	5.13
EVAPOTRANSPIRATION	24.603	820086.	98.57
LATERAL DRAINAGE FROM LAYER 1	0.0890	2968.	0.36
PERCOLATION FROM LAYER 2	0.0776	2585.	0.31
PERCOLATION FROM LAYER 4	0.0776	2585.	0.31
CHANGE IN WATER STORAGE	-1.089	-36296.	-4.36
SOIL WATER AT START OF YEAR	35.50	1183491.	
SOIL WATER AT END OF YEAR	34.42	1147195.	
SNOW WATER AT START OF YEAR	0.00	0.	
SNOW WATER AT END OF YEAR	0.00	0.	
ANNUAL WATER BUDGET BALANCE	0.00	0.	0.00

MONTHLY TOTALS FOR YEAR 6

JAN/JUL FEB/AUG MAR/SEP APR/OCT MAY/NOV JUN/DEC

PRECIPITATION (INCHES)	3.36	1.72	1.48	2.06	4.72	6.93
	5.60	1.24	4.44	0.65	0.29	2.76
RUNOFF (INCHES)	1.278	0.025	0.000	0.000	0.146	2.091
	0.569	0.000	0.004	0.000	0.000	0.129
EVAPOTRANSPIRATION (INCHES)	1.156	2.522	2.105	1.636	5.117	4.291
	5.599	1.237	4.433	0.512	0.348	0.803
LATERAL DRAINAGE FROM LAYER 1 (INCHES)	0.0211	0.0185	0.0076	0.0011	0.0119	0.0116
	0.0055	0.0000	0.0060	0.0000	0.0000	0.0092
PERCOLATION FROM LAYER 2 (INCHES)	0.0119	0.0107	0.0111	0.0037	0.0112	0.0061
	0.0056	0.0000	0.0065	0.0000	0.0000	0.0065
PERCOLATION FROM LAYER 4 (INCHES)	0.0119	0.0107	0.0111	0.0037	0.0112	0.0060
	0.0058	0.0001	0.0063	0.0000	0.0000	0.0064

MONTHLY SUMMARIES FOR DAILY HEADS

AVG. DAILY HEAD ON LAYER 2 (INCHES)	3.76	3.75	1.52	0.23	2.21	2.18
	1.00	0.00	1.16	0.00	0.00	1.59
STD. DEV. OF DAILY HEAD ON LAYER 2 (INCHES)	1.72	1.30	0.83	0.43	1.71	2.37
	1.75	0.00	1.59	0.00	0.00	2.44
AVG. DAILY HEAD ON LAYER 4 (INCHES)	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00
STD. DEV. OF DAILY HEAD ON LAYER 4 (INCHES)	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00

ANNUAL TOTALS FOR YEAR 6

	(INCHES)	(CU. FT.)	PERCENT
PRECIPITATION	35.25	1175000.	100.00

RUNOFF	4.242	141401.	12.03
EVAPOTRANSPIRATION	29.758	991943.	84.42
LATERAL DRAINAGE FROM LAYER 1	0.0925	3083.	0.26
PERCOLATION FROM LAYER 2	0.0732	2439.	0.21
PERCOLATION FROM LAYER 4	0.0732	2439.	0.21
CHANGE IN WATER STORAGE	1.084	36134.	3.08
SOIL WATER AT START OF YEAR	34.42	1147195.	
SOIL WATER AT END OF YEAR	35.50	1183330.	
SNOW WATER AT START OF YEAR	0.00	0.	
SNOW WATER AT END OF YEAR	0.00	0.	
ANNUAL WATER BUDGET BALANCE	0.00	0.	0.00

MONTHLY TOTALS FOR YEAR 7

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION (INCHES)	0.33 5.63	1.66 0.52	0.33 3.82	3.10 3.64	8.75 1.49	1.81 1.12
RUNOFF (INCHES)	0.000 0.111	0.000 0.000	0.000 0.000	0.603 0.000	2.125 0.000	0.000 0.000
EVAPOTRANSPIRATION (INCHES)	1.614 4.347	1.635 1.658	0.788 3.225	1.303 3.552	6.338 1.955	3.377 1.085
LATERAL DRAINAGE FROM LAYER 1 (INCHES)	0.0163 0.0063	0.0064 0.0011	0.0038 0.0021	0.0042 0.0073	0.0248 0.0044	0.0016 0.0001

PERCOLATION FROM LAYER 2 (INCHES)	0.0116	0.0099	0.0106	0.0022	0.0121	0.0018
	0.0054	0.0018	0.0028	0.0091	0.0105	0.0007
PERCOLATION FROM LAYER 4 (INCHES)	0.0117	0.0099	0.0107	0.0021	0.0121	0.0022
	0.0051	0.0021	0.0028	0.0088	0.0105	0.0010

 MONTHLY SUMMARIES FOR DAILY HEADS

AVG. DAILY HEAD ON LAYER 2 (INCHES)	3.10	1.33	0.69	0.79	4.32	0.30
	1.29	0.20	0.47	1.49	0.82	0.01
STD. DEV. OF DAILY HEAD ON LAYER 2 (INCHES)	1.18	0.32	0.35	1.79	1.61	0.83
	1.63	0.55	0.92	1.09	0.27	0.04
AVG. DAILY HEAD ON LAYER 4 (INCHES)	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00
STD. DEV. OF DAILY HEAD ON LAYER 4 (INCHES)	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00

ANNUAL TOTALS FOR YEAR 7

	(INCHES)	(CU. FT.)	PERCENT
PRECIPITATION	32.20	1073333.	100.00
RUNOFF	2.839	94645.	8.82
EVAPOTRANSPIRATION	30.878	1029282.	95.90
LATERAL DRAINAGE FROM LAYER 1	0.0783	2609.	0.24
PERCOLATION FROM LAYER 2	0.0786	2619.	0.24
PERCOLATION FROM LAYER 4	0.0789	2631.	0.25
CHANGE IN WATER STORAGE	-1.675	-55833.	-5.20

SOIL WATER AT START OF YEAR	35.50	1183330.	
SOIL WATER AT END OF YEAR	33.82	1127496.	
SNOW WATER AT START OF YEAR	0.00	0.	
SNOW WATER AT END OF YEAR	0.00	0.	
ANNUAL WATER BUDGET BALANCE	0.00	0.	0.00

MONTHLY TOTALS FOR YEAR 8

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION (INCHES)	0.61 1.65	1.98 2.07	0.99 3.79	3.61 4.98	11.03 1.29	1.21 1.00
RUNOFF (INCHES)	0.000 0.000	0.000 0.000	0.000 0.000	0.079 0.386	4.738 0.017	0.000 0.000
EVAPOTRANSPIRATION (INCHES)	0.647 1.676	1.402 2.040	1.013 3.525	2.240 2.987	6.370 2.455	3.096 0.744
LATERAL DRAINAGE FROM LAYER 1 (INCHES)	0.0000 0.0003	0.0009 0.0000	0.0013 0.0027	0.0039 0.0125	0.0178 0.0179	0.0025 0.0049
PERCOLATION FROM LAYER 2 (INCHES)	0.0000 0.0011	0.0028 0.0000	0.0042 0.0035	0.0098 0.0085	0.0117 0.0114	0.0020 0.0109
PERCOLATION FROM LAYER 4 (INCHES)	0.0000 0.0012	0.0025 0.0000	0.0045 0.0031	0.0095 0.0085	0.0117 0.0114	0.0023 0.0109

MONTHLY SUMMARIES FOR DAILY HEADS

AVG. DAILY HEAD ON LAYER 2 (INCHES)	0.00	0.19	0.23	0.79	3.28	0.44
	0.07	0.00	0.61	2.39	3.37	0.89
STD. DEV. OF DAILY HEAD ON LAYER 2 (INCHES)	0.00	0.32	0.34	1.05	1.64	1.13
	0.20	0.00	1.01	1.96	1.37	0.19
AVG. DAILY HEAD ON LAYER 4 (INCHES)	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00
STD. DEV. OF DAILY HEAD ON LAYER 4 (INCHES)	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00

ANNUAL TOTALS FOR YEAR 8

	(INCHES)	(CU. FT.)	PERCENT
PRECIPITATION	34.21	1140333.	100.00
RUNOFF	5.220	173984.	15.26
EVAPOTRANSPIRATION	28.196	939861.	82.42
LATERAL DRAINAGE FROM LAYER 1	0.0647	2158.	0.19
PERCOLATION FROM LAYER 2	0.0659	2197.	0.19
PERCOLATION FROM LAYER 4	0.0656	2186.	0.19
CHANGE IN WATER STORAGE	0.664	22143.	1.94
SOIL WATER AT START OF YEAR	33.82	1127496.	
SOIL WATER AT END OF YEAR	34.49	1149640.	
SNOW WATER AT START OF YEAR	0.00	0.	
SNOW WATER AT END OF YEAR	0.00	0.	
ANNUAL WATER BUDGET BALANCE	0.00	0.	0.00

MONTHLY TOTALS FOR YEAR 9

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION (INCHES)	1.58 2.57	0.14 0.88	0.92 3.60	5.90 6.18	4.19 1.26	1.30 3.29
RUNOFF (INCHES)	0.000 0.000	0.000 0.000	0.000 0.000	0.029 1.506	0.538 0.000	0.000 0.613
EVAPOTRANSPIRATION (INCHES)	0.711 3.604	1.654 0.989	0.583 2.177	5.078 3.840	4.719 2.633	0.367 1.456
LATERAL DRAINAGE FROM LAYER 1 (INCHES)	0.0068 0.0010	0.0086 0.0000	0.0001 0.0027	0.0149 0.0224	0.0080 0.0180	0.0000 0.0138
PERCOLATION FROM LAYER 2 (INCHES)	0.0110 0.0026	0.0101 0.0000	0.0010 0.0042	0.0106 0.0120	0.0081 0.0115	0.0002 0.0115
PERCOLATION FROM LAYER 4 (INCHES)	0.0110 0.0027	0.0101 0.0000	0.0014 0.0039	0.0102 0.0120	0.0081 0.0115	0.0003 0.0115

MONTHLY SUMMARIES FOR DAILY HEADS

AVG. DAILY HEAD ON LAYER 2 (INCHES)	1.45 0.19	1.84 0.00	0.01 0.58	2.90 4.15	1.51 3.70	0.00 2.82
STD. DEV. OF DAILY HEAD ON LAYER 2 (INCHES)	0.94 0.38	1.16 0.00	0.05 1.18	1.64 1.02	1.65 0.99	0.02 1.26
AVG. DAILY HEAD ON LAYER 4 (INCHES)	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00
STD. DEV. OF DAILY HEAD ON LAYER 4 (INCHES)	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00

ANNUAL TOTALS FOR YEAR 9

	(INCHES)	(CU. FT.)	PERCENT
PRECIPITATION	31.81	1060333.	100.00
RUNOFF	2.686	89544.	8.44
EVAPOTRANSPIRATION	27.812	927080.	87.43
LATERAL DRAINAGE FROM LAYER 1	0.0964	3212.	0.30
PERCOLATION FROM LAYER 2	.0828	2759.	0.26
PERCOLATION FROM LAYER 4	0.0828	2758.	0.26
CHANGE IN WATER STORAGE	1.132	37739.	3.56
SOIL WATER AT START OF YEAR	34.49	1149640.	
SOIL WATER AT END OF YEAR	35.62	1187379.	
SNOW WATER AT START OF YEAR	0.00	0.	
SNOW WATER AT END OF YEAR	0.00	0.	
ANNUAL WATER BUDGET BALANCE	0.00	0.	0.00

MONTHLY TOTALS FOR YEAR 10

JAN/JUL FEB/AUG MAR/SEP APR/OCT MAY/NOV JUN/DEC

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION (INCHES)	2.09 4.97	2.12 4.76	2.21 6.30	2.96 4.89	3.32 2.09	3.96 2.18

RUNOFF (INCHES)	0.420	0.000	0.000	0.000	0.000	0.000
	0.000	0.132	0.981	1.519	0.000	0.000
EVAPOTRANSPIRATION (INCHES)	1.740	2.156	2.849	3.382	3.120	3.951
	4.828	4.095	5.658	3.054	2.053	1.550
LATERAL DRAINAGE FROM LAYER 1 (INCHES)	0.0295	0.0179	0.0129	0.0079	0.0040	0.0022
	0.0012	0.0039	0.0179	0.0210	0.0165	0.0164
PERCOLATION FROM LAYER 2 (INCHES)	0.0123	0.0107	0.0114	0.0107	0.0065	0.0029
	0.0029	0.0036	0.0107	0.0119	0.0114	0.0117
PERCOLATION FROM LAYER 4 (INCHES)	0.0123	0.0107	0.0114	0.0107	0.0065	0.0029
	0.0029	0.0036	0.0107	0.0119	0.0114	0.0117

