Settle3D Analysis Information
Labadie UWL

Project Settings

Document Name: circle 47.s3z
Project Title: Labadie UWL
Analysis: Settlement
Author: Christopher Cook
Company: Reitz & Jens, Inc
Date Created: 10/17/2012, 11:48:36 AM
Stress Computation Method: Boussinesq
Use average properties to calculate layered stresses
Groundwater method: Water Table
Water Unit Weight: 0.0624 kips/ft^3
Depth to water table: 1 [ft]

Stage Settings

Stage #	Name
1	Stage 1

Results

Time taken to compute: 0 seconds

Stage: Stage 1

Data Type	Minimum	Maximum
Total Settlement [in]	0	20.9532
Consolidation Settlement [in]	0	7.85148
Immediate Settlement [in]	0	13.1102
Loading Stress [ksf]	0	10.3292
Effective Stress [ksf]	0	16.4014
Total Stress [ksf]	0	22.7662
Total Strain	0	0.083698
Pore Water Pressure [ksf]	0	6.3648
Degree of Consolidation [%]	0	100
Pre-consolidation Stress [ksf]	0.0585001	16.3699
Over-consolidation Ratio	1	9.15019
Void Ratio	0	0.916997
Hydroconsolidation Settlement [in]	0	0

Loads

1. Polygonal Load

Load Type: Flexible
Area of Load: 183389 ft^2
Depth: 0 ft
Installation Stage: Stage 1

Coordinates and Load

X [ft]	Y [ft]	Load Magnitude [ksf]
-1929.25	862.473	0
-1332.07	-407.189	0
-210.328	-424.303	0
-270.312	-363.597	2.9
-1293.01	-349.297	2.9
-1870.41	874.203	2.9
-1852.31	1508.1	2.9
-1908.21	1557.97	0

2. Polygonal Load

Load Type: Flexible
Area of Load: 234768 ft^2
Depth: 0 ft
Installation Stage: Stage 1

Coordinates and Load

X [ft]	Y [ft]	Load Magnitude [ksf]
-1852.31	1508.1	2.9
-221.212	1808.9	2.9
-270.312	-363.597	2.9
-210.328	-424.303	0
-162.623	1880.73	0
-1908.21	1557.97	0

3. Polygonal Load

Load Type: Flexible
Area of Load: 156632 ft^2
Depth: 0 ft
Installation Stage: Stage 1

Coordinates and Load

X [ft]	Y [ft]	Load Magnitude [ksf]
-1870.41	874.203	2.9
-1293.01	-349.297	2.9
-270.312	-363.597	2.9
-317.264	-315.23	5
-1259.26	-297.655	5
-1809.13	885.67	5
-1806.79	1469.02	5
-1852.31	1508.1	2.9

4. Polygonal Load

Load Type: Flexible
Area of Load: 171981 ft^2
Depth: 0 ft
Installation Stage: Stage 1

Coordinates and Load

X [ft]	Y [ft]	Load Magnitude [ksf]
-1852.31	1508.1	2.9
-1806.79	1469.02	5
-267.217	1755.15	5
-317.264	-315.23	5
-270.312	-363.597	2.9
-221.212	1808.9	2.9

5. Polygonal Load

Load Type: Flexible
Area of Load: 244557 ft^2
Depth: 0 ft
Installation Stage: Stage 1

Coordinates and Load

X [ft]	Y [ft]	Load Magnitude [ksf]
-102.643	-2757.4	0
1076.16	-2794.88	0
1109.25	-1637.87	0
3035.41	-1668.34	0
2874.5	-1608.34	2.9
1048.12	-1576.89	2.9
1016.65	-2734.4	2.9
-39.0646	-2705.7	2.9

6. Polygonal Load

Load Type: Flexible
Area of Load: 433982 ft^2
Depth: 0 ft
Installation Stage: Stage 1

Coordinates and Load

X [ft]	Y [ft]	Load Magnitude [ksf]
-39.0604	-2705.58	2.9
88.9461	776.742	2.9
2874.5	-1608.34	2.9
3035.41	-1668.34	0
35.4746	897.295	0
-102.643	-2757.4	0

7. Polygonal Load

Load Type: Flexible
Area of Load: 451309 ft^2
Depth: 0 ft
Installation Stage: Stage 1

Coordinates and Load

X [ft]	Y [ft]	Load Magnitude [ksf]
27.8223	-2642.81	5
153.042	647.667	5
2690.18	-1545.21	5
2874.5	-1608.34	2.9
88.9461	776.742	2.9
-39.0604	-2705.58	2.9

8. Polygonal Load

Load Type: Flexible
Area of Load: 238713 ft^2
Depth: 0 ft
Installation Stage: Stage 1

Coordinates and Load

X [ft]	Y [ft]	Load Magnitude [ksf]
-39.0644	-2705.7	2.9
1018.23	-2734.44	2.9
1048.12	-1576.89	2.9
2874.5	-1608.34	2.9
2690.18	-1545.21	5
989.752	-1516.32	5
956.638	-2672.65	5
27.8223	-2642.81	5

9. Polygonal Load

Load Type: Flexible
Area of Load: 567821 ft^2
Depth: 0 ft
Installation Stage: Stage 1

Coordinates and Load

X [ft]	Y [ft]	Load Magnitude [ksf]
-1637.57	1323.75	10.2
-447.535	1544.49	10.2
-485.349	-142.076	10.2
-317.264	-315.23	10.2
-267.217	1755.15	5
-1806.56	1468.98	5

10. Polygonal Load

Load Type: Flexible
Area of Load: 1.5903e+006 ft^2

Load: 10.2 ksf
Depth: 0 ft
Installation Stage: Stage 1

Coordinates

X [ft]	Y [ft]
-1649.21	915.592
-1153.62	-131.529
-485.349	-142.076
-447.535	1544.49
-1637.57	1323.75

11. Polygonal Load

Load Type: Flexible
Area of Load: 417396 ft^2
Depth: 0 ft
Installation Stage: Stage 1

Coordinates and Load

X [ft]	Y [ft]	Load Magnitude [ksf]
-485.349	-142.076	10.2
-1153.62	-131.529	10.2
-1649.21	915.592	10.2
-1637.57	1323.75	10.2
-1806.56	1468.98	5
-1809.13	885.67	5
-1259.26	-297.655	5
-317.264	-315.23	5

12. Polygonal Load

Load Type: Flexible
Area of Load: 941302 ft^2
Depth: 0 ft
Installation Stage: Stage 1

Coordinates and Load

X [ft]	Y [ft]	Load Magnitude [ksf]
188.83	-2491.7	10.2
293.799	364.216	10.2
2201.69	-1376.73	10.2
2690.18	-1545.21	5
153.042	647.667	5
27.7015	-2645.99	5

13. Polygonal Load

Load Type: Flexible
Area of Load: 551990 ft^2
Depth: 0 ft
Installation Stage: Stage 1

Coordinates and Load

X [ft]	Y [ft]	Load Magnitude [ksf]
952.602	-2672.52	5
989.748	-1516.48	5
2690.18	-1545.21	5
2201.69	-1376.73	10.2
832.524	-1353.16	10.2
802.744	-2507.54	10.2
188.83	-2491.7	10.2
27.7015	-2645.99	5

14. Polygonal Load

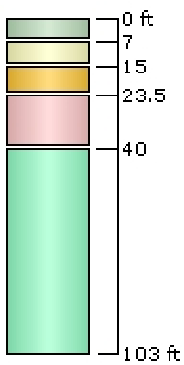
Load Type: Flexible
Area of Load: 2.38333e+006 ft^2
Depth: 0 ft
Installation Stage: Stage 1

Coordinates and Load

X [ft]	Y [ft]	Load Magnitude [ksf]
832.524	-1353.16	10.2
2201.69	-1376.73	10.2
293.799	364.216	10.2
188.83	-2491.7	10.2
802.744	-2507.54	10.2

Soil Layers

Layer #	Type	Thickness [ft]	Depth [ft]
1	SILT	7	0
2	CLAY	8	7
3	SAND & SILT	8.5	15
4	SAND	16.5	23.5
5	SAND & GRAVEL	63	40



Soil Properties

Property	CLAY	SILT	SAND & SILT	SAND	SAND & GRAVEL
Color					
Unit Weight [kips/ft^3]	0.113	0.117	0.122	0.122	0.124
Saturated Unit Weight [kips/ft^3]	0.113	0.117	0.122	0.122	0.124
Immediate Settlement	Disabled	Enabled	Enabled	Enabled	Enabled
Es [ksf]		200	700	1100	1400
Esur [ksf]		200	700	1100	1400
Primary Consolidation	Enabled	Disabled	Disabled	Disabled	Disabled
Material Type	Non-Linear				
Cc	0.3				
Cr	0.05				
e0	0.917				
Pc [ksf]	4.52				
OCR		1	1	1	1
Secondary Consolidation	Standard	Disabled	Disabled	Disabled	Disabled
Cae/Ca	0.005				
Car/Care	0.005				

Query Lines

Line #	Start Location	End Location	Horizontal Divisions	Vertical Divisions
1	-2058.82, 801.176	-110.756, 801.176	100	101

Settle3D Analysis Information
Labadie UWL

Project Settings

Document Name: CIRCLE 48.s3z
Project Title: Labadie UWL
Analysis: Settlement
Author: Christopher Cook
Company: Reitz & Jens, Inc
Date Created: 10/17/2012, 11:48:36 AM
Stress Computation Method: Boussinesq
Use average properties to calculate layered stresses
Groundwater method: Water Table
Water Unit Weight: 0.0624 kips/ft^3
Depth to water table: 1 [ft]

Stage Settings

Stage #	Name
1	Stage 1

Results

Time taken to compute: 0 seconds

Stage: Stage 1

Data Type	Minimum	Maximum
Total Settlement [in]	0	20.4739
Consolidation Settlement [in]	0	7.35604
Immediate Settlement [in]	0	13.1178
Loading Stress [ksf]	0	10.2043
Effective Stress [ksf]	0	16.5216
Total Stress [ksf]	0	23.0112
Total Strain	3.9992e-008	0.0983004
Pore Water Pressure [ksf]	0	6.4896
Degree of Consolidation [%]	0	100
Pre-consolidation Stress [ksf]	0.506464	16.4897
Over-consolidation Ratio	1	80.6776
Void Ratio	0	0.862
Hydroconsolidation Settlement [in]	0	0

Loads

1. Polygonal Load

Load Type: Flexible
Area of Load: 183389 ft^2
Depth: 0 ft
Installation Stage: Stage 1

Coordinates and Load

X [ft]	Y [ft]	Load Magnitude [ksf]
-1929.25	862.473	0
-1332.07	-407.189	0
-210.328	-424.303	0
-270.312	-363.597	2.9
-1293.01	-349.297	2.9
-1870.41	874.203	2.9
-1852.31	1508.1	2.9
-1908.21	1557.97	0

2. Polygonal Load

Load Type: Flexible
Area of Load: 234768 ft^2
Depth: 0 ft
Installation Stage: Stage 1

Coordinates and Load

X [ft]	Y [ft]	Load Magnitude [ksf]
-1852.31	1508.1	2.9
-221.212	1808.9	2.9
-270.312	-363.597	2.9
-210.328	-424.303	0
-162.623	1880.73	0
-1908.21	1557.97	0

3. Polygonal Load

Load Type: Flexible
Area of Load: 156632 ft^2
Depth: 0 ft
Installation Stage: Stage 1

Coordinates and Load

X [ft]	Y [ft]	Load Magnitude [ksf]
-1870.41	874.203	2.9
-1293.01	-349.297	2.9
-270.312	-363.597	2.9
-317.264	-315.23	5
-1259.26	-297.655	5
-1809.13	885.67	5
-1806.79	1469.02	5
-1852.31	1508.1	2.9

4. Polygonal Load

Load Type: Flexible
Area of Load: 171981 ft^2
Depth: 0 ft
Installation Stage: Stage 1

Coordinates and Load

X [ft]	Y [ft]	Load Magnitude [ksf]
-1852.31	1508.1	2.9
-1806.79	1469.02	5
-267.217	1755.15	5
-317.264	-315.23	5
-270.312	-363.597	2.9
-221.212	1808.9	2.9

5. Polygonal Load

Load Type: Flexible
Area of Load: 244557 ft^2
Depth: 0 ft
Installation Stage: Stage 1

Coordinates and Load

X [ft]	Y [ft]	Load Magnitude [ksf]
-102.643	-2757.4	0
1076.16	-2794.88	0
1109.25	-1637.87	0
3035.41	-1668.34	0
2874.5	-1608.34	2.9
1048.12	-1576.89	2.9
1016.65	-2734.4	2.9
-39.0646	-2705.7	2.9

6. Polygonal Load

Load Type: Flexible
Area of Load: 433982 ft^2
Depth: 0 ft
Installation Stage: Stage 1

Coordinates and Load

X [ft]	Y [ft]	Load Magnitude [ksf]
-39.0604	-2705.58	2.9
88.9461	776.742	2.9
2874.5	-1608.34	2.9
3035.41	-1668.34	0
35.4746	897.295	0
-102.643	-2757.4	0

7. Polygonal Load

Load Type: Flexible
Area of Load: 451309 ft^2
Depth: 0 ft
Installation Stage: Stage 1

Coordinates and Load

X [ft]	Y [ft]	Load Magnitude [ksf]
27.8223	-2642.81	5
153.042	647.667	5
2690.18	-1545.21	5
2874.5	-1608.34	2.9
88.9461	776.742	2.9
-39.0604	-2705.58	2.9

8. Polygonal Load

Load Type: Flexible
Area of Load: 238713 ft^2
Depth: 0 ft
Installation Stage: Stage 1

Coordinates and Load

X [ft]	Y [ft]	Load Magnitude [ksf]
-39.0644	-2705.7	2.9
1018.23	-2734.44	2.9
1048.12	-1576.89	2.9
2874.5	-1608.34	2.9
2690.18	-1545.21	5
989.752	-1516.32	5
956.638	-2672.65	5
27.8223	-2642.81	5

9. Polygonal Load

Load Type: Flexible
Area of Load: 567821 ft^2
Depth: 0 ft
Installation Stage: Stage 1

Coordinates and Load

X [ft]	Y [ft]	Load Magnitude [ksf]
-1637.57	1323.75	10.2
-447.535	1544.49	10.2
-485.349	-142.076	10.2
-317.264	-315.23	10.2
-267.217	1755.15	5
-1806.56	1468.98	5

10. Polygonal Load

Load Type: Flexible
Area of Load: 1.5903e+006 ft^2

Load: 10.2 ksf
Depth: 0 ft
Installation Stage: Stage 1

Coordinates

X [ft]	Y [ft]
-1649.21	915.592
-1153.62	-131.529
-485.349	-142.076
-447.535	1544.49
-1637.57	1323.75

11. Polygonal Load

Load Type: Flexible
Area of Load: 417396 ft^2
Depth: 0 ft
Installation Stage: Stage 1

Coordinates and Load

X [ft]	Y [ft]	Load Magnitude [ksf]
-485.349	-142.076	10.2
-1153.62	-131.529	10.2
-1649.21	915.592	10.2
-1637.57	1323.75	10.2
-1806.56	1468.98	5
-1809.13	885.67	5
-1259.26	-297.655	5
-317.264	-315.23	5

12. Polygonal Load

Load Type: Flexible
Area of Load: 941302 ft^2
Depth: 0 ft
Installation Stage: Stage 1

Coordinates and Load

X [ft]	Y [ft]	Load Magnitude [ksf]
188.83	-2491.7	10.2
293.799	364.216	10.2
2201.69	-1376.73	10.2
2690.18	-1545.21	5
153.042	647.667	5
27.7015	-2645.99	5

13. Polygonal Load

Load Type: Flexible
Area of Load: 551990 ft^2
Depth: 0 ft
Installation Stage: Stage 1

Coordinates and Load

X [ft]	Y [ft]	Load Magnitude [ksf]
952.602	-2672.52	5
989.748	-1516.48	5
2690.18	-1545.21	5
2201.69	-1376.73	10.2
832.524	-1353.16	10.2
802.744	-2507.54	10.2
188.83	-2491.7	10.2
27.7015	-2645.99	5

14. Polygonal Load

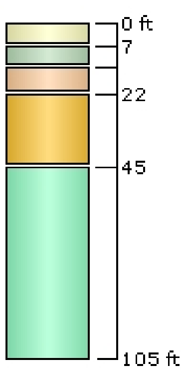
Load Type: Flexible
Area of Load: 2.38333e+006 ft^2
Depth: 0 ft
Installation Stage: Stage 1

Coordinates and Load

X [ft]	Y [ft]	Load Magnitude [ksf]
832.524	-1353.16	10.2
2201.69	-1376.73	10.2
293.799	364.216	10.2
188.83	-2491.7	10.2
802.744	-2507.54	10.2

Soil Layers

Layer #	Type	Thickness [ft]	Depth [ft]
1	CLAY	7	0
2	SILT	7	7
3	SILT & SAND	8	14
4	SAND	23	22
5	SAND & GRAVEL	60	45



Soil Properties

Property	CLAY	SILT	SILT & SAND	SAND	SAND & GRAVEL
Color					
Unit Weight [kips/ft^3]	0.118	0.117	0.12	0.122	0.124
Saturated Unit Weight [kips/ft^3]	0.118	0.117	0.12	0.122	0.124
Immediate Settlement	Disabled	Enabled	Enabled	Enabled	Enabled
Es [ksf]		150	700	900	1400
Es bottom [ksf]		400			
Esur [ksf]		150	700	900	1400
Esur bottom [ksf]		400			
Primary Consolidation	Enabled	Disabled	Disabled	Disabled	Disabled
Material Type	Non-Linear				
Cc	0.32				
Cr	0.04				
e0	0.862				
Pc [ksf]	4.76				
OCR		1	1	1	1
Secondary Consolidation	Standard	Disabled	Disabled	Disabled	Disabled
Cae/Ca	0.004				
Car/Care	0.004				

Query Lines

Line #	Start Location	End Location	Horizontal Divisions	Vertical Divisions
1	-119.939, -437.96	1670.82, -437.96	100	101

Settle3D Analysis Information
Labadie UWL

Project Settings

Document Name: CIRCLE 49.s3z
Project Title: Labadie UWL
Analysis: Settlement
Author: Christopher Cook
Company: Reitz & Jens, Inc
Date Created: 10/17/2012, 11:48:36 AM
Stress Computation Method: Boussinesq
Use average properties to calculate layered stresses
Groundwater method: Water Table
Water Unit Weight: 0.0624 kips/ft^3
Depth to water table: 1 [ft]

Stage Settings

Stage #	Name
1	Stage 1

Results

Time taken to compute: 0 seconds

Stage: Stage 1

Data Type	Minimum	Maximum
Total Settlement [in]	0	24.8356
Consolidation Settlement [in]	0	12.1942
Immediate Settlement [in]	0	12.6414
Loading Stress [ksf]	0	10.2043
Effective Stress [ksf]	0	16.5846
Total Stress [ksf]	0	23.0742
Total Strain	3.9992e-008	0.0983004
Pore Water Pressure [ksf]	0	6.4896
Degree of Consolidation [%]	0	100
Pre-consolidation Stress [ksf]	0.788336	16.5514
Over-consolidation Ratio	1	80.6776
Void Ratio	0	0.862
Hydroconsolidation Settlement [in]	0	0

Loads

1. Polygonal Load

Load Type: Flexible
Area of Load: 183389 ft^2
Depth: 0 ft
Installation Stage: Stage 1

Coordinates and Load

X [ft]	Y [ft]	Load Magnitude [ksf]
-1929.25	862.473	0
-1332.07	-407.189	0
-210.328	-424.303	0
-270.312	-363.597	2.9
-1293.01	-349.297	2.9
-1870.41	874.203	2.9
-1852.31	1508.1	2.9
-1908.21	1557.97	0

2. Polygonal Load

Load Type: Flexible
Area of Load: 234768 ft^2
Depth: 0 ft
Installation Stage: Stage 1

Coordinates and Load

X [ft]	Y [ft]	Load Magnitude [ksf]
-1852.31	1508.1	2.9
-221.212	1808.9	2.9
-270.312	-363.597	2.9
-210.328	-424.303	0
-162.623	1880.73	0
-1908.21	1557.97	0

3. Polygonal Load

Load Type: Flexible
Area of Load: 156632 ft^2
Depth: 0 ft
Installation Stage: Stage 1

Coordinates and Load

X [ft]	Y [ft]	Load Magnitude [ksf]
-1870.41	874.203	2.9
-1293.01	-349.297	2.9
-270.312	-363.597	2.9
-317.264	-315.23	5
-1259.26	-297.655	5
-1809.13	885.67	5
-1806.79	1469.02	5
-1852.31	1508.1	2.9

4. Polygonal Load

Load Type: Flexible
Area of Load: 171981 ft^2
Depth: 0 ft
Installation Stage: Stage 1

Coordinates and Load

X [ft]	Y [ft]	Load Magnitude [ksf]
-1852.31	1508.1	2.9
-1806.79	1469.02	5
-267.217	1755.15	5
-317.264	-315.23	5
-270.312	-363.597	2.9
-221.212	1808.9	2.9

5. Polygonal Load

Load Type: Flexible
Area of Load: 244557 ft^2
Depth: 0 ft
Installation Stage: Stage 1

Coordinates and Load

X [ft]	Y [ft]	Load Magnitude [ksf]
-102.643	-2757.4	0
1076.16	-2794.88	0
1109.25	-1637.87	0
3035.41	-1668.34	0
2874.5	-1608.34	2.9
1048.12	-1576.89	2.9
1016.65	-2734.4	2.9
-39.0646	-2705.7	2.9

6. Polygonal Load

Load Type: Flexible
Area of Load: 433982 ft^2
Depth: 0 ft
Installation Stage: Stage 1

Coordinates and Load

X [ft]	Y [ft]	Load Magnitude [ksf]
-39.0604	-2705.58	2.9
88.9461	776.742	2.9
2874.5	-1608.34	2.9
3035.41	-1668.34	0
35.4746	897.295	0
-102.643	-2757.4	0

7. Polygonal Load

Load Type: Flexible
Area of Load: 451309 ft^2
Depth: 0 ft
Installation Stage: Stage 1

Coordinates and Load

X [ft]	Y [ft]	Load Magnitude [ksf]
27.8223	-2642.81	5
153.042	647.667	5
2690.18	-1545.21	5
2874.5	-1608.34	2.9
88.9461	776.742	2.9
-39.0604	-2705.58	2.9

8. Polygonal Load

Load Type: Flexible
Area of Load: 238713 ft^2
Depth: 0 ft
Installation Stage: Stage 1

Coordinates and Load

X [ft]	Y [ft]	Load Magnitude [ksf]
-39.0644	-2705.7	2.9
1018.23	-2734.44	2.9
1048.12	-1576.89	2.9
2874.5	-1608.34	2.9
2690.18	-1545.21	5
989.752	-1516.32	5
956.638	-2672.65	5
27.8223	-2642.81	5

9. Polygonal Load

Load Type: Flexible
Area of Load: 567821 ft^2
Depth: 0 ft
Installation Stage: Stage 1

Coordinates and Load

X [ft]	Y [ft]	Load Magnitude [ksf]
-1637.57	1323.75	10.2
-447.535	1544.49	10.2
-485.349	-142.076	10.2
-317.264	-315.23	10.2
-267.217	1755.15	5
-1806.56	1468.98	5

10. Polygonal Load

Load Type: Flexible
Area of Load: 1.5903e+006 ft^2

Load: 10.2 ksf
Depth: 0 ft
Installation Stage: Stage 1

Coordinates

X [ft]	Y [ft]
-1649.21	915.592
-1153.62	-131.529
-485.349	-142.076
-447.535	1544.49
-1637.57	1323.75

11. Polygonal Load

Load Type: Flexible
Area of Load: 417396 ft^2
Depth: 0 ft
Installation Stage: Stage 1

Coordinates and Load

X [ft]	Y [ft]	Load Magnitude [ksf]
-485.349	-142.076	10.2
-1153.62	-131.529	10.2
-1649.21	915.592	10.2
-1637.57	1323.75	10.2
-1806.56	1468.98	5
-1809.13	885.67	5
-1259.26	-297.655	5
-317.264	-315.23	5

12. Polygonal Load

Load Type: Flexible
Area of Load: 941302 ft^2
Depth: 0 ft
Installation Stage: Stage 1

Coordinates and Load

X [ft]	Y [ft]	Load Magnitude [ksf]
188.83	-2491.7	10.2
293.799	364.216	10.2
2201.69	-1376.73	10.2
2690.18	-1545.21	5
153.042	647.667	5
27.7015	-2645.99	5

13. Polygonal Load

Load Type: Flexible
Area of Load: 551990 ft^2
Depth: 0 ft
Installation Stage: Stage 1

Coordinates and Load

X [ft]	Y [ft]	Load Magnitude [ksf]
952.602	-2672.52	5
989.748	-1516.48	5
2690.18	-1545.21	5
2201.69	-1376.73	10.2
832.524	-1353.16	10.2
802.744	-2507.54	10.2
188.83	-2491.7	10.2
27.7015	-2645.99	5

14. Polygonal Load

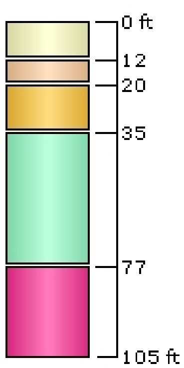
Load Type: Flexible
Area of Load: 2.38333e+006 ft^2
Depth: 0 ft
Installation Stage: Stage 1

Coordinates and Load

X [ft]	Y [ft]	Load Magnitude [ksf]
832.524	-1353.16	10.2
2201.69	-1376.73	10.2
293.799	364.216	10.2
188.83	-2491.7	10.2
802.744	-2507.54	10.2

Soil Layers

Layer #	Type	Thickness [ft]	Depth [ft]
1	CLAY	12	0
2	SILT & SAND	8	12
3	SAND	15	20
4	SAND & GRAVEL	42	35
5	SAND (2)	28	77



Soil Properties

Property	CLAY	SILT & SAND	SAND	SAND & GRAVEL	SAND (2)
Color					
Unit Weight [kips/ft^3]	0.118	0.12	0.122	0.124	0.125
Saturated Unit Weight [kips/ft^3]	0.118	0.12	0.122	0.124	0.125
Immediate Settlement	Disabled	Enabled	Enabled	Enabled	Enabled
Es [ksf]		200	1100	1000	1200
Es bottom [ksf]		500			
Esur [ksf]		200	1100	1000	1200
Esur bottom [ksf]		500			
Primary Consolidation	Enabled	Disabled	Disabled	Disabled	Disabled
Material Type	Non-Linear				
Cc	0.32				
Cr	0.04				
e0	0.862				
Pc [ksf]	4.76				
OCR		1	1	1	1
Secondary Consolidation	Standard	Disabled	Disabled	Disabled	Disabled
Cae/Ca	0.004				
Car/Care	0.004				

Query Lines

Line #	Start Location	End Location	Horizontal Divisions	Vertical Divisions
1	-119.939, -437.96	1670.82, -437.96	100	101

Settle3D Analysis Information
Labadie UWL

Project Settings

Document Name: CIRCLE 50.s3z
Project Title: Labadie UWL
Analysis: Settlement
Author: Christopher Cook
Company: Reitz & Jens, Inc
Date Created: 10/17/2012, 11:48:36 AM
Stress Computation Method: Boussinesq
Use average properties to calculate layered stresses
Groundwater method: Water Table
Water Unit Weight: 0.0624 kips/ft^3
Depth to water table: 1 [ft]

Stage Settings

Stage #	Name
1	Stage 1

Results

Time taken to compute: 0 seconds

Stage: Stage 1

Data Type	Minimum	Maximum
Total Settlement [in]	0	24.747
Consolidation Settlement [in]	0	12.1942
Immediate Settlement [in]	0	12.5528
Loading Stress [ksf]	0	10.2043
Effective Stress [ksf]	0	16.5806
Total Stress [ksf]	0	23.0702
Total Strain	3.9992e-008	0.0983004
Pore Water Pressure [ksf]	0	6.4896
Degree of Consolidation [%]	0	100
Pre-consolidation Stress [ksf]	0.788336	16.5474
Over-consolidation Ratio	1	80.6776
Void Ratio	0	0.862
Hydroconsolidation Settlement [in]	0	0

Loads

1. Polygonal Load

Load Type: Flexible
Area of Load: 183389 ft^2
Depth: 0 ft
Installation Stage: Stage 1

Coordinates and Load

X [ft]	Y [ft]	Load Magnitude [ksf]
-1929.25	862.473	0
-1332.07	-407.189	0
-210.328	-424.303	0
-270.312	-363.597	2.9
-1293.01	-349.297	2.9
-1870.41	874.203	2.9
-1852.31	1508.1	2.9
-1908.21	1557.97	0

2. Polygonal Load

Load Type: Flexible
Area of Load: 234768 ft^2
Depth: 0 ft
Installation Stage: Stage 1

Coordinates and Load

X [ft]	Y [ft]	Load Magnitude [ksf]
-1852.31	1508.1	2.9
-221.212	1808.9	2.9
-270.312	-363.597	2.9
-210.328	-424.303	0
-162.623	1880.73	0
-1908.21	1557.97	0

3. Polygonal Load

Load Type: Flexible
Area of Load: 156632 ft^2
Depth: 0 ft
Installation Stage: Stage 1

Coordinates and Load

X [ft]	Y [ft]	Load Magnitude [ksf]
-1870.41	874.203	2.9
-1293.01	-349.297	2.9
-270.312	-363.597	2.9
-317.264	-315.23	5
-1259.26	-297.655	5
-1809.13	885.67	5
-1806.79	1469.02	5
-1852.31	1508.1	2.9

4. Polygonal Load

Load Type: Flexible
Area of Load: 171981 ft^2
Depth: 0 ft
Installation Stage: Stage 1

Coordinates and Load

X [ft]	Y [ft]	Load Magnitude [ksf]
-1852.31	1508.1	2.9
-1806.79	1469.02	5
-267.217	1755.15	5
-317.264	-315.23	5
-270.312	-363.597	2.9
-221.212	1808.9	2.9

5. Polygonal Load

Load Type: Flexible
Area of Load: 244557 ft^2
Depth: 0 ft
Installation Stage: Stage 1

Coordinates and Load

X [ft]	Y [ft]	Load Magnitude [ksf]
-102.643	-2757.4	0
1076.16	-2794.88	0
1109.25	-1637.87	0
3035.41	-1668.34	0
2874.5	-1608.34	2.9
1048.12	-1576.89	2.9
1016.65	-2734.4	2.9
-39.0646	-2705.7	2.9

6. Polygonal Load

Load Type: Flexible
Area of Load: 433982 ft^2
Depth: 0 ft
Installation Stage: Stage 1

Coordinates and Load

X [ft]	Y [ft]	Load Magnitude [ksf]
-39.0604	-2705.58	2.9
88.9461	776.742	2.9
2874.5	-1608.34	2.9
3035.41	-1668.34	0
35.4746	897.295	0
-102.643	-2757.4	0

7. Polygonal Load

Load Type: Flexible
Area of Load: 451309 ft^2
Depth: 0 ft
Installation Stage: Stage 1

Coordinates and Load

X [ft]	Y [ft]	Load Magnitude [ksf]
27.8223	-2642.81	5
153.042	647.667	5
2690.18	-1545.21	5
2874.5	-1608.34	2.9
88.9461	776.742	2.9
-39.0604	-2705.58	2.9

8. Polygonal Load

Load Type: Flexible
Area of Load: 238713 ft^2
Depth: 0 ft
Installation Stage: Stage 1

Coordinates and Load

X [ft]	Y [ft]	Load Magnitude [ksf]
-39.0644	-2705.7	2.9
1018.23	-2734.44	2.9
1048.12	-1576.89	2.9
2874.5	-1608.34	2.9
2690.18	-1545.21	5
989.752	-1516.32	5
956.638	-2672.65	5
27.8223	-2642.81	5

9. Polygonal Load

Load Type: Flexible
Area of Load: 567821 ft^2
Depth: 0 ft
Installation Stage: Stage 1

Coordinates and Load

X [ft]	Y [ft]	Load Magnitude [ksf]
-1637.57	1323.75	10.2
-447.535	1544.49	10.2
-485.349	-142.076	10.2
-317.264	-315.23	10.2
-267.217	1755.15	5
-1806.56	1468.98	5

10. Polygonal Load

Load Type: Flexible
Area of Load: 1.5903e+006 ft^2

Load: 10.2 ksf
Depth: 0 ft
Installation Stage: Stage 1

Coordinates

X [ft]	Y [ft]
-1649.21	915.592
-1153.62	-131.529
-485.349	-142.076
-447.535	1544.49
-1637.57	1323.75

11. Polygonal Load

Load Type: Flexible
Area of Load: 417396 ft^2
Depth: 0 ft
Installation Stage: Stage 1

Coordinates and Load

X [ft]	Y [ft]	Load Magnitude [ksf]
-485.349	-142.076	10.2
-1153.62	-131.529	10.2
-1649.21	915.592	10.2
-1637.57	1323.75	10.2
-1806.56	1468.98	5
-1809.13	885.67	5
-1259.26	-297.655	5
-317.264	-315.23	5

12. Polygonal Load

Load Type: Flexible
Area of Load: 941302 ft^2
Depth: 0 ft
Installation Stage: Stage 1

Coordinates and Load

X [ft]	Y [ft]	Load Magnitude [ksf]
188.83	-2491.7	10.2
293.799	364.216	10.2
2201.69	-1376.73	10.2
2690.18	-1545.21	5
153.042	647.667	5
27.7015	-2645.99	5

13. Polygonal Load

Load Type: Flexible
Area of Load: 551990 ft^2
Depth: 0 ft
Installation Stage: Stage 1

Coordinates and Load

X [ft]	Y [ft]	Load Magnitude [ksf]
952.602	-2672.52	5
989.748	-1516.48	5
2690.18	-1545.21	5
2201.69	-1376.73	10.2
832.524	-1353.16	10.2
802.744	-2507.54	10.2
188.83	-2491.7	10.2
27.7015	-2645.99	5

14. Polygonal Load

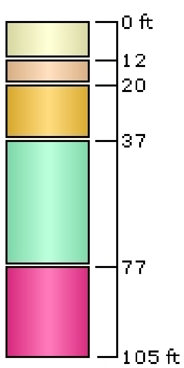
Load Type: Flexible
Area of Load: 2.38333e+006 ft^2
Depth: 0 ft
Installation Stage: Stage 1

Coordinates and Load

X [ft]	Y [ft]	Load Magnitude [ksf]
832.524	-1353.16	10.2
2201.69	-1376.73	10.2
293.799	364.216	10.2
188.83	-2491.7	10.2
802.744	-2507.54	10.2

Soil Layers

Layer #	Type	Thickness [ft]	Depth [ft]
1	CLAY	12	0
2	SILT & SAND	8	12
3	SAND	17	20
4	SAND & GRAVEL	40	37
5	SAND (2)	28	77



Soil Properties

Property	CLAY	SILT & SAND	SAND	SAND & GRAVEL	SAND (2)
Color					
Unit Weight [kips/ft^3]	0.118	0.12	0.122	0.124	0.125
Saturated Unit Weight [kips/ft^3]	0.118	0.12	0.122	0.124	0.125
Immediate Settlement	Disabled	Enabled	Enabled	Enabled	Enabled
Es [ksf]		300	900	1000	1200
Es bottom [ksf]		500			
Esur [ksf]		300	900	1000	1200
Esur bottom [ksf]		500			
Primary Consolidation	Enabled	Disabled	Disabled	Disabled	Disabled
Material Type	Non-Linear				
Cc	0.32				
Cr	0.04				
e0	0.862				
Pc [ksf]	4.76				
OCR		1	1	1	1
Secondary Consolidation	Standard	Disabled	Disabled	Disabled	Disabled
Cae/Ca	0.004				
Car/Care	0.004				

Query Lines

Line #	Start Location	End Location	Horizontal Divisions	Vertical Divisions
1	-119.939, -437.96	1670.82, -437.96	100	101

Settle3D Analysis Information

Project Settings

Document Name: circle 12 Labadie.s3z
Date Created: 3/15/2011, 2:21:05 PM
Stress Computation Method: Boussinesq
Include buoyancy effect when material settles below water table
Use average properties to calculate layered stresses
Groundwater method: Water Table
Water Unit Weight: 0.0624 kips/ft^3
Depth to water table: 0 [ft]

Stage Settings

Stage #	Name
1	Stage 1

Results

Time taken to compute: 0 seconds

Stage: Stage 1

Data Type	Minimum	Maximum
Total Settlement [in]	0	0.167998
Consolidation Settlement [in]	0	0.0707617
Immediate Settlement [in]	0	0.142156
Loading Stress [ksf]	0	0.531582
Effective Stress [ksf]	0	6.69012
Total Stress [ksf]	0	13.1166
Total Strain	4.27224e-009	0.00181831
Pore Water Pressure [ksf]	0	6.42712
Degree of Consolidation [%]	0	100
Pre-consolidation Stress [ksf]	1.13095	6.68765
Over-consolidation Ratio	1	171.223
Void Ratio	0	0.862
Hydroconsolidation Settlement [in]	0	0

Loads

1. Polygonal Load

Load Type: Flexible
Area of Load: 183389 ft^2

Depth: 0 ft
Installation Stage: Stage 1

Coordinates and Load

X [ft]	Y [ft]	Load Magnitude [ksf]
-1929.25	862.473	0
-1332.07	-407.189	0
-210.328	-424.303	0
-270.312	-363.597	2.9
-1293.01	-349.297	2.9
-1870.41	874.203	2.9
-1852.31	1508.1	2.9
-1908.21	1557.97	0

2. Polygonal Load

Load Type: Flexible
Area of Load: 234768 ft^2
Depth: 0 ft
Installation Stage: Stage 1

Coordinates and Load

X [ft]	Y [ft]	Load Magnitude [ksf]
-1852.31	1508.1	2.9
-221.212	1808.9	2.9
-270.312	-363.597	2.9
-210.328	-424.303	0
-162.623	1880.73	0
-1908.21	1557.97	0

3. Polygonal Load

Load Type: Flexible
Area of Load: 156632 ft^2
Depth: 0 ft
Installation Stage: Stage 1

Coordinates and Load

X [ft]	Y [ft]	Load Magnitude [ksf]
-1870.41	874.203	2.9
-1293.01	-349.297	2.9
-270.312	-363.597	2.9
-317.264	-315.23	5
-1259.26	-297.655	5
-1809.13	885.67	5
-1806.79	1469.02	5
-1852.31	1508.1	2.9

4. Polygonal Load

Load Type: Flexible

Area of Load: 171981 ft^2
Depth: 0 ft
Installation Stage: Stage 1

Coordinates and Load

X [ft]	Y [ft]	Load Magnitude [ksf]
-1852.31	1508.1	2.9
-1806.79	1469.02	5
-267.217	1755.15	5
-317.264	-315.23	5
-270.312	-363.597	2.9
-221.212	1808.9	2.9