 MONTHLY SUMMARIES FOR DAILY HEADS

AVG. DAILY HEAD ON LAYER 2 (INCHES)	5.01	3.72	2.33	1.56	0.79	0.47
	0.24	0.71	3.34	3.90	3.54	3.30
STD. DEV. OF DAILY HEAD ON LAYER 2 (INCHES)	0.51	1.10	1.55	1.11	1.06	0.85
	0.51	1.54	1.87	1.32	0.48	1.02
AVG. DAILY HEAD ON LAYER 4 (INCHES)	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00
STD. DEV. OF DAILY HEAD ON LAYER 4 (INCHES)	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00

ANNUAL TOTALS FOR YEAR 10

	(INCHES)	(CU. FT.)	PERCENT
PRECIPITATION	41.85	1395000.	100.00
RUNOFF	3.051	101707.	7.29
EVAPOTRANSPIRATION	38.436	1281188.	91.84

LATERAL DRAINAGE FROM LAYER 1	0.1513	5042.	0.36
PERCOLATION FROM LAYER 2	0.1067	3557.	0.25
PERCOLATION FROM LAYER 4	0.1067	3557.	0.25
CHANGE IN WATER STORAGE	0.105	3507.	0.25
SOIL WATER AT START OF YEAR	35.62	1187379.	
SOIL WATER AT END OF YEAR	35.52	1184092.	
SNOW WATER AT START OF YEAR	0.00	0.	
SNOW WATER AT END OF YEAR	0.20	6794.	
ANNUAL WATER BUDGET BALANCE	0.00	0.	0.00

AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1 THROUGH 10

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	1.61 3.51	1.40 2.19	1.69 4.80	3.03 3.15	5.00 1.74	3.96 1.82
STD. DEVIATIONS	0.94 1.69	0.77 1.81	1.70 1.71	1.62 1.97	2.97 1.11	2.23 0.95
RUNOFF						
TOTALS	0.219 0.126	0.089 0.046	0.166 0.626	0.127 0.499	0.985 0.346	0.376 0.181
STD. DEVIATIONS	0.407 0.212	0.196 0.094	0.526 1.133	0.240 0.690	1.512 0.706	0.799 0.367

EVAPOTRANSPIRATION

TOTALS	1.265	1.752	1.637	2.515	4.219	4.090
	3.222	2.052	3.738	2.232	1.792	1.288
STD. DEVIATIONS	0.390	0.576	0.966	1.357	1.490	1.861
	1.612	1.292	1.244	1.239	0.795	0.386

LATERAL DRAINAGE FROM LAYER 1

TOTALS	0.0150	0.0113	0.0064	0.0060	0.0091	0.0046
	0.0020	0.0017	0.0080	0.0090	0.0138	0.0116
STD. DEVIATIONS	0.0107	0.0083	0.0056	0.0043	0.0075	0.0050
	0.0026	0.0027	0.0067	0.0077	0.0094	0.0072

PERCOLATION FROM LAYER 2

TOTALS	0.0097	0.0087	0.0083	0.0084	0.0082	0.0038
	0.0022	0.0014	0.0058	0.0065	0.0092	0.0099
STD. DEVIATIONS	0.0043	0.0039	0.0047	0.0035	0.0039	0.0028
	0.0022	0.0019	0.0034	0.0042	0.0046	0.0036

PERCOLATION FROM LAYER 4

TOTALS	0.0098	0.0086	0.0084	0.0083	0.0082	0.0040
	0.0022	0.0014	0.0057	0.0064	0.0091	0.0099
STD. DEVIATIONS	0.0043	0.0039	0.0046	0.0035	0.0039	0.0028
	0.0021	0.0019	0.0034	0.0043	0.0046	0.0035

AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1 THROUGH 10

	(INCHES)		(CU. FT.)	PERCENT
PRECIPITATION	33.91	(5.675)	1130367.	100.00
RUNOFF	3.787	(1.904)	126226.	11.17
EVAPOTRANSPIRATION	29.803	(4.721)	993437.	87.89
LATERAL DRAINAGE FROM LAYER 1	0.0985	(0.0289)	3284.	0.29

PERCOLATION FROM LAYER 2	0.0820 (0.0170)	2735.	0.24
PERCOLATION FROM LAYER 4	0.0820 (0.0170)	2734.	0.24
CHANGE IN WATER STORAGE	0.141 (1.062)	4685.	0.41

PEAK DAILY VALUES FOR YEARS 1 THROUGH 10

	(INCHES)	(CU. FT.)
PRECIPITATION	3.45	115000.0
RUNOFF	3.159	105315.7
LATERAL DRAINAGE FROM LAYER 1	0.0012	39.8
PERCOLATION FROM LAYER 2	0.0004	13.7
HEAD ON LAYER 2	6.4	
PERCOLATION FROM LAYER 4	0.0004	13.6
HEAD ON LAYER 4	0.0	
SNOW WATER	1.31	43500.3
MAXIMUM VEG. SOIL WATER (VOL/VOL)	0.4730	
MINIMUM VEG. SOIL WATER (VOL/VOL)	0.0955	

FINAL WATER STORAGE AT END OF YEAR 10

LAYER	(INCHES)	(VOL/VOL)
1	2.53	0.4220
2	4.50	0.1500
3	23.09	0.1309
4	5.40	0.1500
SNOW WATER	0.20	

KERR-MCGEE REMEDIAL DESIGN CUSHING
CELL A (5 ft. liner)
02/08/94

FAIR GRASS

LAYER 1

LATERAL DRAINAGE LAYER

THICKNESS	=	6.00 INCHES
POROSITY	=	0.4730 VOL/VOL
FIELD CAPACITY	=	0.2217 VOL/VOL
WILTING POINT	=	0.1043 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.2217 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.001530000009 CM/SEC
SLOPE	=	3.00 PERCENT
DRAINAGE LENGTH	=	650.0 FEET

LAYER 2

BARRIER SOIL LINER

THICKNESS	=	30.00 INCHES
POROSITY	=	0.4000 VOL/VOL
FIELD CAPACITY	=	0.3560 VOL/VOL
WILTING POINT	=	0.2899 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.1500 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.000000010000 CM/SEC

LAYER 3

VERTICAL PERCOLATION LAYER

THICKNESS	=	168.00 INCHES
POROSITY	=	0.4570 VOL/VOL

FIELD CAPACITY	=	0.1309 VOL/VOL
WILTING POINT	=	0.0580 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.1309 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.008100000210 CM/SEC

LAYER 4

BARRIER SOIL LINER

THICKNESS	=	60.00 INCHES
POROSITY	=	0.4000 VOL/VOL
FIELD CAPACITY	=	0.3560 VOL/VOL
WILTING POINT	=	0.2899 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.3560 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.000000010000 CM/SEC

GENERAL SIMULATION DATA

SCS RUNOFF CURVE NUMBER	=	74.26
TOTAL AREA OF COVER	=	572000. SQ FT
EVAPORATIVE ZONE DEPTH	=	22.00 INCHES
UPPER LIMIT VEG. STORAGE	=	2.8380 INCHES
INITIAL VEG. STORAGE	=	1.3302 INCHES
INITIAL SNOW WATER CONTENT	=	0.0000 INCHES
INITIAL TOTAL WATER STORAGE IN SOIL AND WASTE LAYERS	=	49.1814 INCHES

SOIL WATER CONTENT INITIALIZED BY USER.

CLIMATOLOGICAL DATA

SYNTHETIC RAINFALL WITH SYNTHETIC DAILY TEMPERATURES AND
SOLAR RADIATION FOR TULSA OKLAHOMA

MAXIMUM LEAF AREA INDEX	=	2.00
START OF GROWING SEASON (JULIAN DATE)	=	98
END OF GROWING SEASON (JULIAN DATE)	=	307

NORMAL MEAN MONTHLY TEMPERATURES, DEGREES FAHRENHEIT

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
35.20	40.70	49.30	60.90	69.10	77.70
83.20	81.70	73.80	62.60	49.20	39.80

MONTHLY TOTALS FOR YEAR 1

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION (INCHES)	0.57 3.64	0.88 2.13	1.01 8.00	2.22 2.39	1.75 3.64	5.70 0.59
RUNOFF (INCHES)	0.000 0.000	0.000 0.000	0.000 0.521	0.000 0.000	0.000 1.598	0.000 0.000
EVAPOTRANSPIRATION (INCHES)	0.956 3.919	0.729 2.125	1.383 5.349	2.087 3.001	1.932 1.861	5.456 1.425
LATERAL DRAINAGE FROM LAYER 1 (INCHES)	0.0001 0.0001	0.0000 0.0000	0.0000 0.0146	0.0025 0.0066	0.0000 0.0235	0.0029 0.0079
PERCOLATION FROM LAYER 2 (INCHES)	0.0035 0.0006	0.0000 0.0000	0.0000 0.0104	0.0040 0.0072	0.0000 0.0119	0.0048 0.0112
PERCOLATION FROM LAYER 4 (INCHES)	0.0036 0.0007	0.0000 0.0000	0.0000 0.0092	0.0041 0.0083	0.0000 0.0102	0.0044 0.0105

MONTHLY SUMMARIES FOR DAILY HEADS

AVG. DAILY HEAD ON LAYER 2 (INCHES)	0.02 0.02	0.00 0.00	0.00 3.32	0.66 1.48	0.00 4.98	0.76 1.87
STD. DEV. OF DAILY HEAD ON LAYER 2 (INCHES)	0.03 0.06	0.00 0.00	0.00 1.76	1.10 1.63	0.00 0.77	0.95 1.14

AVG. DAILY HEAD ON	0.00	0.00	0.00	0.00	0.00	0.00
LAYER 4 (INCHES)	0.00	0.00	0.00	0.00	0.00	0.01
STD. DEV. OF DAILY HEAD	0.00	0.00	0.00	0.00	0.00	0.00
ON LAYER 4 (INCHES)	0.00	0.00	0.00	0.00	0.00	0.00

ANNUAL TOTALS FOR YEAR 1

	(INCHES)	(CU. FT.)	PERCENT
PRECIPITATION	32.52	1550120.	100.00
RUNOFF	2.119	100992.	6.52
EVAPOTRANSPIRATION	30.223	1440612.	92.94
LATERAL DRAINAGE FROM LAYER 1	0.0580	2767.	0.18
PERCOLATION FROM LAYER 2	0.0536	2554.	0.16
PERCOLATION FROM LAYER 4	0.0511	2436.	0.16
CHANGE IN WATER STORAGE	0.070	3314.	0.21
SOIL WATER AT START OF YEAR	49.18	2344313.	
SOIL WATER AT END OF YEAR	49.25	2347627.	
SNOW WATER AT START OF YEAR	0.00	0.	
SNOW WATER AT END OF YEAR	0.00	0.	
ANNUAL WATER BUDGET BALANCE	0.00	-1.	0.00

MONTHLY TOTALS FOR YEAR 2

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION (INCHES)	2.58 4.55	2.25 2.93	0.88 6.52	1.74 2.49	5.12 1.86	7.39 1.87
RUNOFF (INCHES)	0.000 0.462	0.603 0.040	0.000 3.616	0.000 0.148	0.733 0.000	1.671 0.000
EVAPOTRANSPIRATION (INCHES)	1.386 4.084	2.253 0.669	1.358 4.157	1.726 1.210	3.366 2.208	7.511 1.898
LATERAL DRAINAGE FROM LAYER 1 (INCHES)	0.0123 0.0044	0.0211 0.0000	0.0067 0.0132	0.0044 0.0023	0.0072 0.0122	0.0132 0.0175
PERCOLATION FROM LAYER 2 (INCHES)	0.0115 0.0038	0.0111 0.0001	0.0111 0.0088	0.0106 0.0030	0.0103 0.0112	0.0102 0.0119
PERCOLATION FROM LAYER 4 (INCHES)	0.0105 0.0098	0.0095 0.0000	0.0105 0.0089	0.0102 0.0025	0.0105 0.0102	0.0102 0.0105

MONTHLY SUMMARIES FOR DAILY HEADS

AVG. DAILY HEAD ON LAYER 2 (INCHES)	2.79 0.97	4.81 0.00	1.63 2.91	1.10 0.55	1.64 2.90	2.95 3.97
STD. DEV. OF DAILY HEAD ON LAYER 2 (INCHES)	1.48 1.72	0.78 0.02	0.60 2.31	0.60 1.44	1.65 1.36	1.91 0.61
AVG. DAILY HEAD ON LAYER 4 (INCHES)	0.01 0.01	0.01 0.00	0.02 0.00	0.02 0.00	0.02 0.00	0.02 0.01
STD. DEV. OF DAILY HEAD ON LAYER 4 (INCHES)	0.00 0.01	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00

ANNUAL TOTALS FOR YEAR 2

	(INCHES)	(CU. FT.)	PERCENT
PRECIPITATION	40.18	1915247.	100.00
RUNOFF	7.272	346655.	18.10
EVAPOTRANSPIRATION	31.826	1517060.	79.21
LATERAL DRAINAGE FROM LAYER 1	0.1146	5463.	0.29
PERCOLATION FROM LAYER 2	0.1036	4938.	0.26
PERCOLATION FROM LAYER 4	0.1035	4934.	0.26
CHANGE IN WATER STORAGE	0.863	41135.	2.15
SOIL WATER AT START OF YEAR	49.25	2347627.	
SOIL WATER AT END OF YEAR	50.11	2388762.	
SNOW WATER AT START OF YEAR	0.00	0.	
SNOW WATER AT END OF YEAR	0.00	0.	
ANNUAL WATER BUDGET BALANCE	0.00	0.	0.00