5. Polygonal Load

Load Type: Flexible
Area of Load: 244557 ft^2
Depth: 0 ft
Installation Stage: Stage 1

Coordinates and Load

X [ft]	Y [ft]	Load Magnitude [ksf]
-102.643	-2757.4	0
1076.16	-2794.88	0
1109.25	-1637.87	0
3035.41	-1668.34	0
2874.5	-1608.34	2.9
1048.12	-1576.89	2.9
1016.65	-2734.4	2.9
-39.0646	-2705.7	2.9

6. Polygonal Load

Load Type: Flexible
Area of Load: 433982 ft^2
Depth: 0 ft
Installation Stage: Stage 1

Coordinates and Load

X [ft]	Y [ft]	Load Magnitude [ksf]
-39.0604	-2705.58	2.9
88.9461	776.742	2.9
2874.5	-1608.34	2.9
3035.41	-1668.34	0
35.4746	897.295	0
-102.643	-2757.4	0

7. Polygonal Load

Load Type: Flexible
Area of Load: 451309 ft^2

Depth: 0 ft
Installation Stage: Stage 1

Coordinates and Load

X [ft]	Y [ft]	Load Magnitude [ksf]
27.8223	-2642.81	5
153.042	647.667	5
2690.18	-1545.21	5
2874.5	-1608.34	2.9
88.9461	776.742	2.9
-39.0604	-2705.58	2.9

8. Polygonal Load

Load Type: Flexible
Area of Load: 238713 ft^2
Depth: 0 ft
Installation Stage: Stage 1

Coordinates and Load

X [ft]	Y [ft]	Load Magnitude [ksf]
-39.0644	-2705.7	2.9
1018.23	-2734.44	2.9
1048.12	-1576.89	2.9
2874.5	-1608.34	2.9
2690.18	-1545.21	5
989.752	-1516.32	5
956.638	-2672.65	5
27.8223	-2642.81	5

9. Polygonal Load

Load Type: Flexible
Area of Load: 567821 ft^2
Depth: 0 ft
Installation Stage: Stage 1

Coordinates and Load

X [ft]	Y [ft]	Load Magnitude [ksf]
-1637.57	1323.75	10
-447.535	1544.49	10
-485.349	-142.076	10
-317.264	-315.23	5
-267.217	1755.15	5
-1806.56	1468.98	5

10. Polygonal Load

Load Type: Flexible
Area of Load: 1.5903e+006 ft^2
Depth: 0 ft

Installation Stage: Stage 1

Coordinates and Load

X [ft]	Y [ft]	Load Magnitude [ksf]
-1649.21	915.592	10.2
-1153.62	-131.529	10.2
-485.349	-142.076	10.2
-447.535	1544.49	10.2
-1637.57	1323.75	10.2

11. Polygonal Load

Load Type: Flexible
Area of Load: 417396 ft^2
Depth: 0 ft
Installation Stage: Stage 1

Coordinates and Load

X [ft]	Y [ft]	Load Magnitude [ksf]
-485.349	-142.076	10
-1153.62	-131.529	10
-1649.21	915.592	10
-1637.57	1323.75	10
-1806.56	1468.98	5
-1809.13	885.67	5
-1259.26	-297.655	5
-317.264	-315.23	5

12. Polygonal Load

Load Type: Flexible
Area of Load: 941302 ft^2
Depth: 0 ft
Installation Stage: Stage 1

Coordinates and Load

X [ft]	Y [ft]	Load Magnitude [ksf]
188.83	-2491.7	10
293.799	364.216	10
2201.69	-1376.73	10
2690.18	-1545.21	5
153.042	647.667	5
27.7015	-2645.99	5

13. Polygonal Load

Load Type: Flexible
Area of Load: 551990 ft^2
Depth: 0 ft
Installation Stage: Stage 1

Coordinates and Load

X [ft]	Y [ft]	Load Magnitude [ksf]
952.602	-2672.52	5
989.748	-1516.48	5
2690.18	-1545.21	5
2201.69	-1376.73	10
832.524	-1353.16	10
802.744	-2507.54	10
188.83	-2491.7	10
27.7015	-2645.99	5

14. Polygonal Load

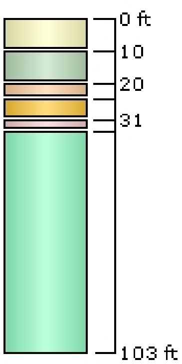
Load Type: Flexible
Area of Load: 2.38333e+006 ft^2
Depth: 0 ft
Installation Stage: Stage 1

Coordinates and Load

X [ft]	Y [ft]	Load Magnitude [ksf]
832.524	-1353.16	10.2
2201.69	-1376.73	10.2
293.799	364.216	10.2
188.83	-2491.7	10.2
802.744	-2507.54	10.2

Soil Layers

Layer #	Type	Thickness [ft]	Depth [ft]
1	CLAY	10	0
2	SILT	10	10
3	SAND	5	20
4	SILT & SAND	6	25
5	LOWER SAND	4	31
6	SAND & GRAVEL	68	35



Soil Properties

Property	CLAY	SILT	SAND	SILT & SAND	LOWER SAND	SAND & GRAVEL
Color						
Unit Weight [kips/ft^3]	0.118	0.117	0.119	0.12	0.122	0.124
Saturated Unit Weight [kips/ft^3]	0.118	0.117	0.119	0.12	0.122	0.124
Immediate Settlement	Disabled	Enabled	Enabled	Enabled	Enabled	Enabled
Es [ksf]		200	800	600	900	1400
Es bottom [ksf]		500				
Esur [ksf]		200	800	600	900	1400
Esur bottom [ksf]		500				
Primary Consolidation	Enabled	Disabled	Disabled	Disabled	Disabled	Disabled
Material Type	Non-Linear					
Cc	0.32					
Cr	0.04					
e0	0.862					
Pc [ksf]	4.76	4.52				
OCR			1	1	1	1
Secondary Consolidation	Standard	Disabled	Disabled	Disabled	Disabled	Disabled
Cae/Ca	0.004					
Car/Care	0.004					

Query Lines

Line #	Start Location	End Location	Horizontal Divisions	Vertical Divisions
1	-37, 1887	-188, -1959	100	Auto: 61

Settle3D Analysis Information

Project Settings

Document Name: circle 11 Labadie.s3z
Date Created: 3/15/2011, 2:21:05 PM
Stress Computation Method: Boussinesq
Include buoyancy effect when material settles below water table
Use average properties to calculate layered stresses
Groundwater method: Water Table
Water Unit Weight: 0.0624 kips/ft^3
Depth to water table: 0 [ft]

Stage Settings

Stage #	Name
1	Stage 1

Results

Time taken to compute: 0 seconds

Stage: Stage 1

Data Type	Minimum	Maximum
Total Settlement [in]	0	0.198016
Consolidation Settlement [in]	0	0.0968068
Immediate Settlement [in]	0	0.148182
Loading Stress [ksf]	0	0.531582
Effective Stress [ksf]	0	6.66916
Total Stress [ksf]	0	13.0956
Total Strain	0	0.00603323
Pore Water Pressure [ksf]	0	6.42712
Degree of Consolidation [%]	0	100
Pre-consolidation Stress [ksf]	1.1603	6.66669
Over-consolidation Ratio	1	713.429
Void Ratio	0	0.862
Hydroconsolidation Settlement [in]	0	0

Loads

1. Polygonal Load

Load Type: Flexible
Area of Load: 183389 ft^2

Depth: 0 ft
Installation Stage: Stage 1

Coordinates and Load

X [ft]	Y [ft]	Load Magnitude [ksf]
-1929.25	862.473	0
-1332.07	-407.189	0
-210.328	-424.303	0
-270.312	-363.597	2.9
-1293.01	-349.297	2.9
-1870.41	874.203	2.9
-1852.31	1508.1	2.9
-1908.21	1557.97	0

2. Polygonal Load

Load Type: Flexible
Area of Load: 234768 ft^2
Depth: 0 ft
Installation Stage: Stage 1

Coordinates and Load

X [ft]	Y [ft]	Load Magnitude [ksf]
-1852.31	1508.1	2.9
-221.212	1808.9	2.9
-270.312	-363.597	2.9
-210.328	-424.303	0
-162.623	1880.73	0
-1908.21	1557.97	0

3. Polygonal Load

Load Type: Flexible
Area of Load: 156632 ft^2
Depth: 0 ft
Installation Stage: Stage 1

Coordinates and Load

X [ft]	Y [ft]	Load Magnitude [ksf]
-1870.41	874.203	2.9
-1293.01	-349.297	2.9
-270.312	-363.597	2.9
-317.264	-315.23	5
-1259.26	-297.655	5
-1809.13	885.67	5
-1806.79	1469.02	5
-1852.31	1508.1	2.9

4. Polygonal Load

Load Type: Flexible

Area of Load: 171981 ft^2
Depth: 0 ft
Installation Stage: Stage 1

Coordinates and Load

X [ft]	Y [ft]	Load Magnitude [ksf]
-1852.31	1508.1	2.9
-1806.79	1469.02	5
-267.217	1755.15	5
-317.264	-315.23	5
-270.312	-363.597	2.9
-221.212	1808.9	2.9

5. Polygonal Load

Load Type: Flexible
Area of Load: 244557 ft^2
Depth: 0 ft
Installation Stage: Stage 1

Coordinates and Load

X [ft]	Y [ft]	Load Magnitude [ksf]
-102.643	-2757.4	0
1076.16	-2794.88	0
1109.25	-1637.87	0
3035.41	-1668.34	0
2874.5	-1608.34	2.9
1048.12	-1576.89	2.9
1016.65	-2734.4	2.9
-39.0646	-2705.7	2.9

6. Polygonal Load

Load Type: Flexible
Area of Load: 433982 ft^2
Depth: 0 ft
Installation Stage: Stage 1

Coordinates and Load

X [ft]	Y [ft]	Load Magnitude [ksf]
-39.0604	-2705.58	2.9
88.9461	776.742	2.9
2874.5	-1608.34	2.9
3035.41	-1668.34	0
35.4746	897.295	0
-102.643	-2757.4	0

7. Polygonal Load

Load Type: Flexible
Area of Load: 451309 ft^2

Depth: 0 ft
Installation Stage: Stage 1

Coordinates and Load

X [ft]	Y [ft]	Load Magnitude [ksf]
27.8223	-2642.81	5
153.042	647.667	5
2690.18	-1545.21	5
2874.5	-1608.34	2.9
88.9461	776.742	2.9
-39.0604	-2705.58	2.9

8. Polygonal Load

Load Type: Flexible
Area of Load: 238713 ft^2
Depth: 0 ft
Installation Stage: Stage 1

Coordinates and Load

X [ft]	Y [ft]	Load Magnitude [ksf]
-39.0644	-2705.7	2.9
1018.23	-2734.44	2.9
1048.12	-1576.89	2.9
2874.5	-1608.34	2.9
2690.18	-1545.21	5
989.752	-1516.32	5
956.638	-2672.65	5
27.8223	-2642.81	5

9. Polygonal Load

Load Type: Flexible
Area of Load: 567821 ft^2
Depth: 0 ft
Installation Stage: Stage 1

Coordinates and Load

X [ft]	Y [ft]	Load Magnitude [ksf]
-1637.57	1323.75	10
-447.535	1544.49	10
-485.349	-142.076	10
-317.264	-315.23	5
-267.217	1755.15	5
-1806.56	1468.98	5

10. Polygonal Load

Load Type: Flexible
Area of Load: 1.5903e+006 ft^2
Depth: 0 ft

Installation Stage: Stage 1

Coordinates and Load

X [ft]	Y [ft]	Load Magnitude [ksf]
-1649.21	915.592	10.2
-1153.62	-131.529	10.2
-485.349	-142.076	10.2
-447.535	1544.49	10.2
-1637.57	1323.75	10.2

11. Polygonal Load

Load Type: Flexible
Area of Load: 417396 ft^2
Depth: 0 ft
Installation Stage: Stage 1

Coordinates and Load

X [ft]	Y [ft]	Load Magnitude [ksf]
-485.349	-142.076	10
-1153.62	-131.529	10
-1649.21	915.592	10
-1637.57	1323.75	10
-1806.56	1468.98	5
-1809.13	885.67	5
-1259.26	-297.655	5
-317.264	-315.23	5

12. Polygonal Load

Load Type: Flexible
Area of Load: 941302 ft^2
Depth: 0 ft
Installation Stage: Stage 1

Coordinates and Load

X [ft]	Y [ft]	Load Magnitude [ksf]
188.83	-2491.7	10
293.799	364.216	10
2201.69	-1376.73	10
2690.18	-1545.21	5
153.042	647.667	5
27.7015	-2645.99	5

13. Polygonal Load

Load Type: Flexible
Area of Load: 551990 ft^2
Depth: 0 ft
Installation Stage: Stage 1

Coordinates and Load

X [ft]	Y [ft]	Load Magnitude [ksf]
952.602	-2672.52	5
989.748	-1516.48	5
2690.18	-1545.21	5
2201.69	-1376.73	10
832.524	-1353.16	10
802.744	-2507.54	10
188.83	-2491.7	10
27.7015	-2645.99	5

14. Polygonal Load

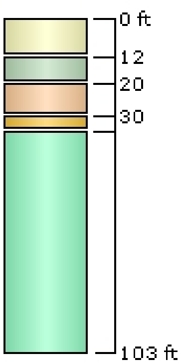
Load Type: Flexible
Area of Load: 2.38333e+006 ft^2
Depth: 0 ft
Installation Stage: Stage 1

Coordinates and Load

X [ft]	Y [ft]	Load Magnitude [ksf]
832.524	-1353.16	10.2
2201.69	-1376.73	10.2
293.799	364.216	10.2
188.83	-2491.7	10.2
802.744	-2507.54	10.2

Soil Layers

Layer #	Type	Thickness [ft]	Depth [ft]
1	CLAY	12	0
2	SILT	8	12
3	SILT & SAND	10	20
4	CLAY & SILT	5	30
5	SAND & GRAVEL	68	35



Soil Properties

Property	CLAY	SILT	SILT & SAND	CLAY & SILT	SAND & GRAVEL
Color					
Unit Weight [kips/ft^3]	0.118	0.117	0.118	0.12	0.124
Saturated Unit Weight [kips/ft^3]	0.118	0.117	0.118	0.12	0.124
Immediate Settlement	Disabled	Enabled	Enabled	Enabled	Enabled
Es [ksf]		400	500	225	1400
Esur [ksf]		400	500	225	1400
Primary Consolidation	Enabled	Disabled	Disabled	Disabled	Disabled
Material Type	Non-Linear				
Cc	0.32				
Cr	0.04				
e0	0.862				
Pc [ksf]	4.76	4.52			
OCR			1	1	1
Secondary Consolidation	Standard	Disabled	Disabled	Disabled	Disabled
Cae/Ca	0.004				
Car/Care	0.004				

Query Lines

Line #	Start Location	End Location	Horizontal Divisions	Vertical Divisions
1	-37, 1887	-188, -1959	100	Auto: 59

Settle3D Analysis Information
Labadie UWL

Project Settings

Document Name: circle 9.s3z
Project Title: Labadie UWL
Analysis: Settlement
Author: Christopher Cook
Company: Reitz & Jens, Inc
Date Created: 10/17/2012, 11:48:36 AM
Stress Computation Method: Boussinesq
Use average properties to calculate layered stresses
Groundwater method: Water Table
Water Unit Weight: 0.0624 kips/ft^3
Depth to water table: 1 [ft]

Stage Settings

Stage #	Name
1	Stage 1

Loads

1. Polygonal Load

Load Type: Flexible
Area of Load: 183389 ft^2
Depth: 0 ft
Installation Stage: Stage 1

Coordinates and Load

X [ft]	Y [ft]	Load Magnitude [ksf]
-1929.25	862.473	0
-1332.07	-407.189	0
-210.328	-424.303	0
-270.312	-363.597	2.9
-1293.01	-349.297	2.9
-1870.41	874.203	2.9
-1852.31	1508.1	2.9
-1908.21	1557.97	0

2. Polygonal Load

Load Type: Flexible
Area of Load: 234768 ft^2
Depth: 0 ft

Installation Stage: Stage 1

Coordinates and Load

X [ft]	Y [ft]	Load Magnitude [ksf]
-1852.31	1508.1	2.9
-221.212	1808.9	2.9
-270.312	-363.597	2.9
-210.328	-424.303	0
-162.623	1880.73	0
-1908.21	1557.97	0

3. Polygonal Load

Load Type: Flexible
Area of Load: 156632 ft^2
Depth: 0 ft
Installation Stage: Stage 1

Coordinates and Load

X [ft]	Y [ft]	Load Magnitude [ksf]
-1870.41	874.203	2.9
-1293.01	-349.297	2.9
-270.312	-363.597	2.9
-317.264	-315.23	5
-1259.26	-297.655	5
-1809.13	885.67	5
-1806.79	1469.02	5
-1852.31	1508.1	2.9

4. Polygonal Load

Load Type: Flexible
Area of Load: 171981 ft^2
Depth: 0 ft
Installation Stage: Stage 1

Coordinates and Load

X [ft]	Y [ft]	Load Magnitude [ksf]
-1852.31	1508.1	2.9
-1806.79	1469.02	5
-267.217	1755.15	5
-317.264	-315.23	5
-270.312	-363.597	2.9
-221.212	1808.9	2.9

5. Polygonal Load

Load Type: Flexible
Area of Load: 244557 ft^2
Depth: 0 ft
Installation Stage: Stage 1

Coordinates and Load

X [ft]	Y [ft]	Load Magnitude [ksf]
-102.643	-2757.4	0
1076.16	-2794.88	0
1109.25	-1637.87	0
3035.41	-1668.34	0
2874.5	-1608.34	2.9
1048.12	-1576.89	2.9
1016.65	-2734.4	2.9
-39.0646	-2705.7	2.9

6. Polygonal Load

Load Type: Flexible
Area of Load: 433982 ft^2
Depth: 0 ft
Installation Stage: Stage 1

Coordinates and Load

X [ft]	Y [ft]	Load Magnitude [ksf]
-39.0604	-2705.58	2.9
88.9461	776.742	2.9
2874.5	-1608.34	2.9
3035.41	-1668.34	0
35.4746	897.295	0
-102.643	-2757.4	0

7. Polygonal Load

Load Type: Flexible
Area of Load: 451309 ft^2
Depth: 0 ft
Installation Stage: Stage 1

Coordinates and Load

X [ft]	Y [ft]	Load Magnitude [ksf]
27.8223	-2642.81	5
153.042	647.667	5
2690.18	-1545.21	5
2874.5	-1608.34	2.9
88.9461	776.742	2.9
-39.0604	-2705.58	2.9

8. Polygonal Load

Load Type: Flexible
Area of Load: 238713 ft^2
Depth: 0 ft
Installation Stage: Stage 1

Coordinates and Load

X [ft]	Y [ft]	Load Magnitude [ksf]

-39.0644	-2705.7	2.9
1018.23	-2734.44	2.9
1048.12	-1576.89	2.9
2874.5	-1608.34	2.9
2690.18	-1545.21	5
989.752	-1516.32	5
956.638	-2672.65	5
27.8223	-2642.81	5

9. Polygonal Load

Load Type: Flexible
Area of Load: 567821 ft^2
Depth: 0 ft
Installation Stage: Stage 1