MONTHLY TOTALS FOR YEAR 3

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION (INCHES)	1.70 1.45	0.14 5.76	6.31 4.63	2.63 4.10	6.23 0.70	4.81 1.49
RUNOFF (INCHES)	0.126 0.000	0.000 0.286	1.674 1.084	0.000 1.426	1.576 0.082	0.000 0.000
EVAPOTRANSPIRATION	1.387	1.605	3.615	3.257	4.599	5.462

(INCHES)	1.481	3.891	4.022	1.978	1.980	1.246
LATERAL DRAINAGE FROM LAYER 1 (INCHES)	0.0231 0.0000	0.0104 0.0067	0.0145 0.0077	0.0056 0.0079	0.0066 0.0120	0.0022 0.0074
PERCOLATION FROM LAYER 2 (INCHES)	0.0122 0.0000	0.0104 0.0052	0.0117 0.0061	0.0107 0.0063	0.0111 0.0112	0.0042 0.0112
PERCOLATION FROM LAYER 4 (INCHES)	0.0105 0.0012	0.0095 0.0049	0.0105 0.0063	0.0102 0.0058	0.0105 0.0102	0.0102 0.0105

 MONTHLY SUMMARIES FOR DAILY HEADS

AVG. DAILY HEAD ON LAYER 2 (INCHES)	4.79 0.00	2.57 1.50	3.23 1.79	1.44 1.70	1.56 2.77	0.54 1.79
STD. DEV. OF DAILY HEAD ON LAYER 2 (INCHES)	0.85 0.00	1.47 1.99	1.69 2.06	0.64 2.24	1.62 1.53	0.81 0.74
AVG. DAILY HEAD ON LAYER 4 (INCHES)	0.01 0.00	0.01 0.00	0.02 0.00	0.02 0.00	0.02 0.00	0.02 0.01
STD. DEV. OF DAILY HEAD ON LAYER 4 (INCHES)	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	0.01 0.00

ANNUAL TOTALS FOR YEAR 3

	(INCHES)	(CU. FT.)	PERCENT
PRECIPITATION	39.95	1904283.	100.00
RUNOFF	6.253	298082.	15.65
EVAPOTRANSPIRATION	34.523	1645573.	86.41
LATERAL DRAINAGE FROM LAYER 1	0.1039	4955.	0.26
PERCOLATION FROM LAYER 2	0.1001	4773.	0.25

PERCOLATION FROM LAYER 4	0.1006	4795.	0.25
CHANGE IN WATER STORAGE	-1.031	-49122.	-2.58
SOIL WATER AT START OF YEAR	50.11	2388762.	
SOIL WATER AT END OF YEAR	49.08	2339640.	
SNOW WATER AT START OF YEAR	0.00	0.	
SNOW WATER AT END OF YEAR	0.00	0.	
ANNUAL WATER BUDGET BALANCE	0.00	0.	0.00

MONTHLY TOTALS FOR YEAR 4

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION (INCHES)	1.49 3.78	1.43 1.04	1.13 2.08	0.66 2.19	2.38 3.58	3.46 2.96
RUNOFF (INCHES)	0.000 0.113	0.000 0.000	0.000 0.000	0.000 0.009	0.000 1.781	0.000 1.076
EVAPOTRANSPIRATION (INCHES)	1.319 1.435	1.205 3.246	2.087 1.841	0.314 0.389	2.554 2.059	3.629 1.691
LATERAL DRAINAGE FROM LAYER 1 (INCHES)	0.0091 0.0002	0.0043 0.0033	0.0041 0.0000	0.0000 0.0006	0.0031 0.0202	0.0041 0.0206
PERCOLATION FROM LAYER 2 (INCHES)	0.0113 0.0003	0.0102 0.0031	0.0094 0.0000	0.0000 0.0004	0.0068 0.0117	0.0033 0.0121
PERCOLATION FROM LAYER 4 (INCHES)	0.0105 0.0002	0.0099 0.0032	0.0105 0.0000	0.0024 0.0003	0.0065 0.0102	0.0033 0.0105

MONTHLY SUMMARIES FOR DAILY HEADS

AVG. DAILY HEAD ON LAYER 2 (INCHES)	2.28	1.11	0.98	0.00	0.76	0.92
	0.09	0.70	0.00	0.18	4.46	4.42
STD. DEV. OF DAILY HEAD ON LAYER 2 (INCHES)	0.88	0.22	0.62	0.00	0.83	1.79
	0.50	1.49	0.00	0.97	0.98	0.91
AVG. DAILY HEAD ON LAYER 4 (INCHES)	0.01	0.01	0.01	0.00	0.00	0.00
	0.00 -	0.00	0.00	0.00	0.00	0.01
STD. DEV. OF DAILY HEAD ON LAYER 4 (INCHES)	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00

ANNUAL TOTALS FOR YEAR 4

	(INCHES)	(CU. FT.)	PERCENT
PRECIPITATION	26.18	1247913.	100.00
RUNOFF	2.979	142005.	11.38
EVAPOTRANSPIRATION	21.770	1037686.	83.15
LATERAL DRAINAGE FROM LAYER 1	0.0697	3322.	0.27
PERCOLATION FROM LAYER 2	0.0687	3276.	0.26
PERCOLATION FROM LAYER 4	0.0677	3225.	0.26
CHANGE IN WATER STORAGE	1.294	61676.	4.94
SOIL WATER AT START OF YEAR	49.08	2339640.	
SOIL WATER AT END OF YEAR	50.38	2401315.	
SNOW WATER AT START OF YEAR	0.00	0.	
SNOW WATER AT END OF YEAR	0.00	0.	
ANNUAL WATER BUDGET BALANCE	0.00	0.	0.00

MONTHLY TOTALS FOR YEAR 5

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION (INCHES)	1.79 1.30	1.72 0.52	1.62 4.85	5.47 0.00	2.49 1.24	3.03 0.93
RUNOFF (INCHES)	0.394 0.000	0.286 0.000	0.000 0.063	0.571 0.000	0.000 0.000	0.000 0.000
EVAPOTRANSPIRATION (INCHES)	1.696 1.247	2.391 0.572	0.995 2.995	3.858 1.805	3.980 0.352	3.738 0.962
LATERAL DRAINAGE FROM LAYER 1 (INCHES)	0.0210 0.0000	0.0151 0.0000	0.0047 0.0055	0.0092 0.0050	0.0045 0.0002	0.0015 0.0085
PERCOLATION FROM LAYER 2 (INCHES)	0.0121 0.0000	0.0107 0.0000	0.0109 0.0049	0.0109 0.0064	0.0067 0.0009	0.0027 0.0113
PERCOLATION FROM LAYER 4 (INCHES)	0.0105 0.0000	0.0095 0.0000	0.0105 0.0040	0.0102 0.0069	0.0105 0.0009	0.0062 0.0105

MONTHLY SUMMARIES FOR DAILY HEADS

AVG. DAILY HEAD ON LAYER 2 (INCHES)	4.47 0.00	3.59 0.00	1.13 1.33	2.12 1.12	1.03 0.05	0.38 2.07
STD. DEV. OF DAILY HEAD ON LAYER 2 (INCHES)	0.88 0.00	1.51 0.00	0.10 1.85	1.76 1.51	1.37 0.17	0.82 0.49
AVG. DAILY HEAD ON LAYER 4 (INCHES)	0.01 0.00	0.02 0.00	0.02 0.00	0.02 0.00	0.02 0.00	0.00 0.00

STD. DEV. OF DAILY HEAD	0.00	0.00	0.00	0.00	0.00	0.00
ON LAYER 4 (INCHES)	0.00	0.00	0.00	0.00	0.00	0.00

ANNUAL TOTALS FOR YEAR 5

	(INCHES)	(CU. FT.)	PERCENT
	-----	-----	-----
PRECIPITATION	24.96	1189760.	100.00
RUNOFF	1.314	62612.	5.26
EVAPOTRANSPIRATION	24.591	1172151.	98.52
LATERAL DRAINAGE FROM LAYER 1	0.0751	3579.	0.30
PERCOLATION FROM LAYER 2	0.0776	3698.	0.31
PERCOLATION FROM LAYER 4	0.0800	3812.	0.32
CHANGE IN WATER STORAGE	-1.099	-52395.	-4.40
SOIL WATER AT START OF YEAR	50.38	2401315.	
SOIL WATER AT END OF YEAR	49.28	2348920.	
SNOW WATER AT START OF YEAR	0.00	0.	
SNOW WATER AT END OF YEAR	0.00	0.	
ANNUAL WATER BUDGET BALANCE	0.00	1.	0.00

MONTHLY TOTALS FOR YEAR 6

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION (INCHES)	3.36 5.60	1.72 1.24	1.48 4.44	2.06 0.65	4.72 0.29	6.93 2.76
RUNOFF (INCHES)	1.281 0.570	0.028 0.000	0.000 0.004	0.000 0.000	0.153 0.000	2.092 0.129
EVAPOTRANSPIRATION (INCHES)	1.155 5.600	2.519 1.237	2.104 4.434	1.636 0.512	5.117 0.348	4.293 0.803
LATERAL DRAINAGE FROM LAYER 1 (INCHES)	0.0176 0.0046	0.0157 0.0000	0.0062 0.0050	0.0009 0.0000	0.0099 0.0000	0.0098 0.0077
PERCOLATION FROM LAYER 2 (INCHES)	0.0119 0.0056	0.0107 0.0000	0.0111 0.0065	0.0037 0.0000	0.0112 0.0000	0.0061 0.0065
PERCOLATION FROM LAYER 4 (INCHES)	0.0105 0.0063	0.0095 0.0000	0.0105 0.0068	0.0074 0.0000	0.0105 0.0000	0.0061 0.0056

MONTHLY SUMMARIES FOR DAILY HEADS

AVG. DAILY HEAD ON LAYER 2 (INCHES)	3.76 1.00	3.76 0.00	1.53 1.16	0.24 0.00	2.22 0.00	2.18 1.59
STD. DEV. OF DAILY HEAD ON LAYER 2 (INCHES)	1.72 1.75	1.30 0.00	0.83 1.59	0.44 0.00	1.70 0.00	2.37 2.44
AVG. DAILY HEAD ON LAYER 4 (INCHES)	0.00 0.00	0.01 0.00	0.01 0.00	0.00 0.00	0.00 0.00	0.00 0.00
STD. DEV. OF DAILY HEAD ON LAYER 4 (INCHES)	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00

ANNUAL TOTALS FOR YEAR 6

(INCHES) (CU. FT.) PERCENT

PRECIPITATION	35.25	1680250.	100.00
RUNOFF	4.257	202919.	12.08
EVAPOTRANSPIRATION	29.758	1418453.	84.42
LATERAL DRAINAGE FROM LAYER 1	0.0774	3691.	0.22
PERCOLATION FROM LAYER 2	0.0732	3488.	0.21
PERCOLATION FROM LAYER 4	0.0733	3494.	0.21
CHANGE IN WATER STORAGE	1.084	51693.	3.08
SOIL WATER AT START OF YEAR	49.28	2348920.	
SOIL WATER AT END OF YEAR	50.36	2400614.	
SNOW WATER AT START OF YEAR	0.00	0.	
SNOW WATER AT END OF YEAR	0.00	0.	
ANNUAL WATER BUDGET BALANCE	0.00	0.	0.00

MONTHLY TOTALS FOR YEAR 7

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION (INCHES)	0.33 5.63	1.66 0.52	0.33 3.82	3.10 3.64	8.75 1.49	1.81 1.12
RUNOFF (INCHES)	0.000 0.112	0.000 0.000	0.000 0.000	0.603 0.000	2.124 0.000	0.000 0.000
EVAPOTRANSPIRATION (INCHES)	1.612 4.347	1.635 1.659	0.788 3.226	1.313 3.552	6.343 1.952	3.378 1.086
LATERAL DRAINAGE FROM	0.0137	0.0050	0.0030	0.0035	0.0208	0.0013

LAYER 1 (INCHES)	0.0054	0.0009	0.0018	0.0059	0.0034	0.0001
PERCOLATION FROM LAYER 2 (INCHES)	0.0117	0.0100	0.0108	0.0022	0.0121	0.0018
PERCOLATION FROM LAYER 4 (INCHES)	0.0105	0.0095	0.0105	0.0043	0.0105	0.0040
	0.0054	0.0018	0.0028	0.0091	0.0105	0.0007
	0.0046	0.0026	0.0025	0.0086	0.0102	0.0015

 MONTHLY SUMMARIES FOR DAILY HEADS

AVG. DAILY HEAD ON LAYER 2 (INCHES)	3.11	1.35	0.71	0.79	4.32	0.30
STD. DEV. OF DAILY HEAD ON LAYER 2 (INCHES)	1.29	0.20	0.47	1.49	0.83	0.01
AVG. DAILY HEAD ON LAYER 4 (INCHES)	0.00	0.01	0.01	0.00	0.00	0.00
STD. DEV. OF DAILY HEAD ON LAYER 4 (INCHES)	0.00	0.00	0.00	0.00	0.00	0.00

ANNUAL TOTALS FOR YEAR 7

	(INCHES)	(CU. FT.)	PERCENT
PRECIPITATION	32.20	1534867.	100.00
RUNOFF	2.838	135286.	8.81
EVAPOTRANSPIRATION	30.889	1472390.	95.93
LATERAL DRAINAGE FROM LAYER 1	0.0649	3093.	0.20
PERCOLATION FROM LAYER 2	0.0788	3754.	0.24
PERCOLATION FROM LAYER 4	0.0794	3786.	0.25
CHANGE IN WATER STORAGE	-1.672	-79688.	-5.19

SOIL WATER AT START OF YEAR	50.36	2400614.	
SOIL WATER AT END OF YEAR	48.69	2320925.	
SNOW WATER AT START OF YEAR	0.00	0.	
SNOW WATER AT END OF YEAR	0.00	0.	
ANNUAL WATER BUDGET BALANCE	0.00	0.	0.00

MONTHLY TOTALS FOR YEAR 8

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION (INCHES)	0.61 1.65	1.98 2.07	0.99 3.79	3.61 4.98	11.03 1.29	1.21 1.00
RUNOFF (INCHES)	0.000 0.000	0.000 0.000	0.000 0.000	0.080 0.385	4.740 0.018	0.000 0.000
EVAPOTRANSPIRATION (INCHES)	0.652 1.677	1.402 2.040	1.013 3.526	2.239 2.988	6.370 2.453	3.097 0.744
LATERAL DRAINAGE FROM LAYER 1 (INCHES)	0.0000 0.0003	0.0007 0.0000	0.0010 0.0023	0.0031 0.0107	0.0149 0.0150	0.0021 0.0038
PERCOLATION FROM LAYER 2 (INCHES)	0.0000 0.0011	0.0028 0.0000	0.0042 0.0035	0.0098 0.0085	0.0117 0.0114	0.0020 0.0109
PERCOLATION FROM LAYER 4 (INCHES)	0.0000 0.0011	0.0027 0.0000	0.0043 0.0032	0.0095 0.0079	0.0105 0.0102	0.0035 0.0105

MONTHLY SUMMARIES FOR DAILY HEADS

AVG. DAILY HEAD ON LAYER 2 (INCHES)	0.00 0.07	0.19 0.00	0.23 0.61	0.79 2.39	3.28 3.38	0.45 0.91
STD. DEV. OF DAILY HEAD ON LAYER 2 (INCHES)	0.00 0.20	0.32 0.00	0.34 1.01	1.05 1.96	1.64 1.37	1.13 0.18
AVG. DAILY HEAD ON LAYER 4 (INCHES)	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.01
STD. DEV. OF DAILY HEAD ON LAYER 4 (INCHES)	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00

ANNUAL TOTALS FOR YEAR 8

	(INCHES)	(CU. FT.)	PERCENT
PRECIPITATION	34.21	1630676.	100.00
RUNOFF	5.224	249024.	15.27
EVAPOTRANSPIRATION	28.202	1344304.	82.44
LATERAL DRAINAGE FROM LAYER 1	0.0537	2562.	0.16
PERCOLATION FROM LAYER 2	0.0659	3143.	0.19
PERCOLATION FROM LAYER 4	0.0636	3030.	0.19
CHANGE IN WATER STORAGE	0.666	31756.	1.95
SOIL WATER AT START OF YEAR	48.69	2320925.	
SOIL WATER AT END OF YEAR	49.36	2352682.	
SNOW WATER AT START OF YEAR	0.00	0.	
SNOW WATER AT END OF YEAR	0.00	0.	
ANNUAL WATER BUDGET BALANCE	0.00	0.	0.00

 MONTHLY TOTALS FOR YEAR 9

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION (INCHES)	1.58 2.57	0.14 0.88	0.92 3.60	5.90 6.18	4.19 1.26	1.30 3.29
RUNOFF (INCHES)	0.000 0.000	0.000 0.000	0.000 0.000	0.038 1.510	0.541 0.000	0.000 0.621
EVAPOTRANSPIRATION (INCHES)	0.712 3.605	1.653 0.989	0.584 2.177	5.076 3.840	4.719 2.631	0.367 1.454
LATERAL DRAINAGE FROM LAYER 1 (INCHES)	0.0058 0.0007	0.0072 0.0000	0.0001 0.0022	0.0125 0.0192	0.0067 0.0154	0.0000 0.0117
PERCOLATION FROM LAYER 2 (INCHES)	0.0110 0.0026	0.0101 0.0000	0.0012 0.0042	0.0106 0.0120	0.0082 0.0115	0.0002 0.0115
PERCOLATION FROM LAYER 4 (INCHES)	0.0105 0.0024	0.0095 0.0000	0.0047 0.0039	0.0095 0.0105	0.0092 0.0102	0.0004 0.0105

 MONTHLY SUMMARIES FOR DAILY HEADS

AVG. DAILY HEAD ON LAYER 2 (INCHES)	1.48 0.19	1.86 0.00	0.02 0.58	2.90 4.15	1.51 3.70	0.00 2.84
STD. DEV. OF DAILY HEAD ON LAYER 2 (INCHES)	0.94 0.38	1.16 0.00	0.06 1.18	1.63 1.02	1.65 0.99	0.02 1.25
AVG. DAILY HEAD ON LAYER 4 (INCHES)	0.01 0.00	0.01 0.00	0.00 0.00	0.00 0.00	0.00 0.01	0.00 0.01
STD. DEV. OF DAILY HEAD ON LAYER 4 (INCHES)	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00

ANNUAL TOTALS FOR YEAR 9

	(INCHES)	(CU. FT.)	PERCENT
PRECIPITATION	31.81	1516277.	100.00
RUNOFF	2.710	129177.	8.52
EVAPOTRANSPIRATION	27.807	1325482.	87.42
LATERAL DRAINAGE FROM LAYER 1	0.0815	3883.	0.26
PERCOLATION FROM LAYER 2	0.0831	3962.	0.26
PERCOLATION FROM LAYER 4	0.0815	3886.	0.26
CHANGE IN WATER STORAGE	1.130	53849.	3.55
SOIL WATER AT START OF YEAR	49.36	2352682.	
SOIL WATER AT END OF YEAR	50.49	2406531.	
SNOW WATER AT START OF YEAR	0.00	0.	
SNOW WATER AT END OF YEAR	0.00	0.	
ANNUAL WATER BUDGET BALANCE	0.00	0.	0.00

MONTHLY TOTALS FOR YEAR 10

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION (INCHES)	2.09 4.97	2.12 4.76	2.21 6.30	2.96 4.89	3.32 2.09	3.96 2.18

RUNOFF (INCHES)	0.426	0.000	0.000	0.000	0.000	0.000
	0.000	0.132	0.983	1.523	0.000	0.000
EVAPOTRANSPIRATION (INCHES)	1.738	2.153	2.846	3.381	3.139	3.945
	4.830	4.095	5.657	3.052	2.050	1.546
LATERAL DRAINAGE FROM LAYER 1 (INCHES)	0.0248	0.0152	0.0107	0.0065	0.0033	0.0018
	0.0010	0.0032	0.0150	0.0178	0.0143	0.0140
PERCOLATION FROM LAYER 2 (INCHES)	0.0123	0.0107	0.0114	0.0107	0.0065	0.0029
	0.0029	0.0036	0.0107	0.0119	0.0114	0.0117
PERCOLATION FROM LAYER 4 (INCHES)	0.0105	0.0095	0.0105	0.0102	0.0105	0.0069
	0.0030	0.0035	0.0102	0.0105	0.0102	0.0105

 MONTHLY SUMMARIES FOR DAILY HEADS

AVG. DAILY HEAD ON LAYER 2 (INCHES)	5.02	3.73	2.36	1.58	0.80	0.47
	0.24	0.71	3.34	3.91	3.55	3.34
STD. DEV. OF DAILY HEAD ON LAYER 2 (INCHES)	0.51	1.10	1.55	1.11	1.06	0.85
	0.51	1.54	1.87	1.32	0.49	1.03
AVG. DAILY HEAD ON LAYER 4 (INCHES)	0.01	0.02	0.02	0.02	0.02	0.00
	0.00	0.00	0.00	0.00	0.01	0.01
STD. DEV. OF DAILY HEAD ON LAYER 4 (INCHES)	0.00	0.00	0.00	0.00	0.01	0.00
	0.00	0.00	0.00	0.00	0.00	0.00

 ANNUAL TOTALS FOR YEAR 10

	(INCHES)	(CU. FT.)	PERCENT
PRECIPITATION	41.85	1994850.	100.00
RUNOFF	3.065	146077.	7.32
EVAPOTRANSPIRATION	38.431	1831879.	91.83

LATERAL DRAINAGE FROM LAYER 1	0.1276	6082.	0.30
PERCOLATION FROM LAYER 2	0.1068	5089.	0.26
PERCOLATION FROM LAYER 4	0.1062	5062.	0.25
CHANGE IN WATER STORAGE	0.121	5751.	0.29
SOIL WATER AT START OF YEAR	50.49	2406531.	
SOIL WATER AT END OF YEAR	50.40	2402567.	
SNOW WATER AT START OF YEAR	0.00	0.	
SNOW WATER AT END OF YEAR	0.20	9715.	
ANNUAL WATER BUDGET BALANCE	0.00	-1.	0.00

AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1 THROUGH 10

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	1.61 3.51	1.40 2.19	1.69 4.80	3.03 3.15	5.00 1.74	3.96 1.82
STD. DEVIATIONS	0.94 1.69	0.77 1.81	1.70 1.71	1.62 1.97	2.97 1.11	2.23 0.95
RUNOFF						
TOTALS	0.223 0.126	0.092 0.046	0.167 0.627	0.129 0.500	0.987 0.348	0.376 0.183
STD. DEVIATIONS	0.408 0.212	0.201 0.094	0.529 1.133	0.243 0.691	1.512 0.709	0.799 0.369

EVAPOTRANSPIRATION

TOTALS	1.261	1.755	1.677	2.489	4.212	4.088
	3.222	2.052	3.738	2.233	1.789	1.285
STD. DEVIATIONS	0.387	0.570	0.975	1.398	1.502	1.862
	1.612	1.293	1.243	1.239	0.794	0.384

LATERAL DRAINAGE FROM LAYER 1

TOTALS	0.0127	0.0095	0.0051	0.0048	0.0077	0.0039
	0.0017	0.0014	0.0067	0.0076	0.0116	0.0099
STD. DEVIATIONS	0.0090	0.0071	0.0047	0.0038	0.0062	0.0042
	0.0022	0.0023	0.0057	0.0066	0.0080	0.0062

PERCOLATION FROM LAYER 2

TOTALS	0.0098	0.0087	0.0082	0.0073	0.0085	0.0038
	0.0022	0.0014	0.0058	0.0065	0.0092	0.0099
STD. DEVIATIONS	0.0043	0.0039	0.0046	0.0043	0.0037	0.0028
	0.0022	0.0019	0.0034	0.0042	0.0046	0.0036

PERCOLATION FROM LAYER 4

TOTALS	0.0088	0.0079	0.0083	0.0078	0.0090	0.0055
	0.0029	0.0014	0.0055	0.0061	0.0082	0.0091
STD. DEVIATIONS	0.0038	0.0035	0.0039	0.0031	0.0034	0.0031
	0.0031	0.0019	0.0033	0.0039	0.0041	0.0031

AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1 THROUGH 10

	(INCHES)	(CU. FT.)	PERCENT
PRECIPITATION	33.91 (5.675)	1616424.	100.00
RUNOFF	3.803 (1.905)	181283.	11.22
EVAPOTRANSPIRATION	29.802 (4.719)	1420559.	87.88
LATERAL DRAINAGE FROM	0.0826 (0.0247)	3940.	0.24

LAYER 1

PERCOLATION FROM LAYER 2	0.0811 (0.0175)	3868.	0.24
PERCOLATION FROM LAYER 4	0.0807 (0.0181)	3846.	0.24
CHANGE IN WATER STORAGE	0.143 (1.064)	6797.	0.42

PEAK DAILY VALUES FOR YEARS 1 THROUGH 10

	(INCHES)	(CU. FT.)
PRECIPITATION	3.45	164450.0
RUNOFF	3.160	150602.9
LATERAL DRAINAGE FROM LAYER 1	0.0010	47.5
PERCOLATION FROM LAYER 2	0.0004	19.5
HEAD ON LAYER 2	6.4	
PERCOLATION FROM LAYER 4	0.0003	16.2
HEAD ON LAYER 4	0.0	
SNOW WATER	1.31	62205.4
MAXIMUM VEG. SOIL WATER (VOL/VOL)	0.4730	
MINIMUM VEG. SOIL WATER (VOL/VOL)	0.0963	