Coordinates and Load

X [ft]	Y [ft]	Load Magnitude [ksf]
-1637.57	1323.75	10.2
-447.535	1544.49	10.2
-485.349	-142.076	10.2
-317.264	-315.23	10.2
-267.217	1755.15	5
-1806.56	1468.98	5

10. Polygonal Load

Load Type: Flexible
Area of Load: 1.5903e+006 ft^2
Load: 10.2 ksf
Depth: 0 ft
Installation Stage: Stage 1

Coordinates

X [ft]	Y [ft]
-1649.21	915.592
-1153.62	-131.529
-485.349	-142.076
-447.535	1544.49
-1637.57	1323.75

11. Polygonal Load

Load Type: Flexible
Area of Load: 417396 ft^2
Depth: 0 ft
Installation Stage: Stage 1

Coordinates and Load

X [ft]	Y [ft]	Load Magnitude [ksf]
-485.349	-142.076	10.2
-1153.62	-131.529	10.2

-1649.21	915.592	10.2
-1637.57	1323.75	10.2
-1806.56	1468.98	5
-1809.13	885.67	5
-1259.26	-297.655	5
-317.264	-315.23	5

12. Polygonal Load

Load Type: Flexible
Area of Load: 941302 ft^2
Depth: 0 ft
Installation Stage: Stage 1

Coordinates and Load

X [ft]	Y [ft]	Load Magnitude [ksf]
188.83	-2491.7	10.2
293.799	364.216	10.2
2201.69	-1376.73	10.2
2690.18	-1545.21	5
153.042	647.667	5
27.7015	-2645.99	5

13. Polygonal Load

Load Type: Flexible
Area of Load: 551990 ft^2
Depth: 0 ft
Installation Stage: Stage 1

Coordinates and Load

X [ft]	Y [ft]	Load Magnitude [ksf]
952.602	-2672.52	5
989.748	-1516.48	5
2690.18	-1545.21	5
2201.69	-1376.73	10.2
832.524	-1353.16	10.2
802.744	-2507.54	10.2
188.83	-2491.7	10.2
27.7015	-2645.99	5

14. Polygonal Load

Load Type: Flexible
Area of Load: 2.38333e+006 ft^2
Depth: 0 ft
Installation Stage: Stage 1

Coordinates and Load

X [ft]	Y [ft]	Load Magnitude [ksf]
832.524	-1353.16	10.2
2201.69	-1376.73	10.2

293.799	364.216	10.2
188.83	-2491.7	10.2
802.744	-2507.54	10.2

15. Polygonal Load

Load Type: Flexible
Area of Load: 6368.13 ft^2
Load: 2.2 ksf
Depth: 0 ft
Installation Stage: Stage 1

Coordinates

X [ft]	Y [ft]
-189.163	598.37
24.1777	598.37
25.3044	628.184
-188.546	628.184

16. Polygonal Load

Load Type: Flexible
Area of Load: 36129.2 ft^2
Depth: 0 ft
Installation Stage: Stage 1

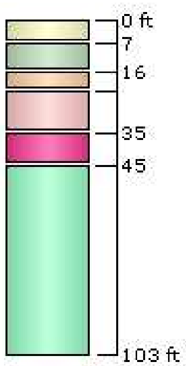
Coordinates and Load

X [ft]	Y [ft]	Load Magnitude [ksf]
-263.883	598.37	0
-190.3	543.421	0
-189.163	598.37	2.2
-188.546	628.184	2.2
25.3044	628.184	2.2
24.1777	598.37	2.2
-189.163	598.37	2.2
-190.3	543.421	0
22.101	543.421	0
100.385	598.37	0
100.385	628.184	0
27.3659	682.733	0
-187.417	682.733	0
-263.883	628.184	0

Soil Layers

Layer #	Type	Thickness [ft]	Depth [ft]
1	CLAY	7	0
2	SILT	9	7
3	SILT & SAND	6	16
4	SAND	13	22

5	LOWER SAND	10	35
6	SAND & GRAVEL	58	45



Soil Properties

Property	CLAY	SILT	SILT & SAND	SAND	SAND & GRAVEL	LOWER SAND
Color						
Unit Weight [kips/ft^3]	0.113	0.117	0.12	0.122	0.124	0.124
Saturated Unit Weight [kips/ft^3]	0.113	0.117	0.12	0.122	0.124	0.124
Immediate Settlement	Disabled	Enabled	Enabled	Enabled	Enabled	Enabled
Es [ksf]		300	900	1100	1400	1300
Esur [ksf]		300	900	1100	1400	1300
Primary Consolidation	Enabled	Disabled	Disabled	Disabled	Disabled	Disabled
Material Type	Non-Linear					
Cc	0.3					
Cr	0.05					
e0	0.917					
Pc [ksf]	4.52					
OCR		1	1	1	1	1
Secondary Consolidation	Standard	Disabled	Disabled	Disabled	Disabled	Disabled
Cae/Ca	0.005					
Car/Care	0.005					

Query Lines

Line #	Start Location	End Location	Horizontal Divisions	Vertical Divisions
1	-37, 1887	-188, -1959	100	100

Settle3D Analysis Information
Labadie UWL

Project Settings

Document Name: CIRCLE 48.s3z
Project Title: Labadie UWL
Analysis: Settlement
Author: Christopher Cook
Company: Reitz & Jens, Inc
Date Created: 10/17/2012, 11:48:36 AM
Stress Computation Method: Boussinesq
Use average properties to calculate layered stresses
Groundwater method: Water Table
Water Unit Weight: 0.0624 kips/ft^3
Depth to water table: 1 [ft]

Stage Settings

Stage #	Name
1	Stage 1

Results

Time taken to compute: 0 seconds

Stage: Stage 1

Data Type	Minimum	Maximum
Total Settlement [in]	0	4.28082
Consolidation Settlement [in]	0	1.93172
Immediate Settlement [in]	0	2.34909
Loading Stress [ksf]	0	2.20022
Effective Stress [ksf]	0	7.76966
Total Stress [ksf]	0	14.2593
Total Strain	2.30708e-009	0.0552686
Pore Water Pressure [ksf]	0	6.4896
Degree of Consolidation [%]	0	100
Pre-consolidation Stress [ksf]	0.498421	7.76591
Over-consolidation Ratio	1	806.771
Void Ratio	0	0.862
Hydroconsolidation Settlement [in]	0	0

Loads

1. Polygonal Load

Load Type: Flexible
Area of Load: 183389 ft^2
Depth: 0 ft
Installation Stage: Stage 1

Coordinates and Load

X [ft]	Y [ft]	Load Magnitude [ksf]
-1929.25	862.473	0
-1332.07	-407.189	0
-210.328	-424.303	0
-270.312	-363.597	2.9
-1293.01	-349.297	2.9
-1870.41	874.203	2.9
-1852.31	1508.1	2.9
-1908.21	1557.97	0

2. Polygonal Load

Load Type: Flexible
Area of Load: 234768 ft^2
Depth: 0 ft
Installation Stage: Stage 1

Coordinates and Load

X [ft]	Y [ft]	Load Magnitude [ksf]
-1852.31	1508.1	2.9
-221.212	1808.9	2.9
-270.312	-363.597	2.9
-210.328	-424.303	0
-162.623	1880.73	0
-1908.21	1557.97	0

3. Polygonal Load

Load Type: Flexible
Area of Load: 156632 ft^2
Depth: 0 ft
Installation Stage: Stage 1

Coordinates and Load

X [ft]	Y [ft]	Load Magnitude [ksf]
-1870.41	874.203	2.9
-1293.01	-349.297	2.9
-270.312	-363.597	2.9
-317.264	-315.23	5
-1259.26	-297.655	5
-1809.13	885.67	5
-1806.79	1469.02	5
-1852.31	1508.1	2.9

4. Polygonal Load

Load Type: Flexible
Area of Load: 171981 ft^2
Depth: 0 ft
Installation Stage: Stage 1

Coordinates and Load

X [ft]	Y [ft]	Load Magnitude [ksf]
-1852.31	1508.1	2.9
-1806.79	1469.02	5
-267.217	1755.15	5
-317.264	-315.23	5
-270.312	-363.597	2.9
-221.212	1808.9	2.9

5. Polygonal Load

Load Type: Flexible
Area of Load: 244557 ft^2
Depth: 0 ft
Installation Stage: Stage 1

Coordinates and Load

X [ft]	Y [ft]	Load Magnitude [ksf]
-102.643	-2757.4	0
1076.16	-2794.88	0
1109.25	-1637.87	0
3035.41	-1668.34	0
2874.5	-1608.34	2.9
1048.12	-1576.89	2.9
1016.65	-2734.4	2.9
-39.0646	-2705.7	2.9

6. Polygonal Load

Load Type: Flexible
Area of Load: 433982 ft^2
Depth: 0 ft
Installation Stage: Stage 1

Coordinates and Load

X [ft]	Y [ft]	Load Magnitude [ksf]
-39.0604	-2705.58	2.9
88.9461	776.742	2.9
2874.5	-1608.34	2.9
3035.41	-1668.34	0
35.4746	897.295	0
-102.643	-2757.4	0

7. Polygonal Load

Load Type: Flexible
Area of Load: 451309 ft^2
Depth: 0 ft
Installation Stage: Stage 1

Coordinates and Load

X [ft]	Y [ft]	Load Magnitude [ksf]
27.8223	-2642.81	5
153.042	647.667	5
2690.18	-1545.21	5
2874.5	-1608.34	2.9
88.9461	776.742	2.9
-39.0604	-2705.58	2.9

8. Polygonal Load

Load Type: Flexible
Area of Load: 238713 ft^2
Depth: 0 ft
Installation Stage: Stage 1

Coordinates and Load

X [ft]	Y [ft]	Load Magnitude [ksf]
-39.0644	-2705.7	2.9
1018.23	-2734.44	2.9
1048.12	-1576.89	2.9
2874.5	-1608.34	2.9
2690.18	-1545.21	5
989.752	-1516.32	5
956.638	-2672.65	5
27.8223	-2642.81	5

9. Polygonal Load

Load Type: Flexible
Area of Load: 567821 ft^2
Depth: 0 ft
Installation Stage: Stage 1

Coordinates and Load

X [ft]	Y [ft]	Load Magnitude [ksf]
-1637.57	1323.75	10.2
-447.535	1544.49	10.2
-485.349	-142.076	10.2
-317.264	-315.23	10.2
-267.217	1755.15	5
-1806.56	1468.98	5

10. Polygonal Load

Load Type: Flexible
Area of Load: 1.5903e+006 ft^2

Load: 10.2 ksf
Depth: 0 ft
Installation Stage: Stage 1

Coordinates

X [ft]	Y [ft]
-1649.21	915.592
-1153.62	-131.529
-485.349	-142.076
-447.535	1544.49
-1637.57	1323.75

11. Polygonal Load

Load Type: Flexible
Area of Load: 417396 ft^2
Depth: 0 ft
Installation Stage: Stage 1

Coordinates and Load

X [ft]	Y [ft]	Load Magnitude [ksf]
-485.349	-142.076	10.2
-1153.62	-131.529	10.2
-1649.21	915.592	10.2
-1637.57	1323.75	10.2
-1806.56	1468.98	5
-1809.13	885.67	5
-1259.26	-297.655	5
-317.264	-315.23	5

12. Polygonal Load

Load Type: Flexible
Area of Load: 941302 ft^2
Depth: 0 ft
Installation Stage: Stage 1

Coordinates and Load

X [ft]	Y [ft]	Load Magnitude [ksf]
188.83	-2491.7	10.2
293.799	364.216	10.2
2201.69	-1376.73	10.2
2690.18	-1545.21	5
153.042	647.667	5
27.7015	-2645.99	5

13. Polygonal Load

Load Type: Flexible
Area of Load: 551990 ft^2
Depth: 0 ft
Installation Stage: Stage 1

Coordinates and Load

X [ft]	Y [ft]	Load Magnitude [ksf]
952.602	-2672.52	5
989.748	-1516.48	5
2690.18	-1545.21	5
2201.69	-1376.73	10.2
832.524	-1353.16	10.2
802.744	-2507.54	10.2
188.83	-2491.7	10.2
27.7015	-2645.99	5

14. Polygonal Load

Load Type: Flexible
Area of Load: 2.38333e+006 ft^2
Depth: 0 ft
Installation Stage: Stage 1

Coordinates and Load

X [ft]	Y [ft]	Load Magnitude [ksf]
832.524	-1353.16	10.2
2201.69	-1376.73	10.2
293.799	364.216	10.2
188.83	-2491.7	10.2
802.744	-2507.54	10.2

15. Polygonal Load

Load Type: Flexible
Area of Load: 6083.7 ft^2
Load: 2.2 ksf
Depth: 0 ft
Installation Stage: Stage 1

Coordinates

X [ft]	Y [ft]
-209.08	-363.999
-12.1921	-363.999
-11.0259	-333.141
-208.441	-333.141

16. Polygonal Load

Load Type: Flexible
Area of Load: 34847 ft^2
Depth: 0 ft
Installation Stage: Stage 1

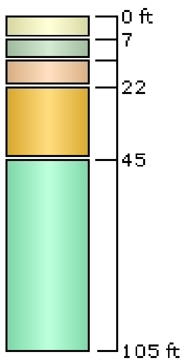
Coordinates and Load

X [ft]	Y [ft]	Load Magnitude [ksf]
-270.312	-363.597	0
-210.328	-424.303	0

-209.08	-363.999	2.2
-208.441	-333.141	2.2
-11.0259	-333.141	2.2
-12.1921	-363.999	2.2
-209.08	-363.999	2.2
-210.328	-424.303	0
-14.4711	-424.303	0
64.675	-363.999	0
64.675	-333.141	0
-8.95688	-278.393	0
-207.308	-278.393	0
-270.312	-333.141	0

Soil Layers

Layer #	Type	Thickness [ft]	Depth [ft]
1	CLAY	7	0
2	SILT	7	7
3	SILT & SAND	8	14
4	SAND	23	22
5	SAND & GRAVEL	60	45



Soil Properties

Property	CLAY	SILT	SILT & SAND	SAND	SAND & GRAVEL
Color					
Unit Weight [kips/ft^3]	0.118	0.117	0.12	0.122	0.124
Saturated Unit Weight [kips/ft^3]	0.118	0.117	0.12	0.122	0.124
Immediate Settlement	Disabled	Enabled	Enabled	Enabled	Enabled
Es [ksf]		150	700	900	1400
Es bottom [ksf]		400			
Esur [ksf]		150	700	900	1400
Esur bottom [ksf]		400			
Primary Consolidation	Enabled	Disabled	Disabled	Disabled	Disabled
Material Type	Non-Linear				

Cc	0.32				
Cr	0.04				
e0	0.862				
Pc [ksf]	4.76				
OCR		1	1	1	1
Secondary Consolidation	Standard	Disabled	Disabled	Disabled	Disabled
Cae/Ca	0.004				
Car/Care	0.004				

Query Lines

Line #	Start Location	End Location	Horizontal Divisions	Vertical Divisions
1	-37, 1887	-188, -1959	100	101
2	-114.933, -268.397	-121.003, -437.214	100	Auto: 61

<u>Appendix G</u>

DESIGN OF FABRIC-FORMED CONCRETE MAT (FCM)
Revised August 2013

REITZ & JENS, INC.
CONSULTING ENGINEERS

PROJECT AMEREN LABADIE UWL
SUBJECT DESIGN OF FABRIC-FORM CONCRETE MAT EROSION PROTECTION
DATE 6/12/2012 BY JLF Proj. Number 2008012455 SHEET 1 OF 1

REVISED JULY 2013

DESIGN OF FABRIC-FORMED CONCRETE MAT (FCM)

FCM IS FOR EROSION PROTECTION OF PERMANENT EXTERIOR SLOPE OF BERMS. FROM FLOODPLAIN ANALYSIS BY CDG, HIGHEST VELOCITIES OCCUR ALONG WEST BERM AT STA. 57.38 (RM).

MAX. VELOCITY = 1.30 TO 1.40 FPS
DEPTH OF FLOW (Y) = EL 481.6 − 465 = 16.6 FT FOR 100-YR FLOOD

FROM FHWA HEC-23, VOL. 2 (SEPT. 2009), CHAPTER 9

$$\text{FACTOR SAFETY (FS)} = \left[\frac{\mu(t)(\gamma_c-\gamma_w)\cos\theta\cos\alpha-\tau_{DES}}{\sqrt{[t(\gamma_c-\gamma_w)\sin\theta]^2+\tau_{DES}^2}}\right]$$

WHERE μ = COEFF. BASE SHEAR = TAN δ
RECOMMENDED δ FOR FCM ON FILTER GEOFABRIC OVER COHESIVE SOIL IS 32.5°
$\therefore \mu = \tan(32.5°) = 0.637$

t = THICKNESS OF FCM, TRY HYDROTEX FILTER POINT (FP) LINER FP220, WHICH IS 2.2" THICK, OR 0.183 FT
γ_c = UNIT WEIGHT OF FINE AGGREGATE CONCRETE
RECOMMENDED γ_c = 130 PCF
γ_w = 62.4 PCF (WATER)
θ = SLOPE ANGLE = 18.435° FOR 1(V)-3(H)
α = SLOPE OF BED, ASSUME 0

$$\text{ASSUME F.S.} = 1.5 = \left[\frac{(0.637)(0.183')(130\text{ PCF}-62.4\text{ PCF})\cos(18.435°)\cos(0°)-\tau_{DES}}{\sqrt{[(0.183')(130-62.4)\sin 18.435]^2+\tau_{DES}^2}}\right]$$

SOLVING, τ_{DES} = 1.294 PSF FOR F.S. = 1.5

DESIGN VELOCITY: $\tau_{DES} = \dfrac{\gamma_w}{Y^{1/3}}\left(\dfrac{n V_{DES}}{K_u}\right)^2$ WHERE K_u = 1.486 (ENG. UNITS)
n = MANNING COEFF. FOR FCM
n = 0.03 TO 0.025

$$1.294\text{ PSF} = \frac{62.4\text{ PCF}}{(16.6')^{1/3}}\left(\frac{0.03\cdot V_{DES}}{1.486}\right)^2$$

MAX V_{DES} = 11.4 FPS >> 1.40 FPS ESTIMATED

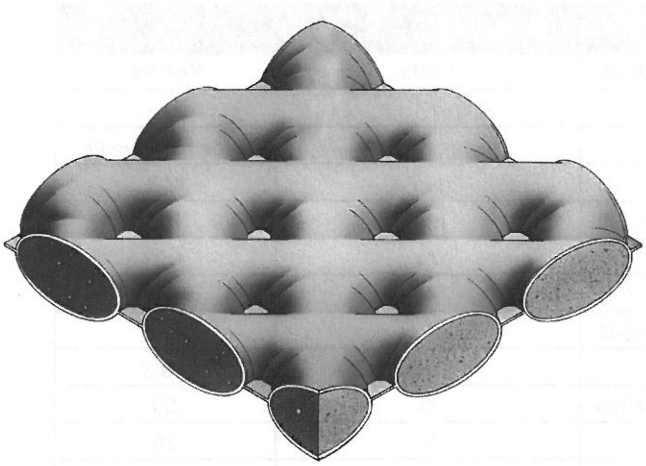
USE: HYDROTEX FP220 OVER GEOFABRIC OVER COHESIVE BERM FILL

CHECKED BY: JDB 2/14/2013

HYDROTEX™

Specification Guideline

Fabric-formed Concrete Erosion Control Systems



Filter Point Lining

Table 1.0 Typical Dimensions and Weights

Filter Point	FP220	FP400	FP600	FP800	FP1000	FP1200
Average Thickness, mm	56	102	152	203	254	305
Mass Per Unit Area, kg/m²	121	220	330	440	550	661
Filter Point Spacing, mm	127	203	254	305	356	406
Area per Filter Point, cm²	12.9	12.9	40.7	40.7	78.7	78.7
Perimeter per Filter Point, mm	165	165	279	279	381	381
Concrete Coverage, m²/m³	16.6	9.1	6.1	4.6	3.6	3.0
Shear Resistance, kg/m²	54	98	146	195	244	293

Note: Values shown are typical and will vary with weight of concrete and field conditions.

Product Description

Filter Point Linings with filtering points (drains) provide an erosion resistant, permeable concrete lining for ditches, channels, canals, streams, rivers, ponds, lakes, reservoirs, marinas, and protected port and harbor areas. Filter Point Linings have a cobbled surface and a relatively high coefficient of hydraulic friction in order to achieve lower flow velocities and to reduce wave run-up. The filter points provide for the relief of hydrostatic uplift pressure, increasing the system's stability.

Filter Point Linings are generally used in lieu of stone rip rap or slope paving due to their lower cost and higher performance. Filter Point Linings have greater stability than conventional slope paving because of several factors – they can mitigate uplift pressure from ground water, reduce hydraulic uplift of flowing water by slowing channel velocities, and conform to soil contours during installation to reduce the potential for underscour.

Filter Point forms are woven from multifilament and textured yarns. The double-layer fabric is joined by interwoven filter points on controlled centers to form a lining with a deeply cobbled appearance. The spacing of the filter points determines the lining's thickness and weight, while the specially designed filter points relieve hydrostatic pressure and reduce applied stress to the fabric during pumping. Filter Point Linings are available in a wide range of thicknesses.

1.0 GENERAL

1.1 Scope of Work: The Contractor shall furnish all labor, materials, equipment, and incidentals required to perform all operations in connection with the installation of the proposed Filter Point (FP) Lining in accordance with the lines, grades, design, and dimensions shown on the Contract Drawings and as specified herein.

1.2 Description: The work shall consist of installing an unreinforced concrete lining by positioning specially woven, double-layer synthetic forms on the surface to be protected and filling them with a pumpable, fine aggregate concrete (structural grout) in such a way as to form a stable lining of required thickness, weight and configuration.

2.0 MATERIALS REQUIREMENTS

2.1 Fine Aggregate Concrete: Fine aggregate concrete shall consist of a proportioned mixture of Portland cement, fine aggregate (sand) and water. The consistency of the fine aggregate concrete delivered to the concrete pump shall be proportioned and mixed as to have an efflux time of 9-12 seconds when passed through the 19 mm orifice of the standard flow cone that is described in ASTM C 939. Pozzolan, fluidifier or pumping aid conforming to this Specification may be used at the option of the Contractor. The mix shall exhibit a compressive strength of 13.8 MPa at 28 days, when made and tested in accordance with ASTM C 31 and C 39.

2.1.1 Portland cement shall conform to ASTM C 150, Type I or Type II.

2.1.2 Fine aggregate shall conform to ASTM C 33, except as to grading. Aggregate grading shall be reasonably consistent and shall not exceed the maximum size which can be conveniently handled with available pumping equipment.

PROPERTY REQUIREMENTS - FILTER POINT FABRIC[1, 2]				
Property		**Test Method**	**Units**	**Values**
Physical:				
Composition of Yarns				Nylon or polyester
Mass Per Unit Area (double-layer)		ASTM D 5261	g/m^2	403
Thickness		ASTM D 5199	mm	0.6
Mill Width			m	1.92
Mechanical:				
Wide-Width Strip Tensile Strength	- Machine	ASTM D 4595	kN/m	24.5
	- Cross		kN/m	19.3
Elongation at Break	- Machine	ASTM D 4595	%	20
	- Cross		%	30
Trapezoidal Tear Strength	- Machine	ASTM D 4533	N	665
	- Cross		N	445
Hydraulic:				
Apparent Opening Size (AOS)		ASTM D 4751	mm	0.425
Flow Rate		ASTM D 4491	$l/min/m^2$	3665
Flow Rate through Filter Point		ASTM D 4491	$l/min/m^2$	285

Notes:

1. *Conformance of fabric to specification property requirements shall be based on ASTM D 4759, "Practice for Determining the Specification Conformance of Geotextiles."*
2. *All numerical values represent minimum average roll values (i.e., average of test results from any sample roll in a lot shall meet or exceed the minimum values). Lots shall be sampled according to ASTM D 4354, "Practice for Sampling of Geosynthetics for Testing."*

2.1.3 Water for mixing shall be clean and free from injurious amounts of oil, acid, salt, alkali, organic matter or other deleterious substances.

2.1.4 Pozzolan, if used, shall conform to ASTM C 618, Class C, F or N.

2.1.5 Plasticizing and air entraining admixtures, if used, shall conform to ASTM C 494 and ASTM C 260, respectively.

2.2 Fabric Forms: The fabric forms shall be as specified, HYDROTEX™ Filter Point (see Note A) forms as manufactured by Geostar Corporation; 74 Perimeter Center East, Suite 7420; Atlanta, Georgia 30346-1803, Tel: 800.253.0561 (770.399.5051); or approved equal. The fabric forms shall be composed of synthetic yarns formed into a woven fabric. Yarns used in the manufacture of the fabric shall be composed of nylon and/or polyester. Forms shall be woven with a minimum of 50% textured yarns (by weight) to improve adhesion to fine aggregate concrete and to improve filtration. Partially-oriented (POY), draw-textured, and/or staple yarns shall not be used in the manufacture of the fabric. Each layer of fabric shall conform to the physical, mechanical and hydraulic requirements referenced herein. The fabric forms shall be free of defects or flaws which significantly affect their physical, mechanical, or hydraulic properties.

Note A: The engineer shall indicate the Filter Point Lining size required (see Table 1.0). Example: FP400.

2.2.1 Fabric forms shall consist of double-layer woven fabric joined together by spaced, interwoven filter points to form a concrete lining with a finished average thickness of (*see Table 1.0*) mm, a nominal mass per unit area of (*see Table 1.0*) kg/m^2, and a deeply cobbled surface appearance. After the form has been filled with fine aggregate concrete, the filter points shall be on approximately (*see Table 1.0*) mm spacing when measured along the diagonal. Filter points shall be formed by interweaving the double-layer fabric to form water permeable drains and attachment points for the control of concrete lining thickness. The interweaving of the fabric layers shall form an area of double density, high strength, single-layer fabric with an area of (*see Table 1.0*) cm^2 and a perimeter of (*see Table 1.0*) mm. All filter points shall be cross shaped and shall have twill weave centers designed to function as drains to relieve hydrostatic uplift pressure.

2.2.2 Mill widths of fabric shall be a minimum of 1.92 meters. Each selvage edge of the top and bottom layers of fabric shall be reinforced for a width of not less than 35 mm by adding a minimum of 6 warp yarns to each selvage construction. Mill width rolls shall be cut to the length required, and the double-layer fabric separately joined, bottom layer to bottom layer and top layer to top layer, by means of sewing thread, to form multiple mill width panels with sewn seams on not less than 182 cm centers.

2.2.3 All factory-sewn seams shall be downward facing as shown on the Contract Drawings. All seams sewn in the factory shall be not less than 15.7 kN/m when tested in accordance with ASTM D 4884. All sewn seams and zipper attachments shall be made using a double line of U.S. Federal Standard Type 401 stitch. All stitches shall be sewn simultaneously and be parallel to each other, spaced between 6 and 19 mm apart. Each row of stitching shall consist of 4 to 7 stitches per 25.4 mm. Thread used for seaming shall be nylon and/or polyester.

2.2.4 Baffles shall be installed at predetermined mill width intervals to regulate the distance of lateral flow of fine aggregate concrete. The baffle material shall be nonwoven filter fabric. The grab tensile strength of the filter fabric shall be not less than 400 N when tested in accordance with ASTM D 4632.

2.2.5 The fabric forms shall be kept dry and wrapped such that they are protected from the elements during shipping and storage. If stored outdoors, they shall be elevated and protected with a waterproof cover that is opaque to ultraviolet light. The fabric forms shall be labeled as per ASTM D 4873, "Guide for Identification, Storage and Handling of Geosynthetic Rolls."

2.2.6 The Contractor shall submit a manufacturer's certificate that the supplied fabric forms meet the criteria of these Specifications, as measured in full accordance with the test methods and standards referenced herein. The certificates shall include the following information about each fabric form delivered:

Manufacturer's name and current address;
full product name;
style and product code number;
form number(s);
composition of yarns; and
manufacturer's certification statement.

2.3 Filter Fabrics: The filter fabrics shall be composed of synthetic fibers or yarns formed into a nonwoven or woven fabric. Fibers and yarns used in the manufacture of filter fabrics shall be composed of at least 85% by weight of polypropylene, polyester or polyethylene. They shall be formed into a network such that the filaments or yarns retain dimensional stability relative to each other, including selvages. These materials shall conform to the physical requirements shown below. The filter fabric shall be free of defects or flaws which significantly affect its mechanical or hydraulic properties.

PROPERTY REQUIREMENTS - FILTER FABRIC [1, 2]

Property	Test Method	Units	Values
Grab Tensile Strength	ASTM D 4632	N	400
Elongation at Break	ASTM D 4632	%	15
Trapezoidal Tear Strength	ASTM D 4533	N	130
Permittivity	ASTM D 4491	sec^{-1}	0.5

Notes:

1. *Conformance of filter fabrics to specification property requirements shall be based on ASTM D 4759, "Practice for Determining the Specification Conformance of Geotextiles."*
2. *All numerical values represent minimum average roll values (i.e., average of test results from any sample roll in a lot shall meet or exceed the minimum values). Lots shall be sampled according to ASTM D 4354, "Practice for Sampling of Geosynthetics for Testing."*

3.0 DESIGN REQUIREMENTS

Note B: Select the appropriate pair of paragraphs for the final specification based upon the type of hydraulic application.

The average thickness, mass per unit area and hydraulic resistance of each concrete lining shall withstand the hydraulic loadings (velocity, depth, duration, shear stress, pressure, and frequency of immersion) for the design discharges along the structure(s). The stability analysis for each concrete lining shall be accomplished using a factor-of-safety methodology. A minimum factor of safety of 1.5 shall be required.

The Contractor shall provide to the Engineer calculations and design details, provided by the manufacturer or a professional engineer, attesting to the suitability of each fabric formed concrete lining for the purpose contemplated. Each concrete lining shall be accepted only when accompanied by the documented hydraulic performance characteristics derived from tests performed under controlled flow conditions. Test conditions shall conform to test protocol as documented in "Hydraulic Stability of Fabric Formed Concrete Lining and Mat Systems During Overtopping Flow."

or

The average thickness, mass per unit area and hydraulic resistance of each concrete lining shall withstand the hydraulic loadings (depth, duration, type of wave, wave height and period, and pressure distribution) for the design wave. The stability analysis for the concrete lining shall be accomplished using the factor-of-safety methodology. A minimum factor of safety of 1.5 shall be required.

The Contractor shall provide to the Engineer calculations and design details, provided by the manufacturer or a professional engineer, attesting to the suitability of each fabric formed concrete lining for the purpose contemplated. Each concrete lining shall be accepted only when accompanied by hydraulic stability calculations derived from mathematical models developed specifically for fabric formed concrete linings and for this purpose.

4.0 CONSTRUCTION AND INSTALLATION REQUIREMENTS

4.1 Site Preparation

4.1.1 Areas on which fabric forms are to be placed shall be constructed to the lines, grades, contours, and dimensions shown on the Contract Drawings. All obstructions such as roots and projecting stones shall be removed. Where such areas are below the allowable grades, they shall be brought to grade by placing compacted layers of select material. The thickness of layers and the amount of compaction shall be as specified by the Engineer. Where required by the Contract Specifications, soft and otherwise unsuitable subgrade soils shall be identified, excavated and replaced with select materials in accordance with the Contract Specifications.

4.1.2 Excavation and preparation of aprons as well as anchor, terminal or toe trenches shall be done in accordance with the lines, grades, contours, and dimensions shown on the Contract Drawings.

4.1.3 Immediately prior to placing the fabric forms, the prepared area shall be inspected by the Engineer, and no forms shall be placed thereon until the area has been approved.

4.2 Fabric Form Placement

4.2.1 A filter fabric shall be placed on the graded surface approved by the Engineer.

4.2.2 Fabric forms shall be placed over the filter fabric and within the limits shown on the Contract Drawings. Anchoring of the fabric forms shall be accomplished through the use of anchor, terminal and toe trenches.

4.2.3 Adjacent fabric forms shall be joined before filling with fine aggregate concrete by field sewing or zippering the two bottom layers of fabric together and the two top layers of fabric together. All field seams shall be made using two lines of U.S. Federal Standard Type 101 stitches. All sewn seams shall be downward facing, and all zipper seams shall be fastened as shown on the Contract Drawings, except with the approval of the Engineer.

4.2.4 When conventional joining of fabric forms is impractical or where called for on the Contract Drawings, adjacent forms may be overlapped a minimum of one meter to form a lap joint, pending approval by the Engineer. Based on the predominant flow direction, the downstream edge of the form shall overlap the upstream edge of the next form. In no case shall simple butt joints between forms be permitted.

4.2.5 Expansion joints shall be provided as shown on the Contract Drawings, or as specified by the Engineer.

4.2.6 Immediately prior to filling with fine aggregate concrete, the assembled fabric forms shall be inspected by the Engineer, and no fine aggregate concrete shall be pumped therein until the fabric seams have been approved. At no time shall the unfilled fabric forms be exposed to ultraviolet light (including direct sunlight) for a period exceeding five days.

4.3 Fine Aggregate Concrete Placement

4.3.1 Following the placement of the fabric forms, small slits shall be cut in the top layer of the fabric form to allow the insertion of the filling pipe at the end of the fine aggregate concrete pump hose. These slits shall be of the minimum length to allow proper insertion of the filling pipe. Fine aggregate concrete shall be pumped between the top and bottom layers of fabric, filling the forms to the recommended thickness and configuration.

4.3.2 Fine aggregate concrete shall be pumped in such a way that excessive pressure on the fabric forms and cold joints are avoided. A cold joint is defined as one in which the pumping of the fine aggregate concrete into a given form is discontinued or interrupted for an interval of forty-five or more minutes.

4.3.3 Holes in the fabric forms left by the removal of the filling pipe shall be temporarily closed by inserting a piece of nonwoven fabric or similar material. The nonwoven fabric shall be removed when the concrete is no longer fluid and the concrete surface at the hole shall be cleaned and smoothed by hand. Foot traffic on the filled form shall be restricted to an absolute minimum for one hour after filling.

4.3.4 After the fine aggregate concrete has set, all anchor, terminal and toe trenches shall be backfilled and compacted, as specified by the Engineer.

4.3.5 The Filter Point Lining shall be measured by the number of square meters computed from the payment lines shown on the Contract Drawings or from payment lines established in writing by the Engineer. This includes Filter Point fabric forms, fine aggregate concrete, and filter fabric used in the aprons, overlaps, and anchor, terminal, or toe trenches. Slope preparation, excavation and backfilling, and bedding are separate pay items.

Spec: FP (siu)
Revised December 2001

Call or write for your complete set of HYDROTEX™ and HYDROCAST™ Specification Guidelines. Available as printed specifications, in Adobe® Acrobat® (pdf) format, or in an editable text format. PDF specifications are available for download from our web site at www.geostarcorporation.com.

Hydrotex products are manufactured by:

Geostar Corporation
74 Perimeter Center East, Suite 7420
Atlanta, Georgia 30346-1803
Tel: 1.800.253.0561 or 770.399.5051 Fax: 770.394.5999
www.geostarcorporation.com • e-mail: info@geostarcorporation.com

Appendix K

Soil Material Volume and
Balance Calculations
Revised August 2013

Ameren Missouri Labadie Energy Center
Construction Permit Application for a Proposed Utility Waste Landfill
Franklin County, Missouri

December 2012, Revised August 2013

Appendix K
Soil Material Volume and Balance Calculations

Appendix K contains calculations of soil needed (required) for construction of the Ameren Missouri Labadie Energy Center Utility Waste Landfill (UWL), and the soil available on-site for the construction. Soil is required for construction of the four general components of the UWL: perimeter berms; liner system; intermediate cover; and final cover system. Operational cover (intermediate) is proposed based on the characteristics of the coal combustion products (CCPs) that will be placed in the UWL.

The perimeter berms are designed with 3:1 side slopes, with a typical berm height of 23 feet, and a 12-foot wide access road on top of the berm. The exterior perimeter berm slopes will be lined with a 2.2-in thick, fabric-formed articulated concrete mat. A 2-feet thick compacted clay liner will be placed on the inside slope of the berm to tie-in with the landfill liner in each phase.

The UWL's final cover system will be two (2) feet of nominally compacted soil capable of sustaining vegetation, underlain by a geotextile cushion, which is underlain by a geomembrane liner.

Three general soil types will be used for construction of the UWL components: Liner-quality, non liner-quality, and vegetative soil. Liner-quality soil describes clayey soils that would meet the requirements of 10 CSR 11.010(10)(B)1 for the landfill liner. Non liner-quality soil describes low plastic clayey soil, silty soils, or sandy soils present at the site. Non liner-quality soils would not be suitable for the landfill liner, but would be used for the construction of the core of the perimeter berms. Vegetative soil describes soils that are capable of sustaining vegetation for the UWL final cover or the outside slopes of the perimeter berms.

The following table summarizes the pertinent acreages and berm volumes for each utility waste landfill component. The acreages and berm volumes were determined from the AutoCAD drawings that depict the three storm water ponds and the layout of the four disposal phases.

UWL Component	Design Parameters	Notes/Comments
Phase 1	Cell 1: 31.4 acres	Stormwater Pond 1: 5.7 acres
Phase 2	Cell 2: 35.2 acres	

Phase 3	Cell 3: 57.1 acres	Stormwater Pond 2: 4.4 acres
Phase 4	Cell 4: 42.8 acres	Stormwater Pond 3: 3.4 acres
Total Permitted Disposal Area	**166.5 acres**	**Includes Cells 1 through 4, excludes the Stormwater Ponds.**
Stormwater Pond 1	5.7 acres	Area at 488' contour
Stormwater Pond 2	4.4 acres	Area at 488' contour
Stormwater Pond 3	3.4 acres	Area at 488' contour
Total Area for Excavation	**180.0 acres**	**Includes Phases 1 through 4 and the Stormwater Ponds.**

Final "Top of Landfill" Area	73.7 acres	Final "flat" top of UWL at closure.
Final "Exterior Side Slopes" Area	92.8 acres	Final slopes at closure.
Total Final Area for Closure	**166.5 acres**	**Total Acreage Requiring Final Cap**

All calculated volumes of soil, both needed and available, are rounded up to the nearest 1,000 yd^3.

The total soil balance for Phases 1 through 4 and the three stormwater ponds, for clay liner, final cap (top and side slopes), and all perimeter berms, reveals a total soil shortage of 2,750,000 CY of on-site soils within the foot print of Phases 1 through 4 and the three stormwater ponds.

Soils available: 1,260,000 CY

Soils needed: (perimeter berms, liner, intermediate and final cover): 4,010,000 CY

Net soil balance for the landfill: -2,750,000CY

An estimated 2,600,000 CY of liner-quality soil is available from a borrow area in Callaway County on property owned by Ameren Missouri. This is greater than the 639,000 CY of liner-quality soil needed. A contractor will supply additional soil for berm core fill and vegetative cover.