FINAL WATER STORAGE AT END OF YEAR 10

LAYER	(INCHES)	(VOL/VOL)
1	2.55	0.4246
2	4.50	0.1500
3	22.00	0.1309
4	21.36	0.3560
SNOW WATER	0.20	

KERR-MCGEE REMEDIAL DESIGN CUSHING
CELL B (5 ft. liner)
02/08/94

FAIR GRASS

LAYER 1

LATERAL DRAINAGE LAYER

THICKNESS	=	6.00 INCHES
POROSITY	=	0.4730 VOL/VOL
FIELD CAPACITY	=	0.2217 VOL/VOL
WILTING POINT	=	0.1043 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.2217 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.001530000009 CM/SEC
SLOPE	=	3.00 PERCENT
DRAINAGE LENGTH	=	500.0 FEET

LAYER 2

BARRIER SOIL LINER

THICKNESS	=	30.00 INCHES
POROSITY	=	0.4000 VOL/VOL
FIELD CAPACITY	=	0.3560 VOL/VOL
WILTING POINT	=	0.2899 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.1500 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.000000010000 CM/SEC

LAYER 3

VERTICAL PERCOLATION LAYER

THICKNESS	=	176.40 INCHES
POROSITY	=	0.4570 VOL/VOL

FIELD CAPACITY	=	0.1309 VOL/VOL
WILTING POINT	=	0.0580 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.1309 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.008100000210 CM/SEC

LAYER 4

BARRIER SOIL LINER

THICKNESS	=	60.00 INCHES
POROSITY	=	0.4000 VOL/VOL
FIELD CAPACITY	=	0.3560 VOL/VOL
WILTING POINT	=	0.2899 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.3560 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.000000010000 CM/SEC

GENERAL SIMULATION DATA

SCS RUNOFF CURVE NUMBER	=	74.26
TOTAL AREA OF COVER	=	400000. SQ FT
EVAPORATIVE ZONE DEPTH	=	22.00 INCHES
UPPER LIMIT VEG. STORAGE	=	2.8380 INCHES
INITIAL VEG. STORAGE	=	1.3302 INCHES
INITIAL SNOW WATER CONTENT	=	0.0000 INCHES
INITIAL TOTAL WATER STORAGE IN SOIL AND WASTE LAYERS	=	50.2810 INCHES

SOIL WATER CONTENT INITIALIZED BY USER.

CLIMATOLOGICAL DATA

SYNTHETIC RAINFALL WITH SYNTHETIC DAILY TEMPERATURES AND
 SOLAR RADIATION FOR TULSA OKLAHOMA

MAXIMUM LEAF AREA INDEX	=	2.00
START OF GROWING SEASON (JULIAN DATE)	=	98
END OF GROWING SEASON (JULIAN DATE)	=	307

NORMAL MEAN MONTHLY TEMPERATURES, DEGREES FAHRENHEIT

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
35.20	40.70	49.30	60.90	69.10	77.70
83.20	81.70	73.80	62.60	49.20	39.80

MONTHLY TOTALS FOR YEAR 1

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION (INCHES)	0.57 3.64	0.88 2.13	1.01 8.00	2.22 2.39	1.75 3.64	5.70 0.59
RUNOFF (INCHES)	0.000 0.000	0.000 0.000	0.000 0.518	0.000 0.000	0.000 1.593	0.000 0.000
EVAPOTRANSPIRATION (INCHES)	0.956 3.919	0.729 2.125	1.383 5.348	2.087 3.001	1.932 1.861	5.456 1.425
LATERAL DRAINAGE FROM LAYER 1 (INCHES)	0.0001 0.0001	0.0000 0.0000	0.0000 0.0173	0.0029 0.0078	0.0000 0.0279	0.0033 0.0096
PERCOLATION FROM LAYER 2 (INCHES)	0.0035 0.0006	0.0000 0.0000	0.0000 0.0103	0.0040 0.0072	0.0000 0.0119	0.0048 0.0112
PERCOLATION FROM LAYER 4 (INCHES)	0.0036 0.0007	0.0000 0.0000	0.0000 0.0092	0.0041 0.0083	0.0000 0.0102	0.0044 0.0105

MONTHLY SUMMARIES FOR DAILY HEADS

AVG. DAILY HEAD ON LAYER 2 (INCHES)	0.02 0.02	0.00 0.00	0.00 3.32	0.66 1.48	0.00 4.98	0.76 1.87
STD. DEV. OF DAILY HEAD ON LAYER 2 (INCHES)	0.03 0.05	0.00 0.00	0.00 1.76	1.10 1.63	0.00 0.77	0.95 1.14

AVG. DAILY HEAD ON	0.00	0.00	0.00	0.00	0.00	0.00
LAYER 4 (INCHES)	0.00	0.00	0.00	0.00	0.00	0.01
STD. DEV. OF DAILY HEAD	0.00	0.00	0.00	0.00	0.00	0.00
ON LAYER 4 (INCHES)	0.00	0.00	0.00	0.00	0.00	0.00

ANNUAL TOTALS FOR YEAR 1

	(INCHES)	(CU. FT.)	PERCENT
	-----	-----	-----
PRECIPITATION	32.52	1084000.	100.00
RUNOFF	2.112	70392.	6.49
EVAPOTRANSPIRATION	30.222	1007390.	92.93
LATERAL DRAINAGE FROM LAYER 1	0.0689	2297.	0.21
PERCOLATION FROM LAYER 2	0.0536	1786.	0.16
PERCOLATION FROM LAYER 4	0.0511	1704.	0.16
CHANGE IN WATER STORAGE	0.067	2217.	0.20
SOIL WATER AT START OF YEAR	50.28	1676032.	
SOIL WATER AT END OF YEAR	50.35	1678249.	
SNOW WATER AT START OF YEAR	0.00	0.	
SNOW WATER AT END OF YEAR	0.00	0.	
ANNUAL WATER BUDGET BALANCE	0.00	0.	0.00

MONTHLY TOTALS FOR YEAR 2

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION (INCHES)	2.58 4.55	2.25 2.93	0.88 6.52	1.74 2.49	5.12 1.86	7.39 1.87
RUNOFF (INCHES)	0.000 0.461	0.596 0.040	0.000 3.615	0.000 0.148	0.733 0.000	1.669 0.000
EVAPOTRANSPIRATION (INCHES)	1.386 4.083	2.253 0.669	1.358 4.156	1.726 1.210	3.361 2.208	7.510 1.898
LATERAL DRAINAGE FROM LAYER 1 (INCHES)	0.0140 0.0052	0.0250 0.0000	0.0082 0.0157	0.0055 0.0028	0.0088 0.0144	0.0156 0.0206
PERCOLATION FROM LAYER 2 (INCHES)	0.0115 0.0038	0.0111 0.0001	0.0111 0.0088	0.0106 0.0030	0.0103 0.0112	0.0102 0.0119
PERCOLATION FROM LAYER 4 (INCHES)	0.0105 0.0097	0.0095 0.0000	0.0105 0.0089	0.0102 0.0025	0.0105 0.0102	0.0102 0.0105

MONTHLY SUMMARIES FOR DAILY HEADS

AVG. DAILY HEAD ON LAYER 2 (INCHES)	2.78 0.97	4.80 0.00	1.62 2.91	1.09 0.55	1.63 2.90	2.95 3.96
STD. DEV. OF DAILY HEAD ON LAYER 2 (INCHES)	1.47 1.72	0.78 0.02	0.61 2.31	0.60 1.44	1.66 1.36	1.91 0.61
AVG. DAILY HEAD ON LAYER 4 (INCHES)	0.01 0.01	0.01 0.00	0.02 0.00	0.02 0.00	0.02 0.00	0.02 0.01
STD. DEV. OF DAILY HEAD ON LAYER 4 (INCHES)	0.00 0.01	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00

ANNUAL TOTALS FOR YEAR 2

	(INCHES)	(CU. FT.)	PERCENT
PRECIPITATION	40.18	1339333.	100.00
RUNOFF	7.262	242058.	18.07
EVAPOTRANSPIRATION	31.819	1060628.	79.19
LATERAL DRAINAGE FROM LAYER 1	0.1359	4528.	0.34
PERCOLATION FROM LAYER 2	0.1036	3453.	0.26
PERCOLATION FROM LAYER 4	0.1035	3450.	0.26
CHANGE IN WATER STORAGE	0.860	28669.	2.14
SOIL WATER AT START OF YEAR	50.35	1678249.	
SOIL WATER AT END OF YEAR	51.21	1706918.	
SNOW WATER AT START OF YEAR	0.00	0.	
SNOW WATER AT END OF YEAR	0.00	0.	
ANNUAL WATER BUDGET BALANCE	0.00	0.	0.00

MONTHLY TOTALS FOR YEAR 3

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION (INCHES)	1.70 1.45	0.14 5.76	6.31 4.63	2.63 4.10	6.23 0.70	4.81 1.49
RUNOFF (INCHES)	0.117 0.000	0.000 0.286	1.669 1.083	0.000 1.425	1.573 0.081	0.000 0.000
EVAPOTRANSPIRATION	1.387	1.605	3.615	3.257	4.599	5.461

(INCHES)	1.481	3.890	4.021	1.977	1.980	1.246
LATERAL DRAINAGE FROM LAYER 1 (INCHES)	0.0274 0.0000	0.0124 0.0079	0.0172 0.0092	0.0070 0.0095	0.0079 0.0144	0.0029 0.0084
PERCOLATION FROM LAYER 2 (INCHES)	0.0122 0.0000	0.0104 0.0052	0.0117 0.0061	0.0107 0.0063	0.0111 0.0112	0.0042 0.0112
PERCOLATION FROM LAYER 4 (INCHES)	0.0105 0.0012	0.0095 0.0049	0.0105 0.0063	0.0102 0.0058	0.0105 0.0102	0.0102 0.0105

 MONTHLY SUMMARIES FOR DAILY HEADS

AVG. DAILY HEAD ON LAYER 2 (INCHES)	4.78 0.00	2.56 1.50	3.23 1.79	1.44 1.69	1.55 2.77	0.54 1.78
STD. DEV. OF DAILY HEAD ON LAYER 2 (INCHES)	0.85 0.00	1.48 1.99	1.70 2.06	0.64 2.24	1.63 1.53	0.81 0.74
AVG. DAILY HEAD ON LAYER 4 (INCHES)	0.01 0.00	0.01 0.00	0.02 0.00	0.02 0.00	0.02 0.00	0.02 0.01
STD. DEV. OF DAILY HEAD ON LAYER 4 (INCHES)	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	0.01 0.00

ANNUAL TOTALS FOR YEAR 3

	(INCHES)	(CU. FT.)	PERCENT
PRECIPITATION	39.95	1331666.	100.00
RUNOFF	6.234	207804.	15.60
EVAPOTRANSPIRATION	34.519	1150636.	86.41
LATERAL DRAINAGE FROM LAYER 1	0.1241	4136.	0.31
PERCOLATION FROM LAYER 2	0.1001	3337.	0.25

PERCOLATION FROM LAYER 4	0.1006	3352.	0.25
CHANGE IN WATER STORAGE	-1.028	-34261.	-2.57
SOIL WATER AT START OF YEAR	51.21	1706918.	
SOIL WATER AT END OF YEAR	50.18	1672656.	
SNOW WATER AT START OF YEAR	0.00	0.	
SNOW WATER AT END OF YEAR	0.00	0.	
ANNUAL WATER BUDGET BALANCE	0.00	0.	0.00

MONTHLY TOTALS FOR YEAR 4

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION (INCHES)	1.49 3.78	1.43 1.04	1.13 2.08	0.66 2.19	2.38 3.58	3.46 2.96
RUNOFF (INCHES)	0.000 0.113	0.000 0.000	0.000 0.000	0.000 0.009	0.000 1.779	0.000 1.074
EVAPOTRANSPIRATION (INCHES)	1.319 1.435	1.205 3.246	2.080 1.841	0.314 0.389	2.553 2.059	3.628 1.691
LATERAL DRAINAGE FROM LAYER 1 (INCHES)	0.0105 0.0003	0.0056 0.0039	0.0052 0.0000	0.0000 0.0007	0.0038 0.0238	0.0049 0.0244
PERCOLATION FROM LAYER 2 (INCHES)	0.0113 0.0003	0.0102 0.0031	0.0092 0.0000	0.0000 0.0004	0.0068 0.0117	0.0033 0.0121
PERCOLATION FROM LAYER 4 (INCHES)	0.0105 0.0002	0.0099 0.0032	0.0105 0.0000	0.0019 0.0003	0.0038 0.0102	0.0033 0.0105

MONTHLY SUMMARIES FOR DAILY HEADS

AVG. DAILY HEAD ON LAYER 2 (INCHES)	2.27	1.10	0.96	0.00	0.76	0.92
	0.09	0.70	0.00	0.18	4.46	4.42
STD. DEV. OF DAILY HEAD ON LAYER 2 (INCHES)	0.88	0.22	0.61	0.00	0.83	1.79
	0.50	1.49	0.00	0.97	0.98	0.91
AVG. DAILY HEAD ON LAYER 4 (INCHES)	0.01	0.01	0.01	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.01
STD. DEV. OF DAILY HEAD ON LAYER 4 (INCHES)	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00

ANNUAL TOTALS FOR YEAR 4

	(INCHES)	(CU. FT.)	PERCENT
PRECIPITATION	26.18	872667.	100.00
RUNOFF	2.975	99151.	11.36
EVAPOTRANSPIRATION	21.761	725353.	83.12
LATERAL DRAINAGE FROM LAYER 1	0.0832	2773.	0.32
PERCOLATION FROM LAYER 2	0.0685	2285.	0.26
PERCOLATION FROM LAYER 4	0.0675	2249.	0.26
CHANGE IN WATER STORAGE	1.294	43141.	4.94
SOIL WATER AT START OF YEAR	50.18	1672656.	
SOIL WATER AT END OF YEAR	51.47	1715797.	
SNOW WATER AT START OF YEAR	0.00	0.	
SNOW WATER AT END OF YEAR	0.00	0.	
ANNUAL WATER BUDGET BALANCE	0.00	0.	0.00

MONTHLY TOTALS FOR YEAR 5

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION (INCHES)	1.79 1.30	1.72 0.52	1.62 4.85	5.47 0.00	2.49 1.24	3.03 0.93
RUNOFF (INCHES)	0.390 0.000	0.283 0.000	0.000 0.062	0.565 0.000	0.000 0.000	0.000 0.000
EVAPOTRANSPIRATION (INCHES)	1.695 1.247	2.391 0.572	0.995 2.995	3.858 1.804	3.979 0.352	3.738 0.962
LATERAL DRAINAGE FROM LAYER 1 (INCHES)	0.0248 0.0000	0.0179 0.0000	0.0060 0.0065	0.0110 0.0060	0.0055 0.0002	0.0018 0.0095
PERCOLATION FROM LAYER 2 (INCHES)	0.0121 0.0000	0.0107 0.0000	0.0109 0.0049	0.0109 0.0064	0.0067 0.0009	0.0027 0.0113
PERCOLATION FROM LAYER 4 (INCHES)	0.0105 0.0000	0.0095 0.0000	0.0105 0.0041	0.0102 0.0069	0.0105 0.0009	0.0062 0.0105

MONTHLY SUMMARIES FOR DAILY HEADS

AVG. DAILY HEAD ON LAYER 2 (INCHES)	4.46 0.00	3.57 0.00	1.12 1.33	2.12 1.12	1.03 0.05	0.38 2.07
STD. DEV. OF DAILY HEAD ON LAYER 2 (INCHES)	0.88 0.00	1.51 0.00	0.10 1.85	1.76 1.51	1.37 0.17	0.82 0.48
AVG. DAILY HEAD ON LAYER 4 (INCHES)	0.01 0.00	0.02 0.00	0.02 0.00	0.02 0.00	0.02 0.00	0.00 0.00

STD. DEV. OF DAILY HEAD	0.00	0.00	0.00	0.00	0.00	0.00
ON LAYER 4 (INCHES)	0.00	0.00	0.00	0.00	0.00	0.00

ANNUAL TOTALS FOR YEAR 5

	(INCHES)	(CU. FT.)	PERCENT
PRECIPITATION	24.96	832000.	100.00
RUNOFF	1.300	43345.	5.21
EVAPOTRANSPIRATION	24.588	819584.	98.51
LATERAL DRAINAGE FROM LAYER 1	0.0893	2978.	0.36
PERCOLATION FROM LAYER 2	0.0776	2586.	0.31
PERCOLATION FROM LAYER 4	0.0800	2665.	0.32
CHANGE IN WATER STORAGE	-1.097	-36573.	-4.40
SOIL WATER AT START OF YEAR	51.47	1715797.	
SOIL WATER AT END OF YEAR	50.38	1679224.	
SNOW WATER AT START OF YEAR	0.00	0.	
SNOW WATER AT END OF YEAR	0.00	0.	
ANNUAL WATER BUDGET BALANCE	0.00	0.	0.00

MONTHLY TOTALS FOR YEAR 6

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION (INCHES)	3.36 5.60	1.72 1.24	1.48 4.44	2.06 0.65	4.72 0.29	6.93 2.76
RUNOFF (INCHES)	1.278 0.570	0.026 0.000	0.000 0.004	0.000 0.000	0.149 0.000	2.091 0.129
EVAPOTRANSPIRATION (INCHES)	1.155 5.599	2.519 1.237	2.104 4.433	1.636 0.512	5.117 0.348	4.291 0.803
LATERAL DRAINAGE FROM LAYER 1 (INCHES)	0.0211 0.0055	0.0185 0.0000	0.0076 0.0060	0.0012 0.0000	0.0119 0.0000	0.0116 0.0092
PERCOLATION FROM LAYER 2 (INCHES)	0.0119 0.0056	0.0107 0.0000	0.0111 0.0065	0.0037 0.0000	0.0112 0.0000	0.0061 0.0065
PERCOLATION FROM LAYER 4 (INCHES)	0.0105 0.0063	0.0095 0.0000	0.0105 0.0068	0.0074 0.0000	0.0105 0.0000	0.0061 0.0066

 MONTHLY SUMMARIES FOR DAILY HEADS

AVG. DAILY HEAD ON LAYER 2 (INCHES)	3.76 1.00	3.75 0.00	1.52 1.16	0.23 0.00	2.21 0.00	2.18 1.59
STD. DEV. OF DAILY HEAD ON LAYER 2 (INCHES)	1.72 1.75	1.30 0.00	0.83 1.59	0.44 0.00	1.71 0.00	2.37 2.44
AVG. DAILY HEAD ON LAYER 4 (INCHES)	0.00 0.00	0.01 0.00	0.01 0.00	0.00 0.00	0.00 0.00	0.00 0.00
STD. DEV. OF DAILY HEAD ON LAYER 4 (INCHES)	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00

ANNUAL TOTALS FOR YEAR 6

 (INCHES) (CU. FT.) PERCENT

PRECIPITATION	35.25	1175000.	100.00
RUNOFF	4.246	141537.	12.05
EVAPOTRANSPIRATION	29.754	991796.	84.41
LATERAL DRAINAGE FROM LAYER 1	0.0926	3086.	0.26
PERCOLATION FROM LAYER 2	0.0732	2439.	0.21
PERCOLATION FROM LAYER 4	0.0733	2443.	0.21
CHANGE IN WATER STORAGE	1.084	36139.	3.08
SOIL WATER AT START OF YEAR	50.38	1679224.	
SOIL WATER AT END OF YEAR	51.46	1715363.	
SNOW WATER AT START OF YEAR	0.00	0.	
SNOW WATER AT END OF YEAR	0.00	0.	
ANNUAL WATER BUDGET BALANCE	0.00	0.	0.00

MONTHLY TOTALS FOR YEAR 7

JAN/JUL FEB/AUG MAR/SEP APR/OCT MAY/NOV JUN/DEC

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION (INCHES)	0.33 5.63	1.66 0.52	0.33 3.82	3.10 3.64	8.75 1.49	1.81 1.12
RUNOFF (INCHES)	0.000 0.112	0.000 0.000	0.000 0.000	0.603 0.000	2.124 0.000	0.000 0.000
EVAPOTRANSPIRATION (INCHES)	1.612 4.346	1.635 1.658	0.788 3.225	1.306 3.553	6.339 1.953	3.377 1.085
LATERAL DRAINAGE FROM	0.0163	0.0065	0.0038	0.0042	0.0248	0.0016

LAYER 1 (INCHES)	0.0063	0.0011	0.0021	0.0073	0.0043	0.0001
PERCOLATION FROM LAYER 2 (INCHES)	0.0117	0.0099	0.0106	0.0022	0.0121	0.0018
PERCOLATION FROM LAYER 4 (INCHES)	0.0105	0.0095	0.0105	0.0042	0.0105	0.0036
	0.0054	0.0018	0.0028	0.0091	0.0105	0.0007
	0.0050	0.0021	0.0028	0.0086	0.0102	0.0015

 MONTHLY SUMMARIES FOR DAILY HEADS

AVG. DAILY HEAD ON LAYER 2 (INCHES)	3.11	1.33	0.70	0.79	4.32	0.30
STD. DEV. OF DAILY HEAD ON LAYER 2 (INCHES)	1.29	0.20	0.47	1.49	0.82	0.01
AVG. DAILY HEAD ON LAYER 4 (INCHES)	0.00	0.01	0.01	0.00	0.00	0.00
STD. DEV. OF DAILY HEAD ON LAYER 4 (INCHES)	0.00	0.00	0.00	0.00	0.00	0.00

ANNUAL TOTALS FOR YEAR 7

	(INCHES)	(CU. FT.)	PERCENT
PRECIPITATION	32.20	1073333.	100.00
RUNOFF	2.839	94631.	8.82
EVAPOTRANSPIRATION	30.877	1029250.	95.89
LATERAL DRAINAGE FROM LAYER 1	0.0783	2611.	0.24
PERCOLATION FROM LAYER 2	0.0786	2619.	0.24
PERCOLATION FROM LAYER 4	0.0792	2642.	0.25
CHANGE IN WATER STORAGE	-1.674	-55801.	-5.20

SOIL WATER AT START OF YEAR	51.46	1715363.	
SOIL WATER AT END OF YEAR	49.79	1659562.	
SNOW WATER AT START OF YEAR	0.00	0.	
SNOW WATER AT END OF YEAR	0.00	0.	
ANNUAL WATER BUDGET BALANCE	0.00	0.	0.00

MONTHLY TOTALS FOR YEAR 8

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC

PRECIPITATION (INCHES)	0.61 1.65	1.98 2.07	0.99 3.79	3.61 4.98	11.03 1.29	1.21 1.00
RUNOFF (INCHES)	0.000 0.000	0.000 0.000	0.000 0.000	0.079 0.385	4.738 0.017	0.000 0.000
EVAPOTRANSPIRATION (INCHES)	0.649 1.677	1.402 2.040	1.013 3.526	2.240 2.987	6.370 2.452	3.096 0.744
LATERAL DRAINAGE FROM LAYER 1 (INCHES)	0.0000 0.0003	0.0009 0.0000	0.0013 0.0027	0.0039 0.0125	0.0178 0.0179	0.0025 0.0049
PERCOLATION FROM LAYER 2 (INCHES)	0.0000 0.0011	0.0028 0.0000	0.0042 0.0035	0.0098 0.0085	0.0117 0.0114	0.0020 0.0109
PERCOLATION FROM LAYER 4 (INCHES)	0.0000 0.0011	0.0027 0.0000	0.0043 0.0032	0.0095 0.0079	0.0105 0.0102	0.0035 0.0105

 MONTHLY SUMMARIES FOR DAILY HEADS

AVG. DAILY HEAD ON LAYER 2 (INCHES)	0.00	0.19	0.23	0.79	3.28	0.44
	0.07	0.00	0.61	2.39	3.37	0.90
STD. DEV. OF DAILY HEAD ON LAYER 2 (INCHES)	0.00	0.31	0.34	1.05	1.64	1.13
	0.20	0.00	1.01	1.96	1.37	0.18
AVG. DAILY HEAD ON LAYER 4 (INCHES)	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.01
STD. DEV. OF DAILY HEAD ON LAYER 4 (INCHES)	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00

ANNUAL TOTALS FOR YEAR 8

	(INCHES)	(CU. FT.)	PERCENT
PRECIPITATION	34.21	11403.3	100.00
RUNOFF	5.219	173965.	15.26
EVAPOTRANSPIRATION	28.196	939869.	82.42
LATERAL DRAINAGE FROM LAYER 1	0.0648	2159.	0.19
PERCOLATION FROM LAYER 2	0.0659	2198.	0.19
PERCOLATION FROM LAYER 4	0.0636	2119.	0.19
CHANGE IN WATER STORAGE	0.667	22221.	1.95
SOIL WATER AT START OF YEAR	49.79	1659562.	
SOIL WATER AT END OF YEAR	50.45	1681783.	
SNOW WATER AT START OF YEAR	0.00	0.	
SNOW WATER AT END OF YEAR	0.00	0.	
ANNUAL WATER BUDGET BALANCE	0.00	0.	0.00

MONTHLY TOTALS FOR YEAR 9

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION (INCHES)	1.58 2.57	0.14 0.88	0.92 3.60	5.90 6.18	4.19 1.26	1.30 3.29
RUNOFF (INCHES)	0.000 0.000	0.000 0.000	0.000 0.000	0.032 1.506	0.540 0.000	0.000 0.617
EVAPOTRANSPIRATION (INCHES)	0.712 3.604	1.653 0.989	0.584 2.177	5.076 3.840	4.719 2.631	0.367 1.454
LATERAL DRAINAGE FROM LAYER 1 (INCHES)	0.0068 0.0010	0.0086 0.0000	0.0001 0.0027	0.0149 0.0224	0.0080 0.0180	0.0000 0.0139
PERCOLATION FROM LAYER 2 (INCHES)	0.0110 0.0026	0.0101 0.0000	0.0010 0.0042	0.0106 0.0120	0.0081 0.0115	0.0002 0.0115
PERCOLATION FROM LAYER 4 (INCHES)	0.0105 0.0024	0.0095 0.0000	0.0048 0.0039	0.0092 0.0105	0.0090 0.0102	0.0006 0.0105