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

December 2012, REVISED August 2013

Appendix K
Soil Material Volume and Balance Calculations

Note: All calculated volumes are rounded to the nearest 1,000 CY.
Stripping depth of 1.63 ft is the required minimum for volume of final cover.
Soil balance calculations utilized the minimum stripping depth required.
Stripping depth of 1.75 ft is recommended.

Lifetime Construction: Phases 1 through 4 and Stormwater Ponds

ESTIMATE OF TOTAL SOIL NEEDED

ESTIMATE OF NOMINALLY COMPACTED FINAL COVER SOIL NEEDED
SOIL TYPE REQUIRED: Vegetative
Volume (CY) = Area (AC) x 43,560 SF/AC x 2 ft x 1.1 [shrinkage factor] / 27 CF/CY

Total Area	166.5	AC		
Total Volume of 2 ft Nominally Compacted Final Cover	166.5	AC=	**591,000**	**CY**

ESTIMATE OF UWL LINER SOIL REQUIRED
SOIL TYPE REQUIRED: Liner Quality
Volume (CY) = Area (AC) x 43,560 SF/AC x 2 ft x 1.1 [shrinkage factor] / 27 CF/CY

Disposal Areas	166.5	AC=	**591,000**	**CY**
Pond Areas	13.5	AC=	**48,000**	**CY**
Total Area	180.0	AC		
Total Volume of 2 ft Liner for Disposal Area and Ponds	180.0	AC=	**639,000**	**CY**

ESTIMATE OF GENERAL FILL NEEDED UNDER UWL
SOIL TYPE REQUIRED: Non-Liner Quality
From CADD cut/fill volumes - design grade to existing grade.
Volume of General Site Fill Under UWL & Pond Floors **780,000 CY**

ESTIMATE OF PERIMETER BERM CORE FILL SOIL NEEDED
SOIL TYPE REQUIRED: Non-Liner Quality
From CADD cut/fill volumes - design grade to existing grade, less 2-ft clay liner on slope.

Phase 1	204,115	CY
Phase 2	165,531	CY
Phase 3	393,858	CY
Phase 4	293,945	CY
Pond 1	99,269	CY
Pond 2	93,713	CY
Pond 3	65,730	CY
Total Perimeter Berm Volumes	**1,316,162**	**CY**

ESTIMATE OF GENERAL FILL NEEDED TO REPLACE 1.63' STRIPPING UNDER UWL
SOIL TYPE REQUIRED: Non-Liner Quality
Volume (CY) = Area (225 AC) x Depth (1.63 ft) x 43,560 SF/AC / 27 CF/CY

Volume of Fill to Replace 1.63-ft Stripping in Construction Footprint **592,000 CY**

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

December 2012, REVISED August 2013

Appendix K
Soil Material Volume and Balance Calculations

ESTIMATE OF INTERMEDIATE COVER (IC) NEEDED

SOIL TYPE REQUIRED: Non-Liner

Assumes reuse of IC and maxium area requiring IC < 57 AC

Volume (CY) = Area (57 AC) x Depth (1 ft) x 43,560 SF/AC / 27 CF/CY

Volume of Intermediate Cover	**92,000**	**CY**

ESTIMATE OF TOTAL SOIL NEEDED

Intermediate Cover		
Volume of Intermediate Cover Soil Needed	**92,000**	**CY**
Liner and Cover Systems		
Volume of Final Cover Soil Needed	591,000	CY
Volume of Liner Soil Needed	639,000	CY
Total Needed for Liner and Final Cover Systems	**1,230,000**	**CY**
General Fill and Perimeter Berm Soil Needs		
Volume of General Site Fill Under UWL & Pond Floors	780,000	CY
Volume of Perimeter Berm Core Fill Soil Needed	1,316,000	CY
Volume of 1.63-ft. Stripping Replacement	592,000	CY
Total Needed for General Fill and Perimeter Berm	**2,688,000**	**CY**
Estimated Total Volume of Soil Needed	**4,010,000**	**CY**

ESTIMATE OF SOIL-SPECIFIC REQUIRMENTS

Volume of Liner Quality Soil Needed	639,000	CY
Volume of Vegetative Quality Soil Needed	683,000	CY
Volume of Non-Liner Quality Soil Needed	2,688,000	CY
Estimated Total Volume of Soil Needed	**4,010,000**	**CY**

ESTIMATE OF TOTAL SOIL AVAILABLE

Assumes 1.63 ft of vegetative soil will be excavated from the 225 AC area, 5% swell.

Liner Quality Soil to be Excavated from the Construction Footprint	0	CY
Vegetative Soil to be Excavated from the Construction Footprint	621,000	CY
Non-Liner Quality Soil to be Excavated from the Construction Footprint	0	CY
Total Soil to be Excavated from the Construction Footprint	**621,000**	**CY**
Liner Quality Soil to be Excavated from the Borrow Area	639,000	CY
Made to equal liner soil needed. No surplus from borrow inclued		
Vegetative Soil to be Excavated from the Borrow Area	0	CY
Non-Liner Quality Soil to be Excavated from the Borrow Area	0	CY
Total Soil to be Excavated from the Borrow Area	**639,000**	**CY**
Volume of Liner Quality Soil Available	639,000	CY
Volume of Vegetative Soil Available	621,000	CY
Volume of Non-Liner Quality Soil Available	0	CY
Total Soil Available	**1,260,000**	**CY**

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

December 2012, REVISED August 2013

Appendix K
Soil Material Volume and Balance Calculations

SOIL BALANCE FOR PHASES 1 THROUGH 4 AND THE STORMWATER PONDS

TOTAL SOIL BALANCE

Estimated Volume of Soil Needed	4,010,000	CY
Estimated Volume of Soil Avaiable	1,260,000	CY
Soil Balance	**-2,750,000**	**CY**

SOIL SPECIFIC BALANCE

Estimated Volume of Liner Quality Soil Needed	639,000	CY
Estimated Volume of Liner Quality Soil Available	639,000	CY
Liner Quality Soil Balance	**0**	**CY**
Estimated Volume of Vegetative Soil Needed	683,000	CY
Estimated Volume of Vegetative Soil Available	621,000	CY
Vegetative Quality Soil Balance	**-62,000**	**CY**
Estimated Volume of Non-Liner Quality Soil Needed	2,688,000	CY
Estimated Volume of Non-Liner Quality Soil Available	0	CY
Non-Liner Quality Soil Balance	**-2,688,000**	**CY**

LANDFILL SYSTEMS BALANCE

Estimated Liner Quality Soil for Liner Needed	639,000	CY
Estimated Liner Quality Soil for Liner Available	639,000	CY
Liner and Cover System Liner Quality Soil Balance	**0**	**CY**
Estimated Volume of Vegetative Soil for Cover Systems Needed	683,000	CY
Estimated Volume of Vegetative Soil for Cover Systems Available	621,000	CY
Cover Sytem Vegetative Soil Balance	**-62,000**	**CY**

GENERAL FILL AND PERIMETER BERM BALANCE

Estimated Volume of General Fill and Permieter Berm Core Fill Needed	2,688,000	CY
Estimated Volume of General Fill and Permieter Berm Core Fill Available	0	CY
General Fill and Perimeter Berm Core Fill Balance	**-2,688,000**	**CY**

Appendix L

Landfill Life Estimate

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

January 2013

Appendix L
Landfill Life Estimate

The life of the proposed utility waste landfill (UWL) is estimated based on projected waste volume production rates and the calculated net UWL volume. The total UWL volume was estimated using CADD to measure the volume between a surface 2-feet below the final cover (to adjust for the final cover thickness of 2-feet) and a surface 1-foot above the top-of-liner (to adjust for the protective cover thickness of 1-foot). The net UWL volume was then determined by deducting a volume equal to the area of the relatively flat floor (146.6 acres) times a thickness of 1-foot, to account for the volume occupied by the leachate drainage aggregate layer.

Gross UWL Airspace Volume = 16,513,000 CY

Drainage Layer Volume = 1 ft x 146.6 AC x 43,560 SF/AC x 1 CY/ 27 CF = 236,500 CY

Protective Cover Volume = 1 ft x 166.5 AC x 43,560 SF/AC x 1 CY/ 27 CF = 268,600 CY

Final Cover Volume = 2 ft x 166.5 AC x 43,560 SF/AC x 1 CY/27 CF = 537,200 CY

Net Waste Volume = 16,513,000 – 236,500 - 268,600 - 537,200 = 15,470,700 CY

Two wet flue gas desulfurization (WFGD) systems will come on line at different times, increasing the rate of coal combustion product (CCP) generation over time. The generations rates projected are:

- 2015 to 2019, 2.3 MCY,
- 2020 to 2024, 2.9 MCY,
- 2025 to 2029, 3.6 MCY, and
- 2030 and after, 3.8 MCY every five year period or 760,000 CY/year.*

The amount of landfill volume remaining after the first 15 years would be:

15.5 MCY – 2.3 MCY – 2.9 MCY – 3.6 MCY = 6.7 MCY

The years of life available in the remaining volume is:

6.7 MCY / 760,000 CY/year = 8.8 years

The total landfill life is:

15.0 + 8.8 = 23.8 years

---

* CCP production estimates are drawn from the Reitz & Jens Design Basis dated October 16, 2012.

Appendix M

Erosion Calculations

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

Amendments to Erosion Calculations
Appendix M

EROSION PROTECTION CALCULATIONS

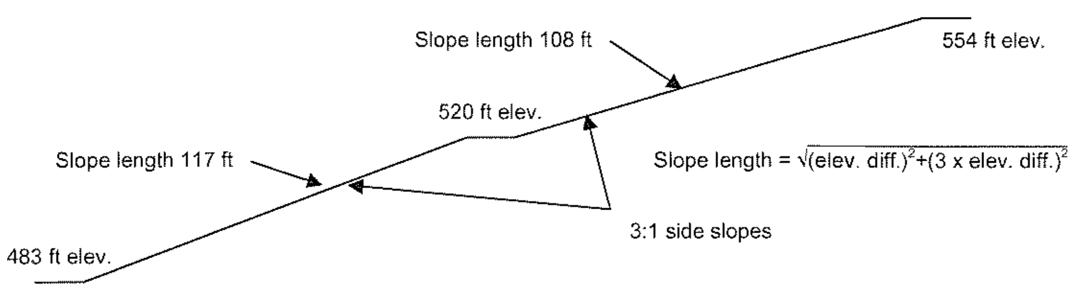
The stormwater drainage structures were checked for erosion control by utilizing the Erosion Control Materials Design Software 4.3 (ECMDS) by North American Green (NAG). This software analyzes erodibility of various channel/slope configurations. The channel/slope is analyzed for erodibility based upon soil type, cover, flow-rate, velocity, Manning's number and channel grade. Channel sections representative of the side slope benches and letdown ditches have been analyzed for erosion using riprap.

SUMMARY OF DESIGN ANALYSIS

1. Typical Landfill Slope Erosion Protection

The typical top of landfill was modeled for erosion using ECDMS, which uses a version of the Revised Universal Soil Loss Equation (RUSLE). The top of the landfill is designed with a minimum 2 percent slope. The maximum distance along the 2 percent slope is 550 ft. The annual soil loss of 0.013 inches per year is less than the permissible 0.03 inches per year, and is considered acceptable (a standard value in ECDMS; see Table 1 and Figure 1a).

The typical side slope was also modeled for erosion using ECDMS. The 3:1 side slope of 225 ft is broken into two sections of approximately 117 ft and 108 ft by a bench at 520 feet elevation. Both segments have annual soil losses less than 0.03 in. The segment with the larger annual soil loss eroded at a rate of 0.017 in/yr (see Table 1 and Figures 1a and 1b).



2. Typical Diversion Structure on Top of Landfill

Flow from the top of the landfill will be directed to the letdowns using diversion structures. The typical diversion structure would have a slope of up to 1 percent, a depth of 1 ft, and side slope of 50:1 and 3:1. ECMDS was used to calculate shear stress resulting from the maximum flow of 4.5 cfs (half the maximum flow in a letdown). Shear stresses were within permissible levels (see Table 1 and Figure 2).

3. Typical Landfill Letdown Structure

The standard letdown design to be utilized at the Ameren Missouri Labadie Power Plant Utility Waste Landfill (8 ft wide bottom and 3:1 side slopes) was checked for permissible shear stress using two types of cover (reinforced vegetation and 22-in riprap). ECMDS was used to calculate shear stress resulting from the maximum flow of 8.9 cfs on the 3:1 bottom slope of the letdowns. The letdown structure flow was calculated in Appendix N using the Rational method, a 25-year, 1-hour storm, the largest area drained by a letdown structure. Shear stresses were within permissible levels (see Table 1 and Figure 3a and 3b).

4. Typical Bench

Benches on the side slope are proposed. They will be at 520 ft elevation and have 1 percent bottom slopes. The bench side slopes will be 3:1 on one side and 10:1 on the other, with a depth of 1.5 ft. As with the letdown structures, these were modeled using ECMDS. The permissible shear stress for a fair stand of vegetation is greater than the estimated shear stress created by a flow of 4.5 cfs (half the maximum flow in a letdown; see Table 1 and Figure 4).

5. Perimeter Ditch

The standard perimeter ditch to be utilized at the Ameren Missouri Labadie Power Plant Utility Waste Landfill (9 ft wide bottom and 3:1 side slopes) was checked for permissible shear stress using a fair stand of unreinforced vegetation. ECMDS was used to calculate shear stress resulting from the maximum flow of 36 cfs. Shear stresses were within permissible levels (see Table 1 and Figure 5).

TABLES

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

Summary Table of Erosion Control
Table 1

	Structure	Description of Cover and Conditions	Safety Factor	Limitations		
				Limiting Factor	Permissible	Calculated
1a	Typical Top of Landfill	Unreinforced vegetation with a fair stand of bunch growth	2.232	Soil Loss	0.03 in/yr	0.013 in/yr
1b	Typical Side Slope Below Bench	117 feet of cover with an excellent stand of sod growth	2.284	Soil Loss	0.03 in/yr	0.013 in/yr
	Typical Side Slope Above Bench	108 feet of cover with a good stand of mixed bunch and sod growth	1.816	Soil Loss	0.03 in/yr	0.017 in/yr
2	Typical Diversion Structure on Top of Landfill	Unreinforced vegetation with a fair stand of bunch growth	9.04	Shear Stress	4.20 psf	0.46 psf
3a	Typical Letdown	Reinforced vegetation	1.55	Shear Stress	7.00 psf	4.52 psf
3b	Typical Letdown	RipRap	1.23	Shear Stress	7.33 psf	5.98 psf
4	Typical Bench	Unreinforced vegetation with a fair stand of bunch growth	6.49	Shear Stress	4.20 psf	0.65 psf
5	Typical Perimeter Ditch	Good stand of mixed bunch and sod growth	70.17	Shear stress	0.035 psf	0.000499 psf

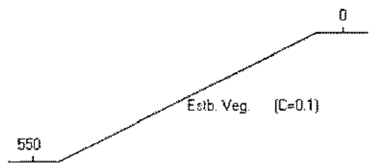
FIGURES

Ameren Missouri Labadie Power Plant
Proposed Utility Waste Landfill
Franklin County, Missouri
Appendix M
Typical Top of Landfill
Figure 1a

North American Green - ECMDS Version 4.3 | 10/31/2012 | 08:10 AM | COMPUTED BY:
PROJECT NAME: Ameren Missouri Labadie | PROJECT NO.: | SLOPE DESCRIPTION: Typical Top of Landfill

Country	United States
State/Region	Missouri
City	St. Louis
Annual R Factor	210
Total Slope Length (ft)	550
Protection Type	Permanent
Protection Period (months)	
Beginning Month	
Adjusted R Value	210.
Slope Gradient (H:1)	50
Soil Type	Silt Loam
K Factor	0.33
Soil Loss Tolerance (in)	0.03

Slope Gradient = 50:1



Not to Scale

Reach	Cum. Dist. Begin (ft)	Cum. Dist. End (ft)	Material	Vegetation Type Growth Habit	Density	ASL bare (in)	ASL mat (in)			SLT (in)	SF	Remarks
1	0	550	Estb. Veg.	Bunch Type	50-75%	0.134	0.013			0.03	2.232	STABLE
2												
3												
	0	550		**Composite**		0.134	0.013					

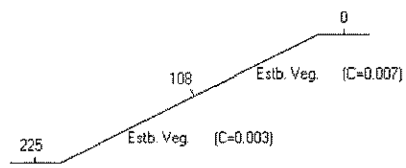
Vegetation Density=Percentage of soil coverage provided by vegetation
ASLbare=Average Soil Loss potential of unprotected soil (uniform inches)
MSLbare=Maximum Soil Loss potential on unprotected soil (uniform inches)
SLT=Soil Loss Tolerance for slope segment (uniform inches)
Composite=Average soil loss from total slope length (uniform inches)
C=Cover material performance factor (Fraction of soil loss of unprotected)
ASLmat=Average Soil Loss potential w/material (uniform inches)
MSLmat=Maximum Soil Loss potential w/material (uniform inches)
SF=Safety Factor

Ameren Missouri Labadie Power Plant
Proposed Utility Waste Landfill
Franklin County, Missouri
Appendix M
Typical Side Slope
Figure 1b

North American Green - ECMDS Version 4.3 | 6/14/2012 | 04:31 PM | COMPUTED BY:
PROJECT NAME: Ameren Missouri Labadie | PROJECT NO.: | SLOPE DESCRIPTION:

Country	United States
State/Region	Missouri
City	St. Louis
Annual R Factor	210
Total Slope Length (ft)	225
Protection Type	Permanent
Protection Period (months)	
Beginning Month	
Adjusted R Value	210.
Slope Gradient (H:1)	3
Soil Type	Silt Loam
K Factor	0.33
Soil Loss Tolerance (in)	0.03

Slope Gradient = 3:1



Not to Scale

Reach	Cum. Dist. Begin (ft)	Cum. Dist. End (ft)	Material	Vegetation Type Growth Habit	Density	ASL bare (in)	ASL mat (in)			SLT (in)	SF	Remarks
1	0	108	Estb. Veg.	Mix (Both Sod/Bunch)	>=95%	2.360	0.017			0.03	1.816	STABLE
2	108	225	Estb. Veg.	Sod Former	>=95%	4.378	0.013			0.03	2.284	STABLE
3												
	0	225		**Composite**		3.409	0.015					

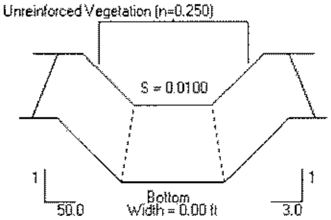
Vegetation Density=Percentage of soil coverage provided by vegetation
ASLbare=Average Soil Loss potential of unprotected soil (uniform inches)
MSLbare=Maximum Soil Loss potential on unprotected soil (uniform inches)
SLT=Soil Loss Tolerance for slope segment (uniform inches)
Composite=Average soil loss from total slope length (uniform inches)
C=Cover material performance factor (Fraction of soil loss of unprotected)
ASLmat=Average Soil Loss potential w/material (uniform inches)
MSLmat=Maximum Soil Loss potential w/material (uniform inches)
SF=Safety Factor

Ameren Missouri Labadie Power Plant
Proposed Utility Waste Landfill
Franklin County, Missouri
Appendix M
Typical Diversion Structure on Top of Landfill
Figure 2

North American Green - ECMDS Version 4.3 | 10/31/2012 | 08:15 AM | COMPUTED BY:
PROJECT NAME: Ameren Missouri Labadie | PROJECT NO.:
FROM STATION/REACH: | TO STATION/REACH: | DRAINAGE AREA: | DESIGN FREQUENCY:

HYDRAULIC RESULTS

Discharge (cfs)	Peak Flow Period (hrs)	Velocity (fps)	Area (sq.ft)	Hydraulic Radius(ft)	Normal Depth (ft)
4.5	1.0	0.31	14.68	0.37	0.74



Not to Scale

LINER RESULTS

Reach	Matting Type / Staple Pattern	Stability Analysis	Vegetation Characteristics: Phase	Class	Type	Density	Permissible Shear Stress (psf)	Calculated Shear Stress (psf)	Safety Factor	Remarks
Straight	Unreinforced	Vegetation		C	Mix	50-75%	4.20	0.46	9.04	STABLE
		Soil	Silt Loam				0.035	0.001	48.47	STABLE

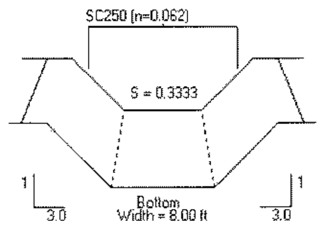
Back to Input Screer

Ameren Missouri Labadie Power Plant
Proposed Utility Waste Landfill
Franklin County, Missouri
Appendix M
Typical Reinforced Vegetation Letdown Structure
Figure 3a

North American Green - ECMDS Version 4.3 | 10/31/2012 | 08:17 AM | COMPUTED BY:
PROJECT NAME: Ameren Missouri Labadie | PROJECT NO.:
FROM STATION/REACH: | TO STATION/REACH: | DRAINAGE AREA: | DESIGN FREQUENCY:

HYDRAULIC RESULTS

Discharge (cfs)	Peak Flow Period (hrs)	Velocity (fps)	Area (sq.ft)	Hydraulic Radius(ft)	Normal Depth (ft)
8.9	1.0	4.74	1.88	0.20	0.22



Not to Scale

LINER RESULTS

Reach	Matting Type / Staple Pattern	Stability Analysis	Vegetation Characteristics: Phase	Class	Type	Density	Permissible Shear Stress (psf)	Calculated Shear Stress (psf)	Safety Factor	Remarks
Straight	SC250	Vegetation	2	D	Mix	75-95%	7.00	4.52	1.55	STABLE
	Staple E	Soil	Silt Loam				2.500	0.470	5.32	STABLE

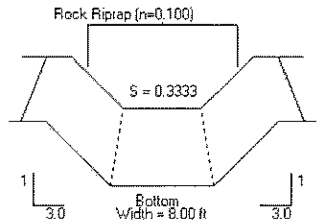
Back to Input Screen

Ameren Missouri Labadie Power Plant
Proposed Utility Waste Landfill
Franklin County, Missouri
Appendix M
Typical Riprap Letdown Structure
Figure 3b

North American Green - ECMDS Version 4.3 | 10/31/2012 | 08:19 AM | COMPUTED BY:
PROJECT NAME: Ameren Missouri Labadie | PROJECT NO.:
FROM STATION/REACH: | TO STATION/REACH: | DRAINAGE AREA: | DESIGN FREQUENCY:

HYDRAULIC RESULTS

Discharge (cfs)	Peak Flow Period (hrs)	Velocity (fps)	Area (sq.ft)	Hydraulic Radius(ft)	Normal Depth (ft)
8.9	1.0	3.49	2.56	0.26	0.29



Not to Scale

LINER RESULTS

Reach	Matting Type / Staple Pattern	Stability Analysis	Vegetation Characteristics				Permissible Shear Stress (psf)	Calculated Shear Stress (psf)	Safety Factor	Remarks
			Phase	Class	Type	Density				
Straight	Rock Riprap	Unvegetated					7.33	5.98	1.23	STABLE
	22in									

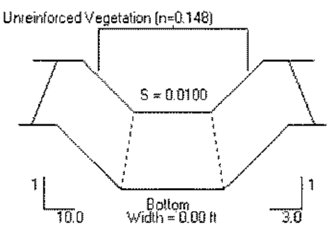
Back to Input Screen

Ameren Missouri Labadie Power Plant
Proposed Utility Waste Landfill
Franklin County, Missouri
Appendix M
Typical Bench
Figure 4

North American Green - ECMDS Version 4.3 | 10/31/2012 | 08:20 AM | COMPUTED BY:
PROJECT NAME: Ameren Missouri Labadie | PROJECT NO.:
FROM STATION/REACH: | TO STATION/REACH: | DRAINAGE AREA: | DESIGN FREQUENCY:

HYDRAULIC RESULTS

Discharge (cfs)	Peak Flow Period (hrs)	Velocity (fps)	Area (sq.ft)	Hydraulic Radius(ft)	Normal Depth (ft)
4.5	1.0	0.64	7.00	0.51	1.04



Not to Scale

LINER RESULTS

Reach	Matting Type / Staple Pattern	Stability Analysis	Vegetation Characteristics: Phase	Class	Type	Density	Permissible Shear Stress (psf)	Calculated Shear Stress (psf)	Safety Factor	Remarks
Straight	Unreinforced	Vegetation		C	Bunch	50-75%	4.20	0.65	6.49	STABLE
		Soil	Silt Loam				0.035	0.004	8.06	STABLE

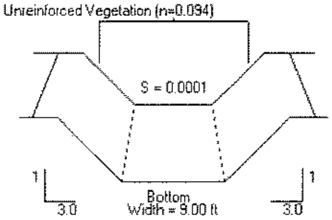
Back to Input Screen

Ameren Missouri Labadie Power Plant
Proposed Utility Waste Landfill
Franklin County, Missouri
Appendix M
Typical Perimeter Berm
Figure 5

North American Green - ECMDS Version 4.3 | 10/31/2012 | 08:23 AM | COMPUTED BY:
PROJECT NAME: Ameren Missouri Labadie | PROJECT NO.:
FROM STATION/REACH: | TO STATION/REACH: | DRAINAGE AREA: | DESIGN FREQUENCY:

HYDRAULIC RESULTS

Discharge (cfs)	Peak Flow Period (hrs)	Velocity (fps)	Area (sq.ft)	Hydraulic Radius(ft)	Normal Depth (ft)
36.0	1.0	0.32	112.74	2.86	4.81



Not to Scale

LINER RESULTS

Reach	Matting Type / Staple Pattern	Stability Analysis	Vegetation Characteristics				Permissible Shear Stress (psf)	Calculated Shear Stress (psf)	Safety Factor	Remarks
			Phase	Class	Type	Density				
Straight	Unreinforced	Vegetation		C	Bunch	50-75%	4.20	0.03	139.90	STABLE
		Soil	Silt Loam				0.035	0.000499	70.17	STABLE

Back to Input Screen

Appendix N

Stormwater Calculations

Ameren Missouri Labadie Energy Center
Proposed Utility Waste Landfill
December 2012

Appendix N

STORMWATER DRAINAGE STRUCTURE SUMMARY

10 CSR 80-11.010 (8)(B)1.F.II of the Missouri Solid Waste Management Regulations requires that "On-site drainage structures and channels shall be designed to prevent flow onto the active portion of the utility waste landfill during peak discharge from at least a twenty-five (25)-year storm...." 10 CSR 80-11.010 (8)(B)1.F.III of the Missouri Solid Waste Management Regulations requires that "On-site drainage structures and channels shall be designed to collect and control at least the water volume resulting from a twenty-four (24)-hour, twenty-five (25)-year storm." In this document, the capacities of the stormwater drainage structures are calculated and compared to expected storm flows using the Rational Method equation. Channel design calculations utilized a 1-hour, 25-year storm intensity as the basis for estimating runoff and peak discharge. The 1-hour intensity storm results in a larger peak flow than the 24-hour intensity storm. Pond storage capacity calculations utilized the 24-hour, 25-year storm intensity for the peak design volume.

Drainage Areas and Flows

To determine the spacing of letdown structure, limits on the grade within the side benches were set. The flow line of the benches were set at a grade of 200H:1V (0.5%), and were limited to a depth of 1.5 feet difference in elevation along the length of the bench. Using those limits, the letdown structures were spaced approximately 600 feet apart, with benches rising away in both directions from each letdown structure. Figure N-1 shows the locations of letdown structures. The first letdown ditch is expected to be built in line with the eastern side of Pond 1 in Cell 1. From this location, letdown structures are numbered proceeding clockwise around the footprint of the landfill. Ponds are located on Figure 1 and are numbered in the order they are expected to be constructed.

Table N-1 is a summary of the letdown structures and is set up to indicate which pond will serve each letdown structure. The letdown structure flows are directed to the nearest pond. Table N-1 lists:

- a location at a letdown structure or pond,
- the distance along the perimeter of the side-slope crest,
- the side slope area below the top of slope which is conservatively assumed to collect in the perimeter ditch at the letdown ditch,
- the side slope area below the top of slope is also assumed to flow into the perimeter ditch through the letdown structure,
- the sum of the total drainage area flowing in the letdown structure,
- the sum of all areas served by the perimeter ditch at and above the letdown structure,
- the flow contributed to the perimeter ditch at each letdown structure, and;
- the cumulative flow in the perimeter ditch at the location of each letdown structure.

The table is set up to allow convenient coordination with the tables estimating the water profiles in the perimeter ditch.

Capacity

The Rational Method was used to estimate the landfill's runoff. The rational method equation is:

$$Q = CIA$$

Where: Q is the flow rate (cfs)
C is the runoff coefficient (unitless)
I is the rainfall intensity (in/hr)
A is the drainage area (acres)

A runoff coefficient of C=0.4 is used and is considered representative for low to moderate permeability soils with emergent ground cover on steep slopes.

Areas served by side benches and letdowns are expected to be less than 11 acres each. For a 25-yr, 1-hr storm, the expected rainfall is 2.63 in/hr and the anticipated runoff from 11 acres is:

$$Q = 0.4 \text{ X } 2.63 \text{ in/hr X } 11 \text{ ac X } 43{,}560 \text{ ft}^2\text{/ac X } 1 \text{ ft/12 in X } 1 \text{ hr/3,600 s} = 11.67 \text{ cfs}$$

The 25-yr, 1-hr storm intensity (2.63 in/hr) is used as more conservative than the 25-yr, 24-hr storm intensity of 5.6 in. The 24-hr storm intensity would require the flow to be adjusted by dividing by 24 hours; 5.6 in/24 hr. = 0.233 in/hr. The storm intensity table is found in Rainfall Frequency Atlas of the Midwest by Floyd A. Huff and James R. Angel, Table 7 (http://www.sws.uiuc.edu/pubdoc/B/ ISWSB-71.pdf). Capacity for flow was evaluated for top of slope diversion berms, intermediate bench diversion berms (side benches) and letdown structures. The largest flow of 11.67 cfs is also used in Appendix M to test the stability of these structures for erosion during peak flow.

Manning's equation was used to calculate the flow capacity of the three types of drainage features: top of slope diversion berms; intermediate bench diversion berm; and letdown structures. Manning's equation is:

$$Q = (1.49/n)(A)(rH)^{2/3}(s)^{1/2}$$

Where: Q is the flow rate (cfs)
n is Manning's coefficient of roughness (unitless)
A is the drainage area (ft^2)
r_H is the hydraulic radius (ft), which equals A/P_w, where P_w is the wetted perimeter, and
s is the slope (ft/ft).

Manning's equation is also used to define the water profile in the perimeter ditch.

Top of Slope Diversion Berms

The purpose of the top of slope diversion berms is to inhibit rill erosion on the upper part of the landfill cap and at the top of the 3:1 slope. Diversion berms are placed on the cap to direct run-off to the letdown structures. The diversion berms are simple mounds of soil constructed as a V-notch channel. The berms are modeled with Manning's equation using a triangular cross-section with side slopes of 3:1 and 50:1 (2%). The following calculation shows the capacity of a berm carrying 0.5 ft. of water with a flow line of one-half percent (0.5%), using a typical n value of .020 for the coefficient of roughness, and an area of 6.63 sq. ft.

$$Q = (1.49/0.020)(6.63)(0.25)^{2/3}(0.005)^{1/2} = 13.9 \text{ cfs} > 11.67 \text{ cfs}$$

This capacity exceeds the flow anticipated at each individual letdown structure shown on Table N-1.

Intermediate Bench Diversion Berm (Side Benches)

The intermediate benches are 1.5 ft deep and have a flowline of one-half percent (0.5%). They have a triangular cross-section with side slopes of 10H:1V and 3H:1V. When full, they have a cross-sectional area of 14.625 sq. ft., a wetted perimeter of 19.8 ft and a hydraulic radius of 0.74 ft. The coefficient of roughness is 0.025.

$$Q = (1.49/0.025)(14.625)(0.74)^{2/3}(0.005)^{1/2} = 50.4 \text{ cfs} > 11.67 \text{ cfs}$$

This capacity exceeds the flow anticipated at each individual letdown structure shown on Table N-1.

Letdown Structure

The letdowns are 1.5 ft deep and have a maximum flowline slope of 33% (3:1). They have a trapezoidal cross-section with and 8 ft bottom and 3:1 side slopes. When full, they have a cross-sectional area of 18.8 sq. ft., a wetted perimeter of 17.5 ft and a hydraulic radius of 1.1 ft. The typical coefficient of roughness equal to 0.035 was used.

$$Q = (1.49/0.035)(18.8)(1.1)^{2/3}(0.33)^{1/2} = 492 \text{ cfs} > 11.67 \text{ cfs}$$

Table N-1 and Figure N-1 (see attached) show the estimated areas served and the estimated flows from each berm and letdown structure.

Perimeter Ditch

Because the perimeter ditch is long and flat and it is expected to flow at a "subcritical" level. Therefore, Manning's equation used alone does not model its capacity well. A combination of Manning's equation and Bernoulli's equation were used to describe the flow in the perimeter ditch. Bernoulli's equation is

$$H = P/\delta + v^2/2g + Z$$

Where: H is the energy measured as depth of water (ft.)
P is the pressure on the water, taken as zero for open systems
δ is gamma, the unit weight of water (lb/ft^3)
v is the velocity of water (fps)
g is the gravity constant (32 fps^2)
Z is the elevation of the fluid element (ft.)

Bernoulli's equations were used to estimate the energy at each letdown structure leading to a specific stormwater pond. Manning's equation was used to estimate the slope of the energy line between the letdown structures. The perimeter ditch was broken into sections between letdowns (see Figure N-1). The depth of flow at the structure was adjusted to estimate the slope of the energy line necessary to match the distances between letdown structures or a letdown structure and the center of the entrance into a stormwater pond. The combination of these equations is used to evaluate the length of the perimeter ditch and the assumption of non-uniform flow.

The flow for the landfill, calculated using the rational method as described above, was proportionally divided between each section and is shown as a cumulative value approaching each pond.

An energy balance was applied to each section to determine the head loss and rise in depth. Bernoulli's and Manning's equations were used to calculate the depth of flow and elevation of the water level in the perimeter ditch. The attached tables summarize these calculations and show the estimated water elevations in each section (see Tables N-2 to N-7). Since these ponds are built at different times during the life of the landfill, consideration was given to the stormwater volumes to those ponds as each cell is constructed. The ponds generally serve the following cells:

- Pond 1 — Cells 1 and 2 — Tables N-2 and N-3
- Pond 2 — Cells 3 and 4 — Tables N-4 and N-5
- Pond 3 — Cells 3 and 4 — Tables N-6 and N-7

Ponds are placed around the Ameren Labadie Energy Center utility waste landfill where space allowed and to minimize the length of flow in the perimeter ditch. The ditch is modeled with a flat bottom width of 9 feet. At a 3:1 slope, two feet (2 ft.) of cover requires 6 feet of the perimeter ditch space. The difference is the placement of soil cover on the initial phases allows for subsequent development of cells without having the amount of infiltration on the caps. The maximum water elevation in the perimeter ditch for all modeled conditions is 485 ft., which is less than the perimeter berm top elevation of 488 ft.

Stormwater Inlet Crests

Runoff flow enters the ponds over stormwater inlet crests constructed in the top of the perimeter berm. These inlets were modeled as broad-crested weirs. Vennard suggests estimating the flow over a broad-crested weir by calculating the flow over the unit length of the weir using the following equation:

$$q = (2/3)^{3/2} \text{ X } g^{1/2} \text{ X } E^{3/2}$$

Where: q is the flow per unit width of a broad-crested weir (cfs/ft.)
g is the gravity constant (32 fps2)
E is the height of the energy line calculated for the entrance to the pond (ft.)

Since the constraints are dependent with not only the flow rate going into the stormwater ponds, but also the weir length of the pond, both elements must be considered. The stormwater collection ponds have the following minimum weir lengths at elevation 483 feet:

Pond 1:	217 ft.
Pond 2:	65 ft.
Pond 3:	300 ft.

The lowest estimated energy grade line coming into any single pond is 0.511 ft. at the influent to Pond 1. Pond 1 has a weir length of 217 ft (see Table N-3). Pond 1 also has the largest design flow at a combined, estimated 69.77 cfs (see Pond 1, Table N-1). Using the equation above, the capacity of the influent structure to Pond 1 is calculated as:

$$Q = (2/3)^{3/2}(32)^{1/2}(0.646)^{3/2} = 1.59 \text{ cfs/ft.}$$

$$1.59 \text{ cfs/ft} * 217 \text{ ft} = 345 \text{ cfs} > 69.77 \text{ cfs}$$

Therefore, the influent structure to Pond 1 has sufficient capacity for the anticipated design flow.

Pond 2 has the shortest weir length, with a weir length of 65 ft. Pond 2 has an estimated energy grade line of 1.064 ft. (see Pond 2, Table N-5). The combined, estimated design flow into Pond 2 is estimated at 50.37 cfs.

$$Q = (2/3)^{3/2}(32)^{1/2}(0.836)^{3/2} = 2.35 \text{ cfs/ft.}$$

$$2.35 \text{ cfs/ft} * 65 \text{ ft} = 152.75 \text{ cfs} > 50.37 \text{ cfs}$$

Therefore, the influent structure to Pond 2 has sufficient capacity for the anticipated design flow.

It is concluded that the influent structures for the stormwater collection ponds have adequate flow capacity based on their respective weir length and the estimated height of energy grade line entering the ponds.

Stormwater Ponds

Three stormwater ponds will be placed around the landfill for stormwater runoff storage and management. They are identified as Pond 1, collecting runoff from Cells 1 and 2; Pond 2, collecting runoff from Cells 3 and 4; and Pond 3, collecting runoff from Cells 3 and 4. Tables N-8 through N-10 provide stage-storage data for Ponds 1 through 3, respectively. Run-off volumes were calculated using Rational Method theory (i.e., run-off Volume=CIA, where I = rainfall in total inches). A runoff coefficient of C= 0.4 is considered representative of low to moderate permeability soils with emergent ground cover on steep slopes.

A runoff coefficient of C= 1 is used for the stormwater ponds to reflect that any direct rainfall to the pond surface will accumulate completely to the pond's stored volume.

The following table compiles the estimated, maximum runoff volumes to each pond during the 25-year, 24-hour design storm event of 5.6 inches. These pond volumes were checked to see if this volume is available at each respective pond to contain the design storm:

Pond 1	5.7 acres	5.6 in.= 0.47 ft.	c=1	2.7 acre-feet
Cells 1 and 2	66.6 acres	5.6 in.= 0.47 ft.	c=0.4	12.4 acre-feet
			Total=	**15.1 acre-feet**
Pond 2	4.4 acres	5.6 in.= 0.47 ft.	c=1	2.1 acre-feet
Cells 3 and 4	47.8 acres	5.6 in.= 0.47 ft.	c=0.4	9.0 acre-feet
			Total=	**11.1 acre-feet**
Pond 3	3.4 acres	5.6 in.= 0.47 ft.	c=1	1.6 acre-feet
Cells 3 and 4	52.1 acres	5.6 in.= 0.47 ft.	c=0.4	9.8 acre-feet
			Total=	**11.4 acre-feet**

The ponds have been designed with an inlet spillway elevation of 483 feet, and are to be maintained at a minimum 3 foot depth (water surface elevation of approximately 471 feet) to inhibit aquatic vegetation. Based on the stage-storage data found in Tables N-8, N-9 and N-10, the following initial maximum water surface elevations have been determined for each pond that represents the 25-year, 24-hour storm runoff volume. All maximum water elevations are well below a water surface elevation of 483 feet, which is the elevation of the bottom of the perimeter ditch. Therefore, if properly managed, the ponds have excess capacity for the anticipated 25-year, 24-hour storm runoff volume.

Respective Pond	Min Elevation (ft.)	Max Elevation (ft.)	Corresponding Table
Pond 1	471	478	N-8
Pond 2	471	480	N-9
Pond 3	471	477	N-10

Temporary Perimeter Ditch Crossings

As phased construction proceeds, the UWL operator may elect to retain interior berms and their top-of-berm roads during subsequent UWL phases. If interior berms are retained, it will be necessary to provide culverts through the intermediate berms at their intersection with the perimeter ditches. Preliminary culvert sizes have been estimates based on the arrangement of letdown ditches and ponds described by the previous discussion. For the purposes of these preliminary size estimates, we have assumed inlet control and one foot of headwater at the culvert inlets. These culvert sizes were estimated using standard hydraulic charts and equations, and the 25-year, 1-hour design storm event (2.63 in/hr).

Culvert System	Letdown(s)	Accumulative Max. Flow (cfs)	Recommended Culvert Diameter (in.)
East Culvert-Cells 1 and 2	4,5,6,7	22.01	30
West Culvert-Cells 1 and 2	7,8,9,10	26.22	36
East Culvert-Cells 3 and 4	17	6.69	15
West Culvert-Cells 3 and 4	25,26	14.62	24

TABLES

Ameren Labadie Energy Center Utility Waste Landfill
Area and Flow At Each Letdown Structure
25-yr, 1-hr Event
Table N-1

Location	Distance	Side Slope Area	Top Area	Total Area	Total Area	Cumulative Area	Flow	
	(ft)	(ac)	(ac)	(sf)	(ac)	(ac)	in letdown, (cfs)	accumulative, (cfs)
LETDOWNS 1-11 (Cells 1 & 2) Flow to Pond 1 Rotating Clockwise from East Side of Outlet Pond 1								
Letdown 2	500	2.17	1.89	176796	4.06	4.06	4.31	35.00
Letdown 3	940	2.75	5.42	356250	8.18	12.24	8.68	30.69
Letdown 4	1450	2.11	3.14	228750	5.25	17.49	5.57	22.02
Letdown 5	1850	2.73	1.40	180000	4.13	21.62	4.38	16.45
Letdown 6	2500	2.51	1.91	192500	4.42	26.04	4.69	12.06
Letdown 7	3000	2.53	4.42	302813	6.95	32.99	7.37	7.37
Flow to Pond 1 Rotating Counter Clockwise from East Side of Outlet Pond 1								
Letdown 1	220	4.19	2.48	290400	6.67	6.67	7.07	34.77
Letdown 11	1020	4.19	4.15	363281	8.34	15.01	8.85	27.70
Letdown 10	1550	2.48	4.82	317813	7.30	22.30	7.74	18.85
Letdown 9	1950	3.80	2.97	295000	6.77	29.07	7.18	11.11
Letdown 8	2920	2.59	1.11	161250	3.70	32.78	3.93	3.93
LETDOWNS 12-29 (Cells 3 & 4) Flow to Pond 3 Rotating Clockwise from East side of Pond 3								
Letdown 14	0	3.24	2.85	265200	6.09	6.09	6.46	18.61
Letdown 15	500	2.81	2.81	244400	5.61	11.70	5.95	12.16
Letdown 16	950	2.81	3.04	254800	5.85	17.55	6.20	6.20
Flow to Pond 2 Rotating Counter-Clockwise from West side of Outlet Pond 2								
Letdown 18	860	4.82	2.18	305000	7.00	7.00	7.43	14.12
Letdown 17	1360	2.81	3.50	274860	6.31	13.31	6.69	6.69
Flow to Pond 2 Rotating Clockwise from East side of Outlet Pond 2								
Letdown 19	600	4.53	1.42	259200	5.95	5.95	6.31	36.25
Letdown 20	1100	2.87	4.99	342300	7.86	13.81	8.34	29.94
Letdown 21	1600	2.87	1.03	170000	3.90	17.71	4.14	21.60
Letdown 22	2100	2.87	1.26	180000	4.13	21.84	4.38	17.46
Letdown 23	2600	3.46	0.09	154800	3.55	25.40	3.77	13.08
Letdown 24	3040	5.17	0.53	248000	5.69	31.09	6.04	9.31
Letdown 25	3790	2.70	3.47	268600	6.17	33.82	6.54	3.27
Flow to Pond 3 Rotating Counter-Clockwise from East-Side of Outlet Pond 3								
Letdown 13	320	1.32	0.22	67200	1.54	1.54	1.64	32.61
Letdown 12	960	3.40	1.32	205900	4.73	6.27	5.01	30.97
Letdown 29	1780	2.70	1.21	170000	3.90	10.17	4.14	25.96
Letdown 28	2240	2.53	2.53	220000	5.05	15.22	5.36	21.82
Letdown 27	2640	2.41	2.41	210000	4.82	20.04	5.11	16.46
Letdown 26	3120	1.89	5.72	331600	7.61	27.66	8.08	11.35
Letdown 25	3330	2.70	3.47	268600	6.17	33.82	6.54	3.27

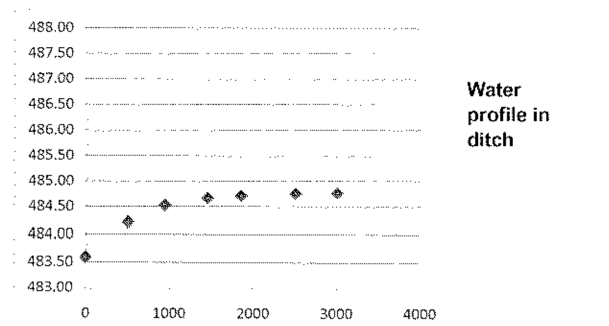
Inputs	25-yr, 1-hr storm	
Intensity	2.63	in
C Factor	0.4	unitless

Ameren Labadie Energy Center Utility Waste Landfill
Perimeter Ditch Water Profile: 25-yr, 1-hr event
Elevation for Stated Flow
Clockwise from Pond 1
Table N-2

			$S_{s,left}$ = 3		$S_{s,right}$ = 3		Base Width (ft) =	9	Mannings N = 0.02		So (ft) = 0		Runoff Factor for 2.63 in/ hr rainfall=		0.017			
Elevation	Depth	Channel Bottom Elevation	Slope of Water Surface	Adjusted Base	Adjusted Height	Area	Velocity	$v^2/2g$	Specific Energy	Hydraulic Radius	Slope	S-So	Distance	Total Distance	True Distance	Location	Distance from Culvert	Q
							Average Velocity		Change in Specfic Energy	Average Hydraulic Radius								
(ft)	(ft)	(ft)	(ft/ft)	(ft)	(ft)	(sf)	(fps)	(ft)	(ft)	(ft)	(ft/ft)	(ft/ft)	(ft)	(ft)	(ft)		(ft)	(cfs)
483.59	0.59	483				6.35	1.898	0.0560	0.646	0.499				0	0	Pond 1	0	12.06
	0.63		0.0011928				2.082		0.654	0.712	1.24E-03	1.24E-03	528	528				
484.22	1.22	483		9.00	1.2200	15.45	2.266	0.0797	1.300	0.924					500	Letdown 2	500	35.00
	0.31		0.0007271				1.871		0.264	1.019	6.19E-04	6.19E-04	426	955				
484.53	1.53	483		9.00	1.5300	20.79	1.476	0.0338	1.564	1.113					940	Letdown 3	940	30.69
	0.13		0.0002606				1.212		0.110	1.152	2.21E-04	2.21E-04	499	1453				
484.66	1.66	483		9.00	1.6600	23.21	0.949	0.0140	1.674	1.190					1450	Letdown 4	1450	22.02
	0.04		0.0001138				0.817		0.033	1.202	9.48E-05	9.48E-05	351	1805				
484.70	1.70	483		9.00	1.7000	23.97	0.686	0.0073	1.707	1.214					1850	Letdown 5	1850	16.45
	0.04		5.238E-05				0.587		0.036	1.225	4.76E-05	4.76E-05	764	2568				
484.74	1.74	483		9.00	1.7400	24.74	0.487	0.0037	1.744	1.237					2500	Letdown 6	2500	12.06
	0.01		2.724E-05				0.392		0.008	1.240	2.09E-05	2.09E-05	367	2936				
484.75	1.75	483		9.00	1.7500	24.94	0.296	0.0014	1.751	1.243					3000	Letdown 7	3000	7.37

Notes:

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

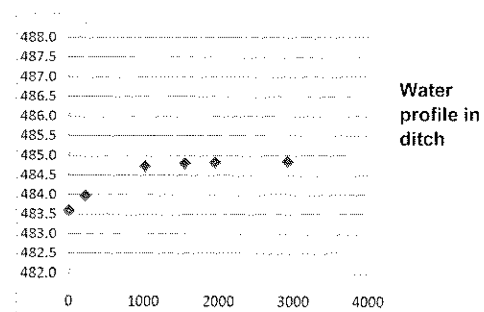


Ameren Labadie Energy Center Utility Waste Landfill
Perimeter Ditch Water Profile: 25-yr, 1-hr event
Elevation for Stated Flow
Counter Clockwise from Pond 1
Table N-3

			$S_{s,left}$ = 3		$S_{s,right}$ = 3		Base Width (ft) =	9	Mannings N = 0.02		So (ft) = 0		Runoff Factor for 2.63 in/ hr rainfall=		0.017			
Elevation	Depth	Channel Bottom Elevation	Slope of Water Surface	Adjusted Base	Adjusted Height	Area	Velocity	$v^2/2g$	Specific Energy	Hydraulic Radius	Slope	S-So	Distance	Total Distance	True Distance	Location	Distance from Culvert	Q
							Average Velocity		Change in Specfic Energy	Average Hydraulic Radius								
(ft)	(ft)	(ft)	(ft/ft)	(ft)	(ft)	(sf)	(fps)	(ft)	(ft)	(ft)	(ft/ft)	(ft/ft)	(ft)	(ft)	(ft)		(ft)	(cfs)
483.59	0.59	483				6.35	1.898	0 0560	0.646	0.499				0	0	Pond 1	0	12.06
	0.37		0.0016659				2.473		0.458	0.628	2.06E-03	2.06E-03	222	222				
483.96	0.96	483		9.00	0.9600	11.40	3.049	0.1443	1.104	0.757					220	Letdown 1	220	34.77
	0.76		0.0009613				2.093		0.636	0.991	8.04E-04	8.04E-04	791	1013				
484.72	1.72	483		9.00	1.7200	24.36	1.137	0.0201	1.740	1.225					1020	Letdown 11	1020	27.70
	0.07		0.0001422				0.935		0.058	1.246	1.18E-04	1.18E-04	492	1505				
484.79	1.79	483		9.00	1.7900	25.72	0.733	0.0083	1.798	1.266					1550	Letdown 10	1550	18.85
	0.03		5.652E-05				0.578		0.019	1.273	4.40E-05	4.40E-05	442	1947				
484.82	1.82	483		9.00	1.8150	26.22	0.424	0.0028	1.818	1.280					1950	Letdown 9	1950	11.11
	0.02		1.269E-05				0.286		0.013	1.285	1.06E-05	1.06E-05	1182	3129				
484.83	1.83	483		9.00	1.8300	26.52	0.148	0.0003	1.830	1.289					2920	Letdown 8	2920	3.93

Notes:

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



Prepared by Gredell Engineering Resources, Inc.

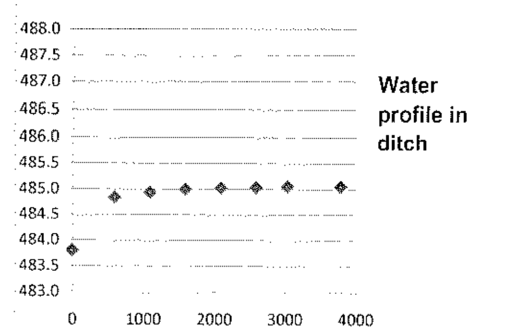
December 2012

Ameren Labadie Energy Center Utility Waste Landfill
Perimeter Ditch Water Profile: 25-yr, 1-hr event
Elevation for Stated Flow
Clockwise from Pond 2
Table N-4

			$S_{s,left}$ = 3		$S_{s,right}$ = 3		Base Width (ft) = 9		Mannings N = 0.02		So (ft) = 0		Runoff Factor for 2.63 in/ hr rainfall= 0.017					
Elevation	Depth	Channel Bottom Elevation	Slope of Water Surface	Adjusted Base	Adjusted Height	Area	Velocity	$v^2/2g$	Specific Energy	Hydraulic Radius	Slope	S-So	Distance	Total Distance	True Distance	Location	Distance from Culvert	Q
							Average Velocity		Change in Specfic Energy	Average Hydraulic Radius								
(ft)	(ft)	(ft)	(ft/ft)	(ft)	(ft)	(sf)	(fps)	(ft)	(ft)	(ft)	(ft/ft)	(ft/ft)	(ft)	(ft)	(ft)		(ft)	(cfs)
483.80	0.80	483				9.12	3.975	0.2453	1.045	0.649				0	0	Pond 2	0	36.3
	1.03		0.001709				2.671		0.814	0.969	1.35E-03	1.35E-03	603	603	600			
484.83	1.83	483		9.00	1.8300	26.52	1.367	0.0290	1.859	1.289						Letdown 19	600	36.3
	0.10		0.000208				1.208		0.088	1.317	1.83E-04	1.83E-04	481	1083	1100			
484.93	1.93	483		9.00	1.9300	28.54	1.049	0.0171	1.947	1.346						Letdown 20	1100	29.9
	0.06		0.000111				0.887		0.051	1.363	9.44E-05	9.44E-05	541	1624	1600			
484.99	1.99	483		9.00	1.9900	29.79	0.725	0.0082	1.998	1.380						Letdown 21	1600	21.6
	0.03		5.5E-05				0.650		0.027	1.389	4.94E-05	4.94E-05	545	2170	2100			
485.02	2.02	483		9.00	2.0200	30.42	0.574	0.0051	2.025	1.397						Letdown 22	2100	17.5
	0.01		3.76E-05				0.501		0.008	1.400	2.90E-05	2.90E-05	266	2436	2600			
485.03	2.03	483		9.00	2.0300	30.63	0.427	0.0028	2.033	1.403						Letdown 23	2600	13.1
	0.02		1.68E-05				0.364		0.014	1.407	1.52E-05	1.52E-05	891	3327	3040			
485.05	2.05	483		9.00	2.0450	30.95	0.301	0.0014	2.046	1.411						Letdown 24	3040	9.3
	0.00		5.91E-06				0.150		0.001	1.412	2.59E-06	2.59E-06	423	3749	3790			
485.05	2.05	483		9.00	2.0475	31.00	0.000	0.0000	2.048	1.413						Letdown 25	3790	3.3

Notes:

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



Prepared by Gredell
Engineering Resources, Inc.

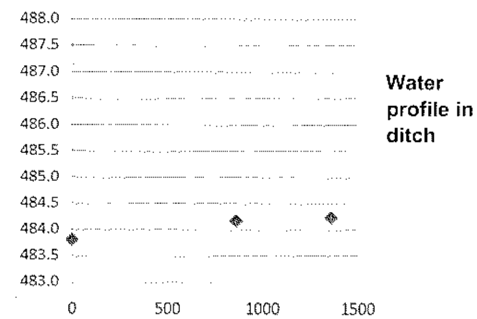
December 2012

Ameren Labadie Energy Center Utility Waste Landfill
Perimeter Ditch Water Profile: 25-yr, 1-hr event
Elevation for Stated Flow
Counter Clockwise from Pond 2
Table N-5

			$S_{s,left}$ = 3		$S_{s,right}$ = 3		Base Width (ft) = 9		Mannings N = 0.02		So (ft) = 0		Runoff Factor for 2.63 in/ hr rainfall= 0.017					
Elevation	Depth	Channel Bottom Elevation	Slope of Water Surface	Adjusted Base	Adjusted Height	Area	Velocity	$v^2/2g$	Specific Energy	Hydraulic Radius	Slope	S-So	Distance	Total Distance	True Distance	Location	Distance from Culvert	Q
							Average Velocity		Change in Specfic Energy	Average Hydraulic Radius								
(ft)	(ft)	(ft)	(ft/ft)	(ft)	(ft)	(sf)	(fps)	(ft)	(ft)	(ft)	(ft/ft)	(ft/ft)	(ft)	(ft)	(ft)		(ft)	(cfs)
483.80	0.80	483				9.12	1.530	0.0363	0.836	0.649				0	0	Pond 2	0	14
	0.36		0.000431				1.253		0.338	0.767	4.05E-04	4.05E-04	836	836	860			
484.16	1.16	483		9.00	1.1600	14.48	0.975	0.0148	1.175	0.886						Letdown 18	860	14
	0.06		0.000128				0.704		0.048	0.905	1.03E-04	1.03E-04	468	1304	1360			
484.22	1.22	483		9.00	1.2200	15.45	0.433	0.0029	1.223	0.924						Letdown 17	1360	7

Notes:

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



Ameren Labadie Energy Center Utility Waste Landfill
Perimeter Ditch Water Profile: 25-yr, 1-hr event
Elevation for Stated Flow
Clockwise from Pond 3
Table N-6

			$S_{s,left}$ = 3		$S_{s,right}$ = 3		Base Width (ft) = 9		Mannings N = 0.02		So (ft) = 0		Runoff Factor for 2.63 in/ hr rainfall= 0.017					
Elevation	Depth	Channel Bottom Elevation	Slope of Water Surface	Adjusted Base	Adjusted Height	Area	Velocity	$v^2/2g$	Specific Energy	Hydraulic Radius	Slope	S-So	Distance	Total Distance	True Distance	Location	Distance from Culvert	Q
							Average Velocity		Change in Specfic Energy	Average Hydraulic Radius								
(ft)	(ft)	(ft)	(ft/ft)	(ft)	(ft)	(sf)	(fps)	(ft)	(ft)	(ft)	(ft/ft)	(ft/ft)	(ft)	(ft)	(ft)		(ft)	(cfs)
483.72	0.72	483				8.04	1.742	0.0471	0.767	0.593				0	0	Pond 3	0	14
	0.00		0				2.029		0.036	0.593	1.50E-03	1.50E-03	24	24	0			
483.72	0.72	483		9.00	0.7200	8.04	2.317	0.0833	0.803	0.593						Letdown 14	0	19
	0.41		0.000848				1.592		0.338	0.730	7.00E-04	7.00E-04	483	508	500			
484.13	1.13	483		9.00	1.1300	14.00	0.868	0.0117	1.142	0.867						Letdown 15	500	12

Notes:

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