MONTHLY SUMMARIES FOR DAILY HEADS

AVG. DAILY HEAD ON LAYER 2 (INCHES)	1.46 0.19	1.85 0.00	0.02 0.58	2.90 4.15	1.50 3.70	0.00 2.83
STD. DEV. OF DAILY HEAD ON LAYER 2 (INCHES)	0.93 0.38	1.16 0.00	0.05 1.18	1.64 1.02	1.65 0.99	0.02 1.26
AVG. DAILY HEAD ON LAYER 4 (INCHES)	0.01 0.00	0.01 0.00	0.00 0.00	0.00 0.00	0.00 0.01	0.00 0.01
STD. DEV. OF DAILY HEAD ON LAYER 4 (INCHES)	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00

 ANNUAL TOTALS FOR YEAR 9

	(INCHES)	(CU. FT.)	PERCENT
PRECIPITATION	31.81	1060333.	100.00
RUNOFF	2.694	89814.	8.47
EVAPOTRANSPIRATION	27.806	926857.	87.41
LATERAL DRAINAGE FROM LAYER 1	0.0965	3217.	0.30
PERCOLATION FROM LAYER 2	0.0828	2759.	0.26
PERCOLATION FROM LAYER 4	0.0812	2707.	0.26
CHANGE IN WATER STORAGE	1.132	37739.	3.56
SOIL WATER AT START OF YEAR	50.45	1681783.	
SOIL WATER AT END OF YEAR	51.59	1719522.	
SNOW WATER AT START OF YEAR	0.00	0.	
SNOW WATER AT END OF YEAR	0.00	0.	
ANNUAL WATER BUDGET BALANCE	0.00	0.	0.00

 MONTHLY TOTALS FOR YEAR 10

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION (INCHES)	2.09	2.12	2.21	2.96	3.32	3.96
	4.97	4.76	6.30	4.89	2.09	2.18

RUNOFF (INCHES)	0.422	0.000	0.000	0.000	0.000	0.000
	0.000	0.132	0.981	1.520	0.000	0.000
EVAPOTRANSPIRATION (INCHES)	1.738	2.153	2.846	3.381	3.128	3.948
	4.829	4.095	5.658	3.053	2.050	1.546
LATERAL DRAINAGE FROM LAYER 1 (INCHES)	0.0295	0.0180	0.0129	0.0080	0.0040	0.0022
	0.0012	0.0039	0.0179	0.0210	0.0166	0.0164
PERCOLATION FROM LAYER 2 (INCHES)	0.0123	0.0107	0.0114	0.0107	0.0065	0.0029
	0.0029	0.0036	0.0107	0.0119	0.0114	0.0117
PERCOLATION FROM LAYER 4 (INCHES)	0.0105	0.0095	0.0105	0.0102	0.0105	0.0069
	0.0030	0.0034	0.0102	0.0105	0.0102	0.0105

 MONTHLY SUMMARIES FOR DAILY HEADS

AVG. DAILY HEAD ON LAYER 2 (INCHES)	5.01	3.73	2.34	1.57	0.79	0.47
	0.24	0.71	3.34	3.90	3.54	3.32
STD. DEV. OF DAILY HEAD ON LAYER 2 (INCHES)	0.51	1.10	1.55	1.11	1.06	0.85
	0.51	1.54	1.87	1.32	0.49	1.02
AVG. DAILY HEAD ON LAYER 4 (INCHES)	0.01	0.02	0.02	0.02	0.02	0.00
	0.00	0.00	0.00	0.00	0.01	0.01
STD. DEV. OF DAILY HEAD ON LAYER 4 (INCHES)	0.00	0.00	0.00	0.00	0.01	0.00
	0.00	0.00	0.00	0.00	0.00	0.00

ANNUAL TOTALS FOR YEAR 10

	(INCHES)	(CU. FT.)	PERCENT
PRECIPITATION	41.85	1395000.	100.00
RUNOFF	3.055	101819.	7.30
EVAPOTRANSPIRATION	38.424	1280812.	91.81

LATERAL DRAINAGE FROM LAYER 1	0.1516	5052.	0.36
PERCOLATION FROM LAYER 2	0.1067	3557.	0.26
PERCOLATION FROM LAYER 4	0.1061	3537.	0.25
CHANGE IN WATER STORAGE	0.113	3780.	0.27
SOIL WATER AT START OF YEAR	51.59	1719522.	
SOIL WATER AT END OF YEAR	51.50	1716508.	
SNOW WATER AT START OF YEAR	0.00	0.	
SNOW WATER AT END OF YEAR	0.20	6794.	
ANNUAL WATER BUDGET BALANCE	0.00	-1.	0.00

AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1 THROUGH 10

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	1.61 3.51	1.40 2.19	1.69 4.80	3.03 3.15	5.00 1.74	3.96 1.82
STD. DEVIATIONS	0.94 1.69	0.77 1.81	1.70 1.71	1.62 1.97	2.97 1.11	2.23 0.95
RUNOFF						
TOTALS	0.221 0.126	0.090 0.046	0.167 0.626	0.128 0.499	0.986 0.347	0.376 0.182
STD. DEVIATIONS	0.407 0.212	0.198 0.094	0.528 1.133	0.242 0.690	1.512 0.707	0.799 0.368

EVAPOTRANSPIRATION

TOTALS	1.261	1.754	1.677	2.488	4.210	4.087
	3.222	2.052	3.738	2.233	1.789	1.285
STD. DEVIATIONS	0.388	0.570	0.975	1.399	1.502	1.862
	1.612	1.292	1.243	1.239	0.794	0.384

LATERAL DRAINAGE FROM LAYER 1

TOTALS	0.0150	0.0113	0.0063	0.0059	0.0093	0.0046
	0.0020	0.0017	0.0080	0.0090	0.0138	0.0117
STD. DEVIATIONS	0.0107	0.0084	0.0056	0.0046	0.0073	0.0050
	0.0026	0.0027	0.0067	0.0077	0.0095	0.0073

PERCOLATION FROM LAYER 2

TOTALS	0.0098	0.0087	0.0081	0.0073	0.0084	0.0038
	0.0022	0.0014	0.0058	0.0065	0.0092	0.0099
STD. DEVIATIONS	0.0043	0.0039	0.0046	0.0043	0.0037	0.0028
	0.0022	0.0019	0.0034	0.0042	0.0046	0.00

PERCOLATION FROM LAYER 4

TOTALS	0.0088	0.0079	0.0083	0.0077	0.0090	0.0055
	0.0030	0.0014	0.0055	0.0061	0.0082	0.0091
STD. DEVIATIONS	0.0038	0.0035	0.0038	0.0032	0.0034	0.0031
	0.0031	0.0019	0.0033	0.0039	0.0041	0.0031

AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1 THROUGH 10

	(INCHES)	(CU. FT.)	PERCENT
PRECIPITATION	33.91 (5.675)	1130367.	100.00
RUNOFF	3.794 (1.903)	126452.	11.19
EVAPOTRANSPIRATION	29.797 (4.719)	993218.	87.87
LATERAL DRAINAGE FROM	0.0985 (0.0291)	3284.	0.29

LAYER 1

PERCOLATION FROM LAYER 2	0.0811 (0.0175)	2702.	0.24
PERCOLATION FROM LAYER 4	0.0806 (0.0181)	2687.	0.24
CHANGE IN WATER STORAGE	0.142 (1.064)	4727.	0.42

PEAK DAILY VALUES FOR YEARS 1 THROUGH 10

	(INCHES)	(CU. FT.)
PRECIPITATION	3.45	115000.0
RUNOFF	3.159	105316.0
LATERAL DRAINAGE FROM LAYER 1	0.0012	39.8
PERCOLATION FROM LAYER 2	0.0004	13.7
HEAD ON LAYER 2	6.4	
PERCOLATION FROM LAYER 4	0.0003	11.3
HEAD ON LAYER 4	0.0	
SNOW WATER	1.31	43500.3
MAXIMUM VEG. SOIL WATER (VOL/VOL)	0.4730	
MINIMUM VEG. SOIL WATER (VOL/VOL)	0.0959	

FINAL WATER STORAGE AT END OF YEAR 10

LAYER	(INCHES)	(VOL/VOL)
1	2.54	0.4233
2	4.50	0.1500
3	23.10	0.1309
4	21.36	0.3560
SNOW WATER	0.20	

APPENDIX C
ODEQ HELP MODEL MEMO



Appendix C - ODEQ HELP Model Memo

Post-It™ brand fax transmittal memo 7671		# of pages = 10	
To	ROA FRANKS	From	JEFF LON
cc	FLUOR DANIEL	cc	KERR-McGEE
Dept.		Phone #	
Fax #		Fax #	

Memorandum

Date: March 25, 1993

To: Scott Thompson, Environmental Specialist Supervisor

From: Terry Andrews, Senior Hydrologist *TA*

Subject: Kerr-McGee Cushing site

On March 18, you asked me to evaluate sample analysis from Kerr-McGee Cushing site pit 5 waste that had been neutralized and solidified. You instructed me to determine, on the basis of fate and transport principles, the type of liner that would be needed if an onsite landfill was constructed and this treated waste was placed within it.

The most likely least cost alternative for landfilling of pit 5 treated waste is by constructing a landfill with 3 feet of compacted clay as a liner. I decided to see whether or not the situation could lead to ground water contamination by using two predictive models, the Hydrologic Evaluation of Landfill Performance (HELP) model and the unconsolidated version of Saturated Model. The HELP model is used to predict the amount of leachate that could infiltrate and then move through the liner and exit the landfill. The HELP model is currently used by the OSDH and EPA to help determine landfill design. The unconsolidated version of the Saturated Model is used to predict the fate and transport of organic chemicals found in the treated waste as it desorbs from the waste and is mixed into an aquifer. I chose this model because it is very useful for predicting fate and transport of organic chemicals when site characterization is limited and many fate and transport variables are unknown. The unconsolidated version of the Saturated Model has been used on several Superfund site remediations and is considered to be a conservative model. More information about this model can be found in EPA/540/2-89/057.

I gathered information and data needed for the modeling exercise using the Phase I Remedial Investigation Report prepared by Burns & McDonnell Waste Consultants, Inc. for Kerr-McGee Corporation. For input into the HELP model, I used a landfill construction scenario consisting of the following:

- A liner consisting of three (3) feet of clay with resulting saturated hydraulic conductivity of 1×10^{-6} cm/sec.
- A twenty five (25) foot thick fill consisting of treated waste with a saturated hydraulic conductivity of 5.8×10^{-6} cm/sec.
- A cap consisting of two (2) feet of uncompacted clay with a saturated hydraulic conductivity of 4.2×10^{-6} cm/sec.

was used for the Venonous-Ada Aquifer.

- A "mixing zone" of fifty (50) feet was used for the thickness of the diffusion zone in the aquifer that the leachate is likely to be diluted into.

- An annual precipitation of thirty (30) inches per year was used.

- The fraction of organic carbon in the liner clay was estimated to be 0.01.

The results of the unremed version of the Summers model are shown in Table 1. The Sunset concentration is the chemical specific concentration at which the waste fill would not cause health-based levels and regulatory levels of contaminants in a drinking water supply to be exceeded. These levels are compared with the highest contaminant concentrations indicated in the analysis of the pit 5 treated waste in Table 2. All of the treated waste concentrations are well below the Sunset concentrations. Based on these results and knowing that a conservative modeling approach was used, I feel that a single 3 foot thick layer of clay would be appropriate as the bottom liner for the proposed landfill.

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TABLE 1

Enter site and contaminant specific data in shaded boxes.

SITE: PROPOSED LANDFILL AT KERR-MCGEE/CUSHING

Data needed for calculations	Enter here
1. Hydraulic conductivity of aquifer (feet per day)	2
2. Piezometric head gradient of aquifer (feet/foot)	0.004
3. Mixing zone or thickness of aquifer (feet)	50
4. Annual precipitation in area of site (inches)	30
5. Fraction of precipitation which infiltrates aquifer	0.25
6. Fraction of organic carbon in background soil	0.01

Calculation of $Q = KIA =$	0.4	cu. ft./day
Calculation of $e =$	0.0017313	cu. ft./day

Organic Chemical	Koc	Kd	HL (mg/l)	Seet (mg/Kg)	Sursat (mg/Kg)
Acanaphthene	4.60E+03	48	0.65	25.3	5.871
Anthracene	1.40E+04	140	2.75	385	88.338
Benzene	8.30E+01	0.83	0.008	0.00415	1
Benzo(a)anthracene	1.38E+06	13800	3.75E-05	0.5175	120
Benzo(a)pyrene	5.80E+06	58000	3.75E-05	0.20625	48
Benzo(b)fluoranthene	5.80E+05	5800	3.75E-05	0.20625	48
Benzo(k)fluoranthene	5.80E+05	5800	3.75E-05	0.20625	48
Benzo(g,h,i)perylene	1.80E+08	18000	0.025	400	92.818
Chrysene	2.00E+05	2000	3.75E-04	0.75	174
Dibenzo(a,h)anthracene	3.30E+08	33000	3.75E-05	0.12375	29
Dimethylphenol, 2,4-	2.24E+02	2.24	1.75E-01	0.392	91
Ethylbenzene	1.10E+03	11	0.008	7.7	1.787
Fluoranthene	3.80E+04	380	0.375	142.5	33.067
Fluorene	7.30E+03	73	0.375	27.575	6.352
Indeno(1,2,3-cd)pyrene	1.60E+06	16000	3.75E-05	0.6	139
Methyl-naphthalene, 2-	8.50E+03	85	0.025	2.125	493
Methylphenol, 2-	1.70E+01	0.77	0.45	0.0765	18
Methylphenol, 4-	1.91E+01	0.191	0.45	0.08595	20
Naphthalene	1.30E+03	13	0.025	0.325	75
Phenanthrene	1.40E+04	140	0.025	3.5	812
Phenol	1.42E+01	0.142	8.5	0.781	181
Pyrene	3.80E+04	380	0.275	104.5	24.248
Toluene	2.57E+02	2.57	0.008	2.57	596
Xylene	8.30E+02	8.3	0.008	83	19.280

Cleanup levels are determined using the unsteady variation of the Summers Model. These critical soil concentrations are derived for both saturated (Seet) and unsaturated (Sursat) soils to prevent ground water in the Varnoosa-Ada Aquifer from exceeding regulatory or health-based levels (HBL). Sursat concentrations represent contaminant concentrations that must not be exceeded in the treated waste fill. Further information about this model can be found in EPA/540/R-89/057.

Maximum Contaminant Levels or Proposed Maximum Contaminant Levels are shaded. Other health-based levels were calculated using Risk Assessment Guidance for Superfund.

Contaminants indicated in analysis of Pit 5 treated waste are bolded.

TABLE 2 - KERR-MCGEE / CUSHING SITE

ORGANIC CHEMICAL DETECTED IN PIT 6 WASTE AFTER TREATMENT TESTING	MAXIMUM TREATED WASTE CONCENTRATION (milligrams/kilogram)	Standard - CONCENTRATION LEVEL OF PILL TO PROTECT GROUND WATER (milligrams/kilogram)
Benzene	0.044	1
Benz(a)pyrene	25	48
Benz(a)fluoranthene	17	48
Benz(a)fluoranthene	33	48
Chrysene	95	174
Ethylbenzene	0.081	1,787
Fluoranthene	0.89	33,067
Fluorene	2.3	6,352
2-Methylnaphthalene	20	493
2-Methylphenol	5.5	18
4-Methylphenol	4.6	20
Naphthalene	0.55	75
Phenanthrene	18	812
Phenol	1.2	181
Pyrene	6.8	24,249
Toluene	0.25	596
Xylene	0.77	19,260

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File: CLMEX 8_312 3-25-95 4:39:02 pm Page 1

CLOSING

PROPOSED LANDFILL FOR TREATED WASTE FROM PVT. 5

1/18/95

FAIR GRASS

LAYER 1

VERTICAL PERCOLATION LAYER

THICKNESS	=	12.00 INCHES
POROSITY	=	0.4170 VOL/VOL
FIELD CAPACITY	=	0.0656 VOL/VOL
WILTING POINT	=	0.0280 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0554 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.02999997767 CM/SEC 10^{-2}

LAYER 2

VERTICAL PERCOLATION LAYER

THICKNESS	=	26.00 INCHES
POROSITY	=	0.4270 VOL/VOL
FIELD CAPACITY	=	0.3672 VOL/VOL
WILTING POINT	=	0.2099 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.3418 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.00062000000 CM/SEC

SICL
 10^{-5}

LAYER 3

VERTICAL PERCOLATION LAYER

7
9
11
13
16

Project: ESTWELP

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Page 2

THICKNESS " 300.00 INCHES
 POROSITY " 0.4370 VOL/VOL
 FIELD CAPACITY " 0.0620 VOL/VOL
 WILTING POINT " 0.0340 VOL/VOL
 INITIAL SOIL WATER CONTENT " 0.2862 VOL/VOL
 SATURATED HYDRAULIC CONDUCTIVITY " 0.002700000000 GV/SEC

LAYER 4

BARRIER SOIL LAYER

THICKNESS " 36.00 INCHES
 POROSITY " 0.4300 VOL/VOL
 FIELD CAPACITY " 0.3667 VOL/VOL
 WILTING POINT " 0.2000 VOL/VOL
 INITIAL SOIL WATER CONTENT " 0.4300 VOL/VOL
 SATURATED HYDRAULIC CONDUCTIVITY " 0.000001000000 GV/SEC

10⁻⁷

GENERAL SIMULATION DATA

NCR SLOPFF CLONG NUMBER " 30.02
 TOTAL AREA OF COVER " 480000.00 FT
 EVAPORATIVE ZONE DEPTH " 22.00 INCHES
 UPPER LIMIT VOL. STORAGE " 9.7140 INCHES
 INITIAL VOL. STORAGE " 3.2986 INCHES
 INITIAL SNOW WATER CONTENT " 0.0000 INCHES
 INITIAL TOTAL WATER STORAGE IN SOIL AND SNOW LAYERS " 112.4880 INCHES

SOIL WATER CONTENT INITIALIZED BY PROGRAM.

CLIMATE/REGION DATA

DEFAULT RAINFALL WITH SYNTHETIC DAILY TEMPERATURES AND SOLAR RADIATION FOR YEAR OKLAHOMA

MAXIMUM LEAF AREA INDEX " 2.00
 START OF GROWING SEASON (JULIAN DATE) " 98
 END OF GROWING SEASON (JULIAN DATE) " 317

NORMAL MEAN MONTHLY TEMPERATURES, DEGREES FAHRENHEIT

JAN/JAN FEB/FEB MAR/MAR APR/APR MAY/MAY JUN/JUN

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File: CLEMS 8.372 3-25-93 4:39:02 pm Page 3

33.20	46.70	49.38	66.90	69.18	77.70
83.20	81.70	73.88	62.68	48.20	39.80

AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 76 THROUGH 78

	JAN/JA	FEB/FEB	MAR/MAR	APR/OCT	MAY/MAY	JUN/JUN
PRECIPITATION						
TOTAL	0.72 3.24	1.92 2.21	2.12 2.37	2.74 2.32	7.28 1.74	3.05 8.71
STD. DEVIATIONS	0.85 2.82	1.14 1.37	0.82 2.19	1.27 1.92	2.37 1.06	1.56 8.63
EVAPOTRANSPIRATION						
TOTALS	0.067 0.222	0.034 0.156	0.130 0.065	0.132 0.145	0.457 0.116	0.133 0.028
STD. DEVIATIONS	0.097 0.326	0.072 0.146	0.226 0.097	0.162 0.125	0.334 0.125	0.279 0.088
PERCOLATION FROM LAYER 4						
TOTALS	0.786 2.378	1.198 2.602	1.586 2.362	2.207 0.716	4.421 1.573	3.723 8.671
STD. DEVIATIONS	0.334 1.163	0.722 1.236	0.611 1.613	0.595 0.233	0.178 0.381	1.889 6.333
TOTALS	0.6633 0.6360	0.5818 0.6381	0.6276 0.6144	0.6167 0.6371	0.6239 0.6118	0.6193 0.6286
STD. DEVIATIONS	0.0632 0.0386	0.0438 0.0628	0.0644 0.0627	0.0633 0.0638	0.0656 0.0678	0.0376 0.0374

AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 76 THROUGH 78

	(INCHES)	(FEET)	PERCENT
PRECIPITATION	32.43 (8.077)	116.025	100.00

Project: E:\HELP

File: CONR3 8,312 .a. 3-25-93 4:39:02 pm Page 4

ETROFF	1.830 (0.877)	48641.	6.02
EVAPOTRANSPIRATION	23.661 (1.338)	857296.	77.81
PERCOLATION FROM LAYER 4	7.4923 (0.3135)	2827967.	26.66
CHANGE IN WATER STORAGE	-2.574 (4.083)	-98231.	-8.66

PEAK DAILY VALUES FOR YEARS 76 THROUGH 78

	(INCHES)	(CU. FT.)
PRECIPITATION	2.92	10990.8
ETROFF	0.666	16783.1
PERCOLATION FROM LAYER 4	0.0223	856.8
NEWS ON LAYER 4	200.2	
SNOW WATER	0.90	33866.2
MAXIMUM VES. SOIL WATER (VOL/VOL)	0.2863	
MINIMUM VES. SOIL WATER (VOL/VOL)	0.1014	

FINAL WATER STORAGE AT END OF YEAR 78

LAYER	(INCHES)	(VOL/VOL)
1	0.56	0.0667
2	6.79	0.2829
3	79.00	0.2633
4	15.48	0.6300
SNOW WATER	0.00	

Memorandum

Date: March 25, 1993

To: Scott Thompson, Environmental Specialist Supervisor

From: Terry Andrews, Senior Hydrologist *TA*

Subject: Kerr-McGee Cushing site

On March 18, you asked me to evaluate sample analysis from Kerr-McGee Cushing site pit 5 waste that had been neutralized and solidified. You instructed me to determine, on the basis of fate and transport principles, the type of liner that would be needed if an onsite landfill was constructed and this treated waste was placed within it.

The most likely least cost alternative for landfilling of pit 5 treated waste is by constructing a landfill with 3 feet of compacted clay as a liner. I decided to test whether or not this situation could lead to ground water contamination by using two predictive models, the Hydrologic Evaluation of Landfill Performance (HELP) model and the unnamed version of Summers model. The HELP model is used to predict the amount of leachate that could infiltrate and then move through the liner and exit the landfill. The HELP model is currently used by the OSDH and EPA to help determine landfill design. The unnamed version of the Summers Model is used to predict the fate and transport of organic chemicals found in the treated waste as it desorbs from the waste and is mixed into an aquifer. I chose this model because it is very useful for predicting fate and transport of organic chemicals when site characterization is limited and many fate and transport variables are unknown. The unnamed version of the Summers Model has been used on several Superfund site remediations and is considered to be a conservative model. More information about this model can be found in EPA/540/2-89/057.

I gathered information and data needed for the modeling exercise using the Phase I Remedial Investigation Report prepared by Burns & McDonnell Waste Consultants, Inc. for Kerr-McGee Corporation. For input into the HELP model, I used a landfill construction scenario consisting of the following:

- A liner consisting of three (3) feet of clay with resulting saturated hydraulic conductivity of 1×10^{-7} cm/sec.
- A twenty five (25) foot thick fill consisting of treated waste with a saturated hydraulic conductivity of 5.8×10^{-3} cm/sec.
- A cap consisting of two (2) feet of uncompacted clay with a saturated hydraulic conductivity of 4.2×10^{-6} cm/sec.

- A topsoil layer placed on top of the cap consisting of one (1) foot of topsoil with a saturated hydraulic conductivity of 3×10^{-3} cm/sec with fair grass.
- I estimated a total landfill area of 450,000 square feet.
- I used climatological data from Tulsa and adjusted this for the Cushing location by correcting the latitude.
- I used default values of typical soils for the soil and moisture variables.

The HELP model results are attached with this memorandum. The solution indicated that 24.6 percent of the annual rainfall will move through the landfill and through the bottom liner. I feel that this value is relatively high when compared to other landfill leachate designs. However, for the purpose of this exercise it will help insure that a conservative approach has been used. The actual percent of precipitation that moves through the landfill and liner will probably be much less. The treated waste will likely have a much lower saturated hydraulic conductivity than the municipal waste which was used in this modeling run. I used the results of the HELP model as inputs into the fate and transport model.

For additional input into the unnamed version of the Summers model, I used chemical characteristics data from EPA Guidance material (EPA/600/8-90/003) and information from the Phase I Remedial Investigation Report. The Maximum Contaminant Levels (MCLs) were obtained in the Code of Federal Regulations (141 subpart B) and the health based levels were calculated by OSDH using the Risk Assessment Guidance for Superfund and modifying the resultant levels by multiplying a safety factor of 0.25. The following assumptions were made while using the fate and transport model:

- The movement of leachate was modeled as if the Vamoosa-Ada aquifer was directly beneath the landfill. Although this is definitely not the case because the landfill would be separated from the Vamoosa-Ada aquifer by approximately 180 feet of mudstones in the Vanoss Group, travel of leachate could potentially occur through the Vanoss Group through fractures. Also, even if fracture systems through the Vanoss do not exist, movement of ground water likely occurs through the Vanoss albeit very slowly. The lapse in time of leachate transport into the aquifer is not likely to significantly affect the resultant contaminant concentration of the aquifer. By modeling the aquifer as if it is directly beneath the landfill liner, a conservative answer to the leachate effect on the aquifer can be calculated.

***APPENDIX D
REFERENCES***



LIST OF REFERENCES

Schroeder, P.R., Peyton, R.L., McEnroe, B.M., Sjostrom, J.W. 1992. "Hydrological Evaluation of Landfill Performance (HELP) Model User's Guide for Version 2", Department of the Army, Vicksburg, Mississippi.

